Development of a Decision Support System for the Design of Good Indoor Air Quality in Office Buildings

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy
in
Product Development
at Massey University, Turitea,
New Zealand.

Volume Two

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LIST OF APPENDICES

APPENDIX 1 - IAQ LITERATURE MATRIX

IAQ LITERATURE MATRIX

	Source Control Strategies	Quality of the Office Environment	Gas Phase Air Quality	Source Control	Carbon Dioxide	Volatile Organic Compounds	Guidelines	VOC Sources	Sink Effect	Interactions	Source Control	Biological Contaminants	Environmental Parameters	Fungi Sources	MVOCs & Metabolites	Bacteria & Viruses	Bacteria Sources	Macromolecular Organic Dust	Mammalian, Avian & Insect Allergens	Source Control	Particulates	Sources of Particles	Particles & Building Parameters	MOD, VOCs & Dust Guidelines & Standards	Source Control	Interactions	Temperature & Humidity	Conclusions
Abraham, 1999																									x			
AS/NZS 3666.1, 1995																				x								
ASHRAE 52.1-1992																									x		x	
ASHRAE Standard 62-1989			x																						x			
Baechler et al., 1991																						x						
Bayer and Black, 1988								x																				
Bearg, 1993					x						x			x					x	x		x						
Becks, 1990.																									x			
Bergland et al., 1982								x																				
Bergland et al., 1986						x																						
Berglund et al., 1989									x																			
Berglund et al., 1992								x																				x
Billings & Vanderslice, 1982	x																								x			
Black, 1993											x																	
Boender, 1994																					x							
Bower, 1997	x										x																	
Brookes, 1998																				x								
Brown et al., 1994						x		x																				
Brundage et al., 1988																	x											
Burge, 1987				x										x			x			x								
Burge, 1990														x			x			x								
Burge, 1995												x				x	x			x								
Burmester & Witter, 1972																				x								
Canadian Public Works, 1993							x				x																	
Chang, et al., 1997								x																				
Chao et al., 1998																									x			
Clausen, 1993								x																				
Colome et al., 1990																						x						
Cometto-Muniz and Cain, 1992						x																						
COSHH, 1987.	x																											
Cox, 1987																	x											

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Cunningham, 1997																			x									
Cutter Corp, 1993											x																	
Cutter Corp, 1994																						x						
Daisey et al., 1994						x		x																				
Dockery & Spengler, 1981,																						x						
Dockery 1981																					x							
Douwes et al., 1998													x															
Dowd et al, 1989															x													
El-Shobokshy, 1990																					x							
EPA, 1994																						x						
Etkin, 1995																							x					
Falk et al, 1993								x																				
Farant et al., 1992								x																				
Farkas, 1983 in Hedge et al., 1993																						x						
Fink, 1978																				x								
Flannigan, 1992																				x								
Foarde, 1996														x						x								
Foarde et al., 1996																				x								
Franke et al., 1997																					x				x			
Garnys, 1995																						x	x					
Gebefugi, 1989									x															x				
Godish, 1981; 1995											x																	
Godish, 1989	x																											
Godish, 1995					x			x	x	x	x	x										x			x			
Gorman, 1984																									x			
Gravesen et al., 1993																		x										
Gross, 1982																						x						
Grot et al., 1991										x																		
Gyntelberg et al., 1994														x										x				
Hanley et al., 1994																					x				x			
Hanley, 1992																									x			

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Hanssen, 1993			x																									
Hayward & Wesoloski, 1993											x																	
Health and Welfare Canada, 1987															x	x												
Hedge et al., 1993					x																	x			x			
Hedge et al., 1994																									x			
Hedge, 1993																						x						
Hirovnen et al., 1994									x																			
Hirovnen, 1994																					x			x				
Hodgeson & Girman, 1989											x																	
Hodgson et al., 1994,							x																					
Hodgson, 1992					x																							
Houk, 1980																	x											
ISIAQ, 1996																				x								
ISO 7730																											x	
Jaakkola et al., 1994									x																			
Jamjiska et al., 1999																						x			x			
Jensen, 1995											x																	
Kemp et al., 1998																						x			x			
Kildeso et al., 1998																									x			
Kinkead, 1990											x																	
Kirchherr et al. 1992						x																						
Kliest, et al., 1989								x																				
Kozak et al., 1978														x														
Lavioe and Comtios, 1993																				x								
Lavoie, 1993														x						x								
Leaderer et al., 1990																						x						
Leaderer, 1990																									x			
Lee et al., 1980																									x			
Lehrer et al., 1991																			x									
Levin, 1987											x																	
Levin, 1989							x				x																	

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Levin, 1990											x																		
Levin, 1996											x																		
Levin, 1992											x																		
Lloy et al., 1985																						x							
Lstiburek, 1994																				x									
Luczynska, 1995																			x										
Mamane et al., 1993																						x							
Mbithi et al., 1991																	x			x									
McCarthy, 1993																										x			
Mendell, 1993			x																										
Michel et al., 1991													x																
Miller et al., 1992																				x									
Miller, 1988															x														
Miller, 1992												x	x	x						x									
Molhave and Neilson, 1992							x																						
Molhave and Thorsen, 1991									x																				
Molhave, 1990							x	x			x																		x
Molhave, 1991										x	x													x					
Molhave, 1996						x	x																						
Molina et al, 1989								x																					
Morawska et al., 1998																						x							
Morey & Williams, 1990																				x						x			
Morey & Williams, 1991																				x						x			
Morey, 1988														x						x									
Morey, 1996																				x						x			
Murdock & Brook, 1979																				x									
Molhave et al, 1992								x																					
Nagda et al., 1991								x		x																			
Nathanson, 1995a					x			x												x									
Nathanson, 1995b																	x			x									
Nathanson, 1995c																			x										

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Newball & Brahim, 1976																						x							
Nielsen et al., 1995							x																						
Nielsen et al., 1997																								x					
Nielsen, 1987									x																				
Nielsen, 1988									x	x																			
NIOSH, 1990		x																											
Norback et al.,1995															x														
Oldaker, et al., 1992, In Etkin, 1995																										x			
Olesen, 1991																												x	
Owen et al., 1992																										x			
Ozkaynak & Spengler, 1996																						x	x						
Ozkaynak et al., 1996																						x	x						
Pesanen et al., 1993														x															
Pesanen, 1996														x															
Pejtersen et al., 1989																						x							
Pejtersen, 1997														x						x									
Pierson et al., 1991							x																						
Purcell, 1976																												x	
Raw et al, 1993		x																	x			x				x			
Raw, 1992				x							x																		
Raw, 1993																			x			x							
Rainhardt, 1991														x						x									
Riley & Nardell, 1993																				x									
Robertson, 1988		x																											
Rodes et al., 1991								x																					
Rothweiler et al., 1993								x																					
Rylander et al., 1986																x													
Rylander, 1993															x														
Samson, 1985															x														
Schneider et al., 1993																						x							
Schneider, 1986																						x							

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Seaton et al., 1995																					x	x							
Seifert et al., 1989										x																			
Seitz, 1990		x			x																								
Seneviratne, 1996															x														
Sheldon et al, 1989,																						x							
Sheldon, 1988											x																		
Skov et al., 1987																						x							
Skov, 1987																						x		x					
Skov, 1990																		x											
Sollinger, 1994										x																			
Sparks et al., 1993									x																				
Spengler & Wilson, 1996																					x		x						
Spengler, 1991																					x								
Squillace, 1995																			x										
Sundell et al, 1993								x																					
Tamblyn et al., 1993																												x	
Tamura & Wilson, 1967																										x			
Tan et al., 1995																						x							
Tichenor & Guo, 1991											x																		
Tichenor, 1991											x																		
Tichnenor, 1992									x																				
Tucker, 1990											x																		
Tucker, 1991								x												x									
Turner, 1990		x																											
Verbeck et al., 1981																						x							
Wager, 1991											x																		
Wallace et al. 1987, 1991								x																					
Wallace et al., 1991						x																							
Wallace, 1991								x			x																		
Walsh et al., 1984								x																					
Weschler and Hodgson, 1992										x																			

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Weschler et al., 1990								x																					
West & Hansen, 1989														x													x		
WHO, 1990								x																					
Wicklow, 1989 in Miller, 1992															x														
Wilkens et al., 1993															x									x					
Wilson et al, 1995 in Wilson & Spengler, 1996																					x	x							
Wilson R & Spengler J, 1996																									x				
Wilson, 1987				x																									
Wolkoff & Wilkens, 1993, 1994																								x					
Wolkoff and Nielsen, 1993											x																		
Wolkoff and Wilkens, 1994									x						x														
Wolkoff et al, 1991								x																					
Wolkoff et al., 1990								x																					
Wolkoff et al., 1991								x																					
Wolkoff et al., 1992								x																					
Wolkoff, 1991								x																					
Wolkoff, 1992						x		x																					
Wolkoff, 1993								x																					
Wolkoff, 1994								x																					
Wolkoff, 1995								x		x	x																		
Wolverton, 1989											x																		
Wood et al., 1997											x																		
Woods, 1987																										x			
Woods, 1988		x																											
Yocom & McCarthy, 1991																						x							

APPENDIX 2 - IAQ AND DSS EXPERTS INTERVIEWED DURING RESEARCH

List of IAQ Experts interviewed during the research:

Gary Raw, Building Research Establishment, Watford, UK;

David Tong, Building Use Studies, London, UK;

Kent Stevens, Ove Arups, London, UK;

Pat O'Sullivan, Barttlet School of Architecture, London, UK;

Clive Broadbent, Clive Broadbent and Assoc., ACT Australia;

Derek Croombe, University of Reading, Reading, UK;

Alistair Robertson, University of Birmingham, Birmingham, UK;

Alan Hedge, Cornell University, Itacha, USA;

Joe Clark, Alex Duffy and John Hand, University of Strathclyde, UK;

Peter Barnard, Fletcher Healthy Buildings, Auckland, New Zealand;

Martin Liddement and Mark Limb, Air Infiltration and Ventilation Centre, International Energy Agency, Coventry, UK and

Tedd Nathanson, Public Works Canada, Ottawa, Canada.

DSS or Expert system experts interviewed during the research:

Mike Donn, Victoria University, Wellington;

Nigel Isaacs and Roman Jacques, Building Research Association of New Zealand, Judgeford, New Zealand;

Barbara Lippiatt, National Institute of Standards, USA;

Elizabeth Kemp and Daniela Mehandjiska-Stavreva, Institute of Information Sciences and Technology, Massey University;

APPENDIX 3 - INSTRUCTIONS TO REVIEWERS FOR PAPERS SUBMITTED TO THE NEW ZEALAND ROYAL SOCIETY OF SCIENCE

The Royal Society of New Zealand
promoting excellence in science and technology

Guide for Referees

Introduction

This guide is sent to all referees of papers submitted to Royal Society of New Zealand journals.

A referee is asked to consider what contribution a paper makes to knowledge. Even though the referee may disagree with the author's opinions, the referee should allow them to stand, provided they are consistent with available evidence.

The criteria listed below are considered important by editors when assessing a paper's suitability for publication. An answer to every question is not essential, but all criticisms should be substantiated. Please note that we are concerned solely with whether the paper is suitable for the journal specified.

A definite recommendation on the paper's suitability for publication should be made. However, please do not make any specific statement about the acceptability of the paper in your comments for transmission to the author, but advise the editor of your opinion in a covering letter with your comments. Any changes necessary to make the paper acceptable for publication should also be indicated. For acceptable papers, we are anxious to improve clarity, succinctness, and quality of presentation generally. Your suggestions to this end will be welcome if you have the time to offer them in your comments. You may write on the manuscript supplied if you wish to go into this degree of detail. The anonymity of a referee will be preserved unless the referee wishes otherwise.

Referees are cautioned about being unduly negative in their comments. Where warranted a referee should point out particularly good aspects of a paper; authors welcome positive feedback as well as constructive criticism.

CRITERIA FOR CONSIDERATION

Information content

As far as you know, does the paper describe new work, new results, or a new theory or interpretation? Does the paper provide valuable confirmation of previously published information?

Technical and experimental methods

Are any new methods described? How adequate are the methods and the controls used?

Amount of experimental material and data

Is this large, adequate, small, or insufficient?

Calculations and statistical treatment

Do any of the calculations contain errors? Is the statistical treatment of the data adequate or erroneous?

Interpretation

Are the conclusions justified? Consider whether the interpretation is adequate, not warranted by the data, or suffers from important omissions or loose generalisation.

Title

Does the title adequately convey the main subject or message of the paper, in as few words as possible? Please examine the title critically, with the needs of information retrieval in mind.

Abstract

Is the abstract a clear and adequate indication of the paper's content, i.e., does it state the purpose of the paper and the investigation on which it is based, indicate the methods used, and summarise the results reported and the conclusions drawn?

Presentation and style

Is the information presented in a logical sequence? Is the paper's length adequate, is it too brief for clarity, or could it be shortened? Does the paper contain irrelevant material? Is the arrangement of sections suitable, would rearrangement improve the paper? Do the abbreviations, formulae, units, and nomenclature used conform with applicable international standards and rules?

Illustrations and tables

Are all the illustrations and tables necessary? Could the information in parts of the text be more clearly and concisely presented by the use of more illustrations and/or tables, or vice versa? Should any table be rearranged to present data more clearly? Is the quality of any photograph or line drawing inadequate?

Literature references

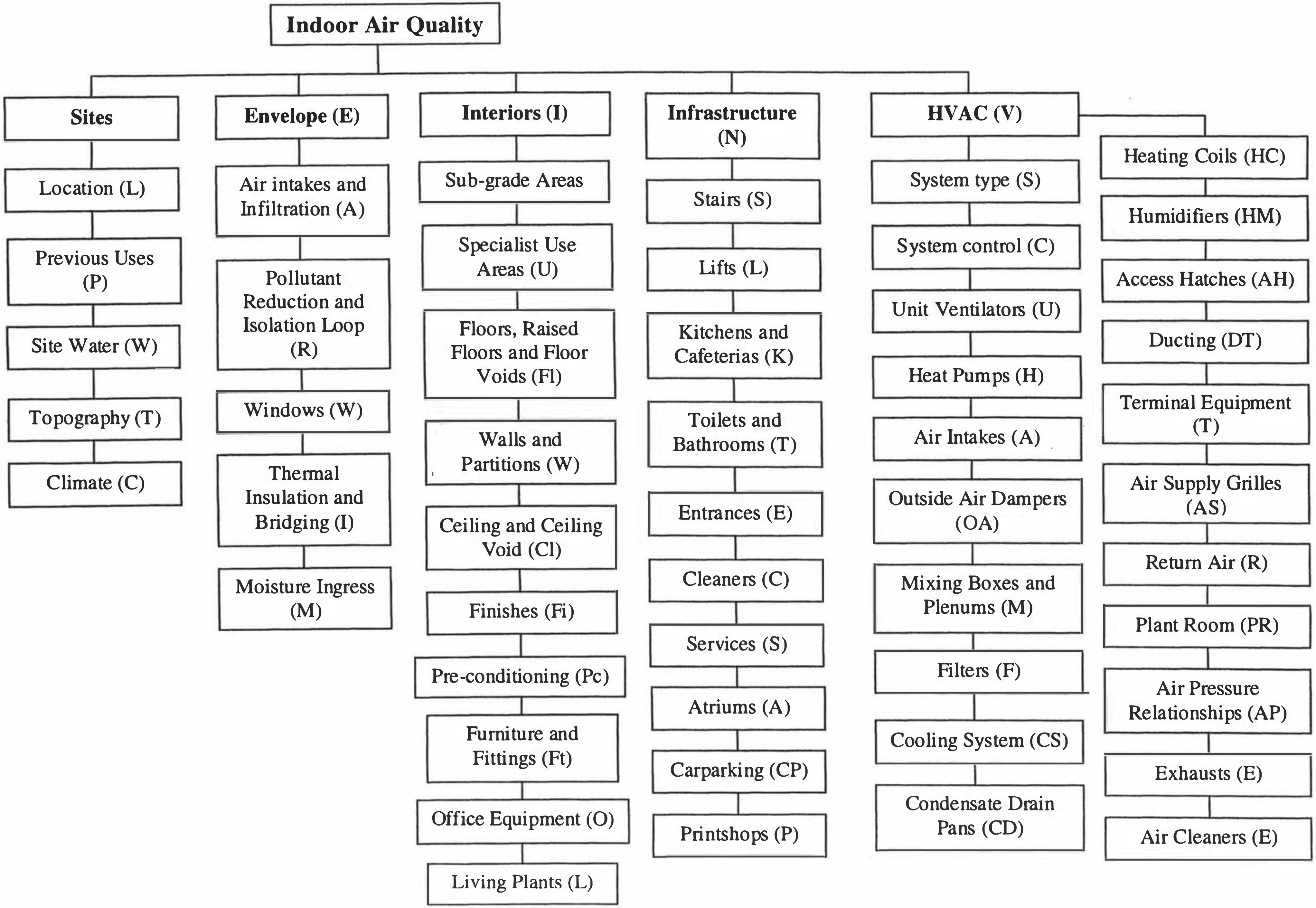
Are all references to other work justified? Has the author omitted reference to any significant work?

Acknowledgments

Do the acknowledgments adequately recognise any assistance received by the author?

Publishing home page

APPENDIX 4 - CONTEXT TREES


Indoor Air Quality
Sites
Location (L)
Previous Uses (P)
Site Water (W)
Topography (T)
Climate (C)
Envelope (E)
Air intakes and Infiltration (A)
Pollutant Reduction and Isolation Loop (R)
Windows (W)
Thermal Insulation and Bridging (I)
Moisture Ingress (M)
Interiors (I)
Sub-grade Areas
Specialist Use Areas (U)
Floors, Raised Floors and Floor Voids (Fl)
Walls and Partitions (W)
Ceiling and Ceiling Void (Cl)
Finishes (Fi)
Pre-conditioning (Pc)
Furniture and Fittings (Ft)
Office Equipment (O)
Living Plants (L)
Infrastructure (N)
Stairs (S)
Lifts (L)
Kitchens and Cafeterias (K)
Toilets and Bathrooms (T)
Entrances (E)
Cleaners (C)
Services (S)
Atriums (A)
Carparking (CP)
Printshops (P)
HVAC (V)
System type (S)
System control (C)
Unit Ventilators (U)
Heat Pumps (H)
Air Intakes (A)
Outside Air Dampers (OA)
Mixing Boxes and Plenums (M)
Filters (F)
Cooling System (CS)
Condensate Drain Pans (CD)
Heating Coils (HC)
Humidifiers (HM)
Access Hatches (AH)
Ducting (DT)
Terminal Equipment (T)
Air Supply Grilles (AS)
Return Air (R)
Plant Room (PR)
Air Pressure Relationships (AP)
Exhausts (E)
Air Cleaners (E)

APPENDIX 5 - HEAD-START QUESTION DATABASE

			Questions		Options	Justification	Recommendations	Linkages	Conclusion	VOCs	Particulates	Microbials	Gaseous	Thermal	
Site (S)															
Location (L)															
S	L	1	Is the proposed building located in an industrial area?	a	no	Healthy indoor environments are easier to achieve when the outdoor environmental quality is high, as outdoor pollutants inevitably migrate indoors.	Sites with low levels of industrial contaminants are recommended.	natural ventilation	No detriment to the quality of the external air being drawn into the building.	0	0	0	0	0	
				b	light industry, such as panel beaters, printers, furniture manufacturers	Healthy indoor environments are easiest to achieve when the outdoor environmental quality is high, as outdoor pollutants inevitably migrate indoors. Light industry can be a source of gaseous, particulate and VOC pollutants.	Full risk assessment and measures to exclude the potential infiltration of pollutants is recommended. Natural ventilation is not recommended. Architectural or landscape buffer zones are recommended between source of pollutant and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs and particulate matter. Need filters of 80% or higher efficiency.	-1	-1	0	-1	0	
				c	heavy industry such as paint manufacturing, wood or chemical processing	Healthy indoor environments are easiest to achieve when the outdoor environmental quality is high. Heavy industry can be a source of gaseous, particulate and VOC pollutants.	Selection of an alternative site is recommended. If this site is to be used, a full risk assessment is required. Specific engineering design may be required to design a very air tight building envelope and high efficiency filtration. Natural ventilation is not recommended. Architectural or landscape buffer zones are recommended between the sources of pollutants and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs and particulate matter. Need filters of 80% or higher efficiency.	-2	-2	0	-2	0	

S	L	2	Do any of the neighbouring activities release any hazardous emissions?	a	no	Healthy indoor environments are easier to achieve when the outdoor environmental quality is high, as outdoor pollutants inevitably migrate indoors.	Sites with low levels of outdoor contaminants are recommended.	natural ventilation	No detriment to the quality of the external air being drawn into the building.	0	0	0	0	0	
				b	yes, irritative	The irritative substance from the outdoor air can migrate indoors.	The air intakes will need to be located in the cleanest possible location. Infiltration should be limited and a high efficiency filtration system will be required. Natural ventilation systems are not recommended. Architectural or landscape buffer zones are recommended between source of pollutant and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs and particulate matter. Need filters of 80% or higher efficiency.	-2	-1	0	-1	0	
				c	yes, toxic	The hazardous substance could be entrainment into the building via intentional openings such as doors, windows and air intakes and unintentional openings such as idle but open exhaust vents or small penetrations in the envelope.	Selection of an alternative site is recommended. If this site is to be used, a full risk assessment is required. The air intakes of the proposed building need to be located as fa from the source of emissions as possible. A very tight building envelope and a high efficiency filtration system will be required. Natural ventilation systems are not recommended. Architectural or landscape buffer zones are recommended between sources of pollutants and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs anc particulate matter. Need filters of 80% or higher efficiency.	-3	-2	0	-3	0	
S	L	3	Is the proposed building to be located near any combustion processes?	a	no	Healthy indoor environments are easier to achieve when the outdoor environmental quality is high, as outdoor pollutants inevitably migrate indoors.	Sites with low levels of combustion emissions are recommended.	natural ventilation	No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	Skip to SL6

				b	near by but not adjacent to the site	Healthy indoor environments are easier to achieve when the outdoor environmental quality is high, as outdoor pollutants inevitably migrate indoors. Locating the proposed building as far away as possible from neighbouring combustion processes will allow the dissipation of contaminants.	The air intakes will need to be located in the cleanest possible location. Infiltration should be limited and high efficiency filtration may be required. Natural ventilation systems are not recommended if there is the potential for entrainment of combustion by-products. Architectural or landscape buffer zones are recommended between source of pollutant an the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants and particulate matter.	0	-2	0	-2	0	
				c	adjacent site	Combustion processes can be a source of fine particles and gaseous pollutants, it is important to prevent these from entering the building.	The air intakes will need to be located in the cleanest possible location. Infiltration should be limited and high efficiency filtration may be required. Natural ventilation systems are not recommended if there is the potential for entrainment of combustion by-products. Architectural or landscape buffer zones are recommended between source of pollutant an the building. Modelling of the neighbouring processes and site conditions should be undertaken to verify that emissions cannot be entrained in the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants and particulate matter.	0	-3	0	-3	0	
S	L	4	Are the emissions from the neighbouring processes exhausted higher than the proposed building?	a	yes	Discharging emissions higher than the proposed building will allow the pollutants to dissipate into the atmosphere. Under most weather conditions emissions from neighbouring processes should not be entrained in the building. Specific modelling of the processes and climatic conditions should be undertaken to verify emissions pathways do not interfere with the proposed building.	Modelling of the neighbouring processes and site conditions should be undertaken to verify that emissions can not be entrained in the proposed building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Reduction of a potential external pathway for gaseous pollutants and particulate matter to come into contact with the building.	0	1	0	1	0	

				b	no	Discharging emissions higher than the proposed building would allow th pollutants to dissipate into the atmosphere. Having the proposed building higher than the discharge height could lead to the entrainment of emissions during the prevailing winds. Specific modelling of the processes and climatic conditions should be undertaken to verify emissions pathways do not interfere with the proposed building.	The air intakes will need to be located in the cleanest possible location. Infiltration should be limited and high efficiency filtration may be required. Natural ventilation systems are not recommended if there is the potential for entrainment of combustion by-products. Architectural or landscape buffer zones are recommended between source of pollutant an the building. Modelling of the neighbouring processes and site conditions should be undertaken to verify that emissions cannot be entrained into the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external pathway for gaseous pollutants and particulate matter to come into contact with the building.	0	0	0	0	0	
S	L	5	Are all the emissions from the neighbouring processes exhausted upwind of the proposed building during the prevailing wind?	a	yes	Under most weather conditions emissions from neighbouring processes should not be entrained in the building. Specific modelling of the processes and climatic conditions should be undertaken to verify emissions pathways do not interfere with the proposed building.	Modelling of the neighbouring processes and site conditions should be undertaken to verify that emissions can not be entrained in the proposed building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Reduction of a potential external pathway for gaseous pollutants and particulate matter to come into contact with the building.	0	1	0	1	0	
				b	no	This could lead to entrainment of the emissions during the prevailing wind.	The air intakes of the proposed building shoul be located on the leeward side of the building. Infiltration should be controlled and high efficiency filtration may be required. Natural ventilation systems are not recommended. Architectural or landscape buffer zones are recommended between the source of the pollutants and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external pathway for gaseous pollutants and particulate matter to come into contact with the building.	0	0	0	0	0	

S	L	6	Is the proposec building locatec near a commercial airport?	a	no				No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	
				b	yes	This could lead to entrainment of the emissions of aviation gas and particulate matter.	The air intakes of the proposed building shoul be located at the furthermost point from the airport. Infiltration should be limited and high efficiency filtration may be required. Natural ventilation systems are not recommended. Double glazing and acoustic insulation of the envelope is recommended. Architectural or landscape buffer zones are recommended between the source of the pollutants and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs anc particulate matter.	-1	0	0	-1	0	
S	L	7	Is the proposec building locatec adjacent to a road or scene of vehicle activity?	a	minor road or vehicle activity	This could lead to the entrainment of particulate matter, gaseous pollutants and VOC at the lower levels. Some urban NZ sites have been found to regularly exceed guidelines for carbo monoxide, benzene and respirable particulates due to heavy traffic and care is required to avoid this being entrained in to building air intakes.	Minimising penetrations at street level is recommended and locating air intakes above the third floor is highly recommended. Architectural or landscape buffer zones are recommended between the areas of vehicular activity and the building.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs and particulate matter.	-1	-1	0	-1	0	
				b	major road or vehicle activity	This could lead to the high concentrations of particulate matter, gaseous pollutants and VOC at the lower levels of the building. Some urban NZ sites have been found to regularly exceed guidelines for carbo monoxide, benzene and respirable particulates due to heavy traffic and care is required to avoid this being entrained in to building air intakes.	Minimising penetrations at street level is recommended and locating air intakes above the third floor is highly recommended. Architectural or landscape buffer zones are recommended between the areas of vehicular activity and the building. Filters of 80% or higher efficiency are recommended.	building envelope, filtration, ventilation type, air intakes, buffer zones	Potential external source of gaseous pollutants, VOCs and particulate matter.	-3	-3	0	-3	0	

S	L	8	Is the proposed building locatec near to large gardens or areas of vegetation?	a	no				No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	
				b	yes	This could lead to localised periods o airbourne contamination, during the application of pesticides, herbicides and compost. Pollen can also be liberated during spring. Landscaped areas however create a buffer zone between other sources of pollution and the proposed building.	High efficiency filtration is recommended to reduce pollen and other particles. Architectural or hard landscape buffer zones are recommended between source of pollutan and the building.	filtration, entrances	Potential external source of airbourne and tracked in pesticides, particulate matter, fungi and bacteria. Potential reduction in the pathway for other outdoor pollutants.	2	-1	-1	2	0	
S	L	9	Is the proposed building locatec adjacent to current or old underground fuel tanks?	a	no				No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	
				b	yes	If the tanks leak, the pore pressure o the fuel in the surrounding soil can be relatively higher than the pressure within the subgrade parts for the building. This can lead to infiltration of the leaked fuel, which can subsequently be communicated throughout the building.	Thorough maintenance of the tanks and leakage control systems are recommended. All subgrade areas of the building should be thoroughly sealed and maintained at positive air pressure at all times to prevent the infiltration of leaked substances from the tanks. Architectural or landscape buffer zones are recommended between source of pollutan and the building.	sub floor, ventilation, buffer zones	Potential external source of VOCs.	-2	0	0	0	0	

S	L	10	Is the proposed building located in a geothermal area?	a	no				No detriment to the quality of the external air being drawn into the building.	0	0	0	0	0	
				b	yes	Geothermal areas have been found t regularly exceed guidelines for hydrogen sulfide.	The air intakes need to be located as high above ground level and far from the pollutant source as possible.	building envelope, filtration, ventilation type, air intakes	Potential external source of gaseous pollutants.	0	0	0	-2	0	
S	L	11	Is the proposed building located near to commercial composting operations?	a	no	Commercial composting sites can liberate high concentrations of bioaerosols into the air. These should be considered as a high risk for infiltration of fungi and bacteria spores.	Buildings located away from commercial composting operations are recommended. Architectural or landscape buffer zones are recommended between source of pollutant an the building.		No detriment to the quality of the external air being drawn into the building.	0	0	0	0	0	
				b	yes	Commercial composting sites can liberate high concentrations of bioaerosols into the air. These should be considered as a high risk for infiltration of fungi and bacteria spores.	Air intakes should be located as far from the composting operation as possible. Filtration should be provided to all intentional air intakes Entrances facing or in the air stream of the composting site should have an airlock arrangement. Great care should be taken within the building to avoid all moist amplification sites. Architectural or landscape buffer zones are recommended between source of pollutant and the building.	air intakes, infiltration, ventilation type, filtration, buffer zones	Potential external source of fungi and bacteria spores and particulate matter.	0	-1	-2	0	0	

S	L	12	Is there a clean, open space between the neighbouring sources of pollutants and the proposed building?	a	yes	Clean, open areas between the building and the sources of pollutants can function as a buffer zone in which the concentration of outdoor pollutants can dissipate to atmosphere. It will also help isolate the building from the pollutants. The effectiveness of the buffer zone will increase with the distance from the source.	Clean, buffers zones are recommended between outdoor sources of pollutants and the proposed building.	air intakes, infiltration, ventilation type, filtration	Potential to reduce the concentration of outdoor pollutants contacting with the building.	2	1	1	2	0	
				b	no	Clean, open areas between the building and the sources of pollutants can function as a buffer zone in which the concentration of outdoor pollutants can dissipate to atmosphere. It will also help isolate the building from the pollutants. The effectiveness of the buffer zone will increase with the distance from the source.	Clean, buffers zones are recommended between outdoor sources of pollutants and the proposed building.	air intakes, infiltration, ventilation type, filtration		0	0	0	0	0	
Previous Uses (P)															
S	P	1	Was the site previously used for agricultural or horticultural activities?	a	no				No detriment to the quality of the external air being drawn into the building.	0	0	0	0	0	

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				b	yes	The soil could be contaminated with residues of pesticides and herbicides These chemicals can become tracked into the building on footwear, wheels etc. and chemicals carried of the surface of soil particles can enter the building via intentional openings or infiltrate via unintentional openings. A comprehensive site investigation is required prior to design of the proposed building.	The surrounding soil should be analysed for residues of chemicals associated with the previous uses. Depending on the extent of th measures remedial measure may range from removal of contaminated soil to containing the contaminated soil with the application of a har surface, such as paving.	subfloor, air intakes, filtration, envelope	Potential external source of particulate matter, pesticides and herbicides.	0	-1	0	0	0	
S	P	2	Was the site previously usec for a waste landfill?	a	no				No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	
				b	yes	The soil could be contaminated with residues of various chemicals and by-product gases. These residues coulc become leached or emitted from the soil. A comprehensive site investigation is required prior to design of the proposed building. If the site is heavily contaminated or incorrectly capped consideration should be given to seeking an alternative location for the building.	Selection of an alternative site should be considered. The surrounding soil should be analysed for residues of chemicals associatec with the previous uses. Depending on the extent of the soil contamination, remedial measure may range from removal of contaminated soil to containing the contaminated soil with the application of a har surface, such as paving. Specific site contaminations investigations and site engineering are required.	subfloor, air intakes, filtration, envelope, entrances	Potential external source of gaseous pollutants, particulate matter from noxious origins, microbial contamination and various chemicals and chemical by-products.	-3	-3	-2	-3	0	
			Topography (T)												

S	T	1	Is the site located in a valley, basin or coastal region where climatic inversions occur?	a	no		Buildings located away from valleys, basins et with inversion layers are recommended.		No detriment to the quality of the externa air being drawn into the building.	0	0	0	0	0	
				b	yes occasionally	Inversions drain cold air and pollutants into a valley, basin or coastal plateau and prevent pollutant from dissipating into the atmosphere. This can lead to high outdoor concentrations of pollutants.	Air intakes should be located above the strata with high levels of pollutants. The building ventilation systems should be installed with a control system to draw minimal quantities of outside air during periods of high exterior pollutant concentrations. This can typically be during the cool night period but this should be checked specifically for each site. To compensate for periods of low ventilation, high levels of air exchange should be delivered during low exterior pollutants concentrations. Detailed mass balance analysis of indoor and exterior pollutant concentrations maybe required.	air intakes & infiltration & ventilation type, openings	Potential external source of particulate matter, gaseous pollutants and VOCs.	-1	-2	0	-2	-2	

				c	yes frequently	Inversions drain cold air and pollutants into a valley or basin prevent pollutants from dissipating into the atmosphere. This can lead t high outdoor concentrations of pollutants.	Air intakes should be located above the strata with high levels of pollutants. The building ventilation systems should be installed with a management system to draw minimal quantities of outside air during periods of high exterior pollutant concentrations. This can typically be during the cool night period but thi should be checked specifically for each site. To compensate for periods of low ventilation, high levels of air exchange should be delivered during low exterior pollutants concentrations. Detailed mass balance analysis of indoor and exterior pollutant concentrations maybe required. The building should be maintained a a higher air pressure relative to the outside during periods of climatic inversion.	air intakes & infiltration & ventilation type, openings	Potential external source of particulate matter, gaseous pollutants and VOCs.	-2	-3	0	-3	-3	
			Site Water (W)												
S	W	1	Is the summer water table below the lowest part of the proposed structure?	a	yes				No increase in the potential for moisture problems from external origins.	0	0	0	0	0	
				b	no	The water pressure in the surrounding soil will be higher than the pressure within the subgrade parts for the building. This can lead to infiltration of dampness, which can subsequently cause microbial colonisation and other moisture problems.	It is recommended that all subgrade. areas of the building are well sealed and maintained at positive pressure at all times to prevent the infiltration of ground moisture.	envelope, subfloor	Potential contribution to externally originated moisture and microbial problems.	0	0	-2	0	0	

S	W	2	Is the winter water table below the lowest part of the proposed structure?	a	yes				No increase in the potential for moisture problems from external origins.	0	0	0	0	0	
				b	no	The water pressure in the surrounding soil will be higher than the pressure within the subgrade parts of the building. This can lead to infiltration of the dampness, which can subsequently cause microbial colonisation and other moisture problems.	It is recommended that all subgrade areas of the building are well sealed and maintained at positive pressure at all times to prevent the infiltration of ground moisture.	envelope, subfloor	Potential contribution to externally originated moisture and microbial problems.	0	0	-2	0	0	
S	W	3	Is the proposed building site located in a flood plane?	a	no				No increase in the potential for moisture problems from external origins.	0	0	0	0	0	skip to SW5
				b	yes, 100 year flood	Saturation of the surrounding soil can cause infiltration of free moisture and dampness, which can subsequently cause microbial colonisation and other moisture problems. Flood waters within the building introduce organic matter, and other undesirable matter from raw sewage to silt.	It is recommended that the building be elevated above the flood potential.	envelope, subfloor	Potential contribution to externally originated moisture and microbial problems.	0	0	-1	0	0	

				c	yes, 50 year flood	Saturation of the surrounding soil car cause infiltration of free moisture anc dampness, which can subsequently cause microbial colonisation and other moisture problems. Flood waters within the building introduce organic matter, and other undesirable matter from raw sewage to silt.	It is recommended that the building be elevate above the flood potential.	envelope, subfloor	Potential contribution to externally originated moisture and microbial problems.	0	0	-2	0	0	
				d	yes, 10 year flood	Saturation of the surrounding soil car cause infiltration of free moisture and dampness, which can subsequently cause microbial colonisation and other moisture problems. Flood waters within the building introduce organic matter, and other undesirable matter from raw sewage to silt.	It is recommended that the building be elevate above the flood potential.	envelope, subfloor	Potential contribution to externally originated moisture and microbial problems.	0	0	-3	0	0	
S	W	4	Will the building be elevated above the flood plane?	a	yes	This will limit flood damage and moisture problems.	Raising all parts of the building above the flood plane and water table is recommended.	envelope, subfloor	Reduction in the potential for moisture problems.						
				b	no	In the event of a flood this could plac the proposed building at significant risk from microbial contamination.	Raising all parts of the building above the flood plane and water table is recommended.	subfloor, site drainage	Potential contribution to externally originated moisture and microbial problems.	0	0	0	0	0	
S	W	5	Is the proposed building locatec in a low lying area?	a	no	Low lying sites are prone to dampness within the building.	Elevated sites are recommended.		No increase in the potential for moisture problems.	0	0	0	0	0	

				b	yes	Low lying sites are prone to dampness within the building.	It is recommended that the building be elevate and attention paid to damp proofing the subgrade portions of the building. Site drainage is recommended.	subfloor, site drainage	Potential contribution to externally originated moisture and microbial problems.	0	0	-2	0	0	
S	W	6	Does the site have any water courses, underground stream or springs?	a	no	Springs and stream can lead to dampness within the building.	Sites without springs or stream close to the buildings are recommended.		No increase in the potential for moisture problems.	0	0	0	0	0	
				b	yes	Springs and stream can lead to dampness within the building.	It is recommended that the building be elevate and attention paid to damp proofing the subgrade portions of the building. Site drainage may be required, and water course may need to be piped.	subfloor, site drainage	Potential contribution to externally originated moisture and microbial problems.	0	0	-2	0	0	
S	W	7	Is the site below road level?	a	no	Structures below road level are prone to the discharge of storm water over the site.			No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Structures below road level are prone to the discharge of storm water over the site.	It is recommended that adequate curb gutters and drains are installed.	subfloor, site drainage	Potential contribution to externally originated moisture and microbial problems.	0	0	-1	0	0	
S	W	8	Will the site be drained?	a	yes	Drainage can improve site moisture conditions. Site drains need to be correctly engineered to collect and dispose of excess site water. Provision for maintenance is required to prevent blockage and reduce the potential for water flooding into the building.	Site drains are recommended if site moisture problems are indicated.		Correctly designed site drainage can mitigate the risk of site moisture problems.	0	0	5	0	0	

				b	no	Drainage can improve site moisture conditions. Site drains need to be correctly engineered to collect and dispose of excess site water. Provision for maintenance is required to prevent blockage and reduce the potential for water flooding into the building.	Site drains are recommended if site moisture problems are indicated.		Potential contribution to moisture and microbial problems.	0	0	-1	0	0	
			Climate (C)												
S	C	1	The maximum daily summer temperature of the proposed site is:	a	10-15 C°	The proposed building may require heating in summer to maintain thermal comfort levels.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required.	insulation, air exchange rate	No detriment to the indoor air quality.	0	0	0	0	-1	
				b	15-20 C°	The proposed building may require a combination of heating and cooling in summer to maintain thermal comfort levels.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required.	insulation, air exchange rate	No detriment to the indoor air quality.	0	0	0	0	0	
				c	20-25 C°	The proposed building will require cooling in summer to maintain thermal comfort levels. High internal temperatures will increase the rate of release of VOCs from construction and furnishing materials.	Specific engineering of the building is required so that thermal comfort for the occupants is maintained. The air exchange rate should be maintained at one or more air changes per hour, to dilute emissions of VOCs from construction and furnishing materials when the internal temperature exceeds 23 deg C. This is particularly important for the first 12 months following the installation of new materials.	insulation, air exchange rate, material selection	Potential contribution to VOC emissions and thermal discomfort.	-1	0	0	0	-1	

				d	25-30 C°	The proposed building will require cooling in summer to maintain thermal comfort levels. High internal temperatures will increase the rate of release of VOCs from construction and furnishing materials.	Specific engineering of the building is requirec so that thermal comfort for the occupants is maintained. The air exchange rate should be maintained at one or more air changes per hour, to dilute emissions of VOCs from construction and furnishing materials when th internal temperature exceeds 23 deg C. This is particularly important for the first 12 months following the installation of new materials.	insulation, air exchange rate, material selection	Potential contribution to VOC emissions and thermal discomfort.	-1	0	0	0	-2	
				e	over 30 C°	The proposed building will require cooling in summer to maintain thermal comfort levels. High internal temperatures will increase the rate of release of VOCs from construction and furnishing materials.	Specific engineering of the building is requirec so that thermal comfort for the occupants is maintained. The air exchange rate should be maintained at one or more air changes per hour, to dilute emissions of VOCs from construction and furnishing materials when th internal temperature exceeds 23 deg C. This is particularly important for the first 12 months following the installation of new materials.	insulation, air exchange rate, material selection	Potential contribution to VOC emissions and thermal discomfort.	-2	0	0	0	-3	
S	C	2	The minimum daily winter temperature of the proposed site is:	a	sub 10 - 5 C°	The proposed building will require heating to maintain thermal comfort levels and prevent condensation. Radiant asymmetry should be avoided. Cold surfaces can cause condensation, which in turn can provide sufficient moisture for fungi.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required. The building envelope will also require specific design to insure condensation doesn't occur on or withir the envelope.	insulation, air exchange rate, thermal bridges	Potential contribution to moisture and microbial problems, as well as thermal discomfort.	0	0	-2	0	-3	
				b	5-10 C°	The proposed building will require heating to maintain thermal comfort levels and prevent condensation. Cold surfaces can cause condensation, which in turn can provide sufficient moisture for fungi.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required. The building envelope will also require specific design to insure condensation doesn't occur on or withir the envelope.	insulation, air exchange rate, thermal bridges	Potential contribution to moisture and microbial problems, and thermal discomfort.	0	0	-1	0	-1	

				c	10 - 15 C°	The proposed building will require heating to maintain thermal comfort levels and prevent condensation. Cold surfaces can cause condensation, which in turn can provide sufficient moisture for fungi.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required. The building envelope will also require specific design to insure condensation doesn't occur on or within the envelope.	insulation, air exchange rate, thermal bridges	Potential contribution to moisture and microbial problems.	0	0	-1	0	0	
				d	15-20 C°	The proposed building will require cooling in summer to maintain thermal comfort levels. High internal temperatures will increase the rate of release of VOCs from construction and furnishing materials.	Specific engineering of the building so that thermal comfort for the occupants is maintained, without compromising the air exchange rate is required.	insulation, air exchange rate	No detriment to the indoor air quality.	0	0	0	0	0	
S	C	3	The mean daily ambient relative humidity at the proposed site is:	a	20-40%	This is unlikely to cause condensation problems. However very dry air can cause electrostatic problems. Dry air can also increase occupants exposure to respirable particulates.		filtration	No detriment to the indoor air quality.	0	-1	0	0	0	
				b	40-60%	A relative humidity within the range of 40 - 60% RH is ideal for human comfort, without contributing to the moisture availability for propagation of microbial colonies.	A relative humidity within this range is recommended.		No detriment to the indoor air quality.	0	0	0	0	0	

				c	60-75%	This will lead to extensive condensation forming on cold surfaces, and available moisture on hygroscopic materials. These can in turn lead to favorable conditions for fungi growth. The emission rate of VOCs from construction and furnishing materials also increases a higher relative humidity levels. High relative humidity can lead to dissatisfaction with the thermal environment. Mechanical cooling is recommended to reduce the internal RH level.	Surfaces which have the potential for wetting from condensation, need to be insulated or warmed to prevent moisture problems. Surfaces which could potentially be wetted should not be made from porous materials. Mechanical cooling is recommended.	Insulation, materials selection, cooling	Potential contribution to moisture and microbial problems, thermal discomfort and increased emission rate of VOCs.	-1	0	-2	0	-1	
				d	75 -100%	This will lead to extensive condensation forming on cold surfaces, and available moisture on hygroscopic materials. These can in turn lead to favorable conditions for fungi growth. The emission rate of VOCs from construction and furnishing materials also increases a higher relative humidity levels. High relative humidity can lead to dissatisfaction with the thermal environment. Mechanical cooling is recommended to reduce the internal RH level.	Surfaces which have the potential for wetting from condensation, need to be insulated or warmed to prevent moisture problems. Surfaces which could potentially be wetted should not be made from porous materials. Mechanical cooling is recommended.	Insulation, materials selection, cooling	Potential contribution to moisture and microbial problems, thermal discomfort and increased emission rate of VOCs.	-2	0	-3	0	-2	
S	C	4	The maximum daily rain fall is:	a	<20mm	This is unlikely to cause moisture problems.			No detriment to the indoor air quality.	0	0	0	0	0	

				b	20-40mm	This is unlikely to cause moisture problems.	To exclude rain penetration, it is recommende that the cladding be at least a two stage system. Face sealed cladding systems are nc recommended.	building height, cladding system, site drainage	No detriment to the indoor air quality.	0	0	0	0	0	
				c	40-60mm	High rain falls increase the probability of inclusion of water through the envelope and site moisture problems Water leakage and pounded site water can form favorable conditions for fungi and bacteria to grow.	To exclude rain penetration, it is recommende that the cladding be at least a two stage system. Fenestration of the facade to promot shedding of water off the face of the building is recommended. Face sealed cladding systems are not recommended.	building height, cladding system, site drainage	Potential contribution to moisture and microbial problems.	0	0	-1	0	0	
				d	60-80mm	High rain falls increase the probability of inclusion of water through the envelope and site moisture problems Water leakage and pounded site water can form favorable conditions for fungi and bacteria to grow.	To exclude rain penetration, it is recommende that the cladding be at least a two stage system. Fenestration of the facade to promot shedding of water off the face of the building is recommended. Face sealed cladding systems are not recommended.	building height, cladding system, site drainage	Potential contribution to moisture and microbial problems.	0	0	-2	0	0	
				e	>80mm	High rain falls increase the probability of inclusion of water through the envelope and site moisture problems Water leakage and pounded site water can form favorable conditions for fungi and bacteria to grow.	To exclude rain penetration, it is recommende that the cladding be design using a rain screer or pressure equalised joint system. Fenestration of the facade to promote shedding of water off the face of the building is recommended.	building height, cladding system, site drainage	Potential contribution to moisture and microbial problems.	0	0	-3	0	0	
S	C	5	The wind zone of the proposec site is:	a	low	Low external air movement can allow urban pollutants such as vehicle fumes to accumulate and poor dispersion of localised contaminants.	Air intakes and openings in the building envelope need to be carefully located at the cleanest possible source of outdoor air.	outdoor pollutant sources, air intakes, filtration	No detriment to the indoor air quality.	0	0	0	0	0	
				b	medium	Wind pressure can drive both water and other outdoor contaminants into building. Wind flow also helps to dissipate urban pollutants.	Air intakes and openings in the building envelope need to be carefully located at the cleanest possible source of outdoor air.	outdoor pollutants sources, cladding system, openable windows, rainfall	=IF(O83+O84<0,"Potential source of water inclusion",)	2	0	-1	2	0	

				c	high	Wind pressure can drive both water and other outdoor contaminants into building. Wind flow also helps to dissipate urban pollutants.	Reliance on openable windows for ventilation not recommended as there may be too many days when can't be opened and air exchange is compromised. The building envelope shoul be a two stage system to prevent rain water ingress.	adjacent pollutants sources, cladding system, openable windows, rainfall, ventilation	=IF(O83+O84<0,"Potential source of water inclusion and dispersion of outdoor gaseous pollutants and VOCs.","Potential reduction in outdoor concentrations of VOCs and gaseous pollutants.")	3	0	-2	3	-1	
				d	very high	Wind pressure can drive both water and other outdoor contaminants into building. Wind flow also helps to dissipate urban pollutants.	Reliance on openable windows for ventilation not recommended as there may be too many days when can't be opened and air exchange is compromised. The building envelope shoul be a two stage system to prevent rain water ingress. Wind tunnel modelling is recommended to determine pathways for pollutants around the outside of the building.	adjacent pollutants sources, cladding system, openable windows, rainfall	=IF(O83+O84<0,"Potential source of water inclusion and dispersion of outdoor gaseous pollutants and VOCs.","Potential reduction in outdoor concentrations of VOCs and gaseous pollutants.")	3	0	-3	3	-2	
S	C	6	Is the proposed building located close enough to adjacent structures to create a wind tunnel effect?	a	no	Wind tunnels can cause unpredictable air pressure relationships and eddies, which can in turn force moisture and pollutants into penetrations in the building envelope.	Wind tunnel modelling is recommended to determine pathways for pollutants around the outside of the building.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	Wind tunnels can cause unpredictable air pressure relationships and eddies, which can in turn force moisture and pollutants into penetrations in the building envelope.	Wind tunnel modelling is recommended to determine pathways for pollutants around the outside of the building.	adjacent pollutants sources, cladding system, openable windows, rainfall	=IF(O83+O84<0,"Potential source of water inclusion",No detriment to the indoor air quality.)	0	0	-2	0	0	
			Summary of outside sources of pollutants:							**-16**	**-24**	**-38**	**-13**	**-22**	

Envelope (E)

			Questions		Options	Justification	Recommendations	Linkages	Conclusion	VOCs	Particulates	Microbials	Gaseous	Thermal	
			Air intakes and infiltration (A)												
E	A	1	Does the proposed site have ambient pollutants at:	a	at the entrance level	Ambient pollutants in urban areas are typically lowest at street level. These pollutants generally arise from vehicle activity, street dirt etc Careful arrangement and positioning of openings in the lower third of the building can reduce the potential for the contaminants to enter the building	Openings to the building should be distant and up wind of sources of pollutants.	site							
				b	at the roof level	Concentrations of ambient pollutants in urban areas typically reduce with the distance from the street level unless there are close exhaust stacks, cooling towers or other elevated pollutants sources. Careful arrangement and positioning of openings in the upper third of the building height can reduce the potential for these pollutants to enter the building.	Air intakes and other openings to th building should be distant and up wind of sources of pollutants.	site							

E	A	2	Does the envelope of the proposed building have:	a	low air tightness	Low air tightness can lead to passive infiltration of air, this can improve the indoor air quality if the outdoor air is clean, or admit environmental pollutants and odours if the outdoor air quality is poor. Low air tightness increases the volume of air which can flow due to the stack effect.	Other means of ventilation are required to dilute indoor air pollutants.	outdoor pollutants	Potential pathway fo infiltration of outdoor pollutants	-2	-2	-2	-2	0	
				b	medium air tightness	Medium air tightness can lead to passive infiltration of air, this can improve the indoor air quality if the outdoor air is clean, or admit environmental pollutants and odours if the outdoor air quality is poor. Low air tightness increases the volume of air which can flow due to the stack effect.	Other means of ventilation are required to dilute indoor air pollutants.	outdoor pollutants	Potential pathway fo infiltration of outdoor pollutants	-2	-2	-2	-2	0	
				c	high air tightness	High air tightness is recommended when the outdoor air quality is less than ideal. Low breathability of the building envelope requires other means of ventilation to dilute indoor contaminants. High air tightness decreases the volume of air which can flow due to the stack effect.	Other means of ventilation are required to dilute indoor air pollutants.	outdoor pollutants	Potential pathway fo infiltration of outdoor pollutants	-2	-2	-2	-2	0	
E	A	3	Does the proposed building have the primary air intakes at roof level:	a	yes	The roof level is usually the cleanest source of air. Care needs to be taken to avoid flues, fume hoods, exhausts, stacks and standing water.	Locating the air intakes at roof level is recommended, unless there are stack, exhausts or other point sources of contamination at roof level of the proposed or neighbouring buildings.	air intakes	Potential to reduce the intake of outdoor pollutants.	3	3	3	3	0	

				b	no, but in the upper two thirds of the building height	The roof level is usually the cleanest source of air. Air intakes for the building should ideally be located in the upper two thirds of the height of the building.	Locating the air intakes at roof level is recommended, unless there are exhaust stacks or other point sources at roof level of the propose or neighbouring buildings.	air intakes	Potential to reduce the intake of outdoor pollutants.	2	2	2	2	0	
				c	no, in the lower two thirds of the height of the building	The roof level is usually the cleanest source of air. Air intakes for the building should ideally be located in the upper two thirds of the height of the building.	Locating the air intakes at roof level is recommended, unless there are stack, exhausts or other point sources at roof level of the propose or neighbouring buildings.	air intakes		-1	-1	-1	-1	0	
E	A	4	Does the proposed building have any air intakes (openings) at street level:	a	no	Air intakes above the lower third o the building tend to draw in the cleanest air possible source.	Air intakes should be located in the upper two thirds of the building and away from other sources of contamination.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes, fire escape doors	Street level air is typically polluted with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, fire exit doors should be fitted with air seals to prevent infiltration of pollutants.	Outside pollutants	No detriment to the indoor air quality.	0	0	0	0	0	
				c	yes, openable windows	Street level air is typically polluted with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, unfiltered air intakes at street level are not recommended as these can admit particulate matter and gaseous pollutants into the building. An alternative means of ventilation from a cleaner source or with filtere air is recommended.	Outside pollutants	Potential pathway fo outdoor pollutants	-1	-1	-1	-1	-1	
				d	yes, entry doors with vestibules	Street level air is typically polluted with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, vestibule arrangements on all entrance ways are highly recommended to limit particulate matter and gaseous pollutants from entering the building.	Outside pollutants	No detriment to the indoor air quality.	1	1	1	1	1	

				e	yes, entry doors without vestibules	Street level air is typically polluted with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, vestibule arrangements on all entrance ways are highly recommended to limit particulate matter and gaseous pollutants from entering the building.	Outside pollutants	Potential pathway fo outdoor pollutants	-1	-1	-1	-1	-1	
				f	yes, air intakes	Street level air is typically polluted with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, unfiltered air intakes at street level are not recommended as these can admit particulate matter and gaseous pollutants into the building.	Outside pollutants	Potential pathway fo outdoor pollutants	-3	-3	-3	-3	-3	
E	A	5	Does the proposed building have any air intakes or openings near or above a truck or loading dock:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes,	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Essential openings close to vehicle areas should be isolated from the interior space by an air lock. The interior should be maintained at positive air pressure relative to the vehicle area at all times.	stairways, lifts	Potential pathway fo VOCs, gaseous pollutants and particulate matter.	-3	-3	0	-3	0	Run ER loop
E	A	6	Does the proposed building have any air intakes (openings) near or above a carpark:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Essential openings close to vehicle areas should be isolated from the interior space by an air lock. The interior should be maintained at positive air pressure relative to the vehicle area at all times. Car parks should be ventilated separately from the remainder of the building.	carparking, stairways, lifts	Potential pathway fo VOCs, gaseous pollutants and particulate matter.	-3	-3	0	-3	0	Run ER loop
E	A	7	Does the proposed building have any air intakes (openings) near or above a wet cooling tower:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Wet cooling towers are a strong point sources of bioaerosols and biocides. Both should not be allowed to enter the building.	It is very important to prevent air from being drawn from reservoirs contaminated with microbial colonie or biocides.	cooling system	Potential pathway fo microbiological contaminants.	0	0	-3	0	0	Run ER loop
E	A	8	Does the proposed building have any air intakes (openings) near a water feature:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building. Water features also require regula maintenance and testing to insure to quality of the water doesn't deteriorate.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to microbial contamination or aerosolized biocides being drawn into the air supply.	It is very important to prevent air from being drawn from reservoirs contaminated with microbial colonie or biocides.		Potential pathway fo microbiological contaminants.	0	0	-3	0	0	Run ER loop
E	A	9	Does the proposed building have any air intakes (openings) near standing water:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	This can lead to microbial contamination or aerosolized biocides being drawn into the air supply.	It is very important to prevent air from reservoirs contaminated with microbial colonies or biocides from being drawn into the air supply		Potential pathway fo microbiological contaminants.	0	0	-3	0	0	Run ER loop
E	A	10	Does the proposed building have any air intakes (openings) near a rubbish collection, compaction or disposal area:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to microbial contamination, particulate matter, gaseous pollutants and/or VOCs being drawn into the air supply.	It is very important to prevent air from rubbish collection compaction, and disposal areas from being drawn into the air supply.		Potential pathway fo microbiological contaminants.	0	-1	-3	-1	0	Run ER loop
E	A	11	Does the proposed building have any air intakes (openings) near a chimney or exhaust vent:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to particulate matter gaseous pollutants and/or VOCs being drawn into the air supply.	It is very important to prevent air from combustion processes and exhausts from being drawn into the air supply.		Potential pathway fo gaseous pollutants and particulate matter.	0	-2	0	-2	0	Run ER loop
E	A	12	Does the proposed building have any openings within a climatic inversion strata?	a	no	Openings where ever possible should be located above the inversion strata to draw air from a clean source. Openings within the inversion layer, such as exterior doors should be provided with air locked lobbies.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	Contaminated air contained within the inversion layer can be drawn into the proposed building. Openings where ever possible should be located above the inversion strata to draw air from a clean source. Openings within the inversion layer, such as exterior doors should be provided with air locked lobbies.	A source of filtered air is recommended during periods when inversions are present. The building interior should be maintained at a higher air pressure relative to the outside air during periods of climatic inversions.	air intakes & infiltration & ventilation type	Potential pathway fo gaseous pollutants, particulate matter and VOCs.	-2	-2	0	-2	0	Fire ER Loop
E	A	13	Does the proposed building have any air intakes (openings) near a kitchen exhaust:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to moisture, microbial contamination, particulate matter and odours being drawn into the air supply.	It is important to prevent air from kitchen exhausts from being drawn into the air supply.		Potential pathway fo gaseous pollutants and microbial contaminants.	0	0	-2	-1	0	Run ER loop
E	A	14	Does the proposed building have any air intakes (openings) 2 m in any direction of a bathroom exhaust:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building.	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to moisture, microbial contamination, gaseous pollutants and odours being drawn into the air supply.	It is very important to prevent air from bathroom exhausts from being drawn into the air supply.		Potential pathway fo microbial contaminants.	0	0	-2	0	0	Run ER loop

E	A	15	Does the proposed building have any air intakes (openings) 5 m in any direction of a plumbing stack vent:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building. Water features require regular maintenance and testing to insure to	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to moisture, microbial contamination, gaseous pollutants and odours being drawn into the air supply.	It is very important to prevent air from bathroom exhausts from being drawn into the air supply.		Potential pathway fo microbial contaminants.	0	0	-2	0	0	Run ER loop
E	A	16	Does the proposed building have any air intakes (openings) near an outdoor smokers area:	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building. Water features require regular maintenance and testing to insure to	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to the entrainment o environmental tobacco smoke into the building.	Either the outdoor smoking area should be relocated or the opening in the building envelope closed.		Potential pathway fo VOCs, particulate matter and gaseous pollutants.	-2	-2	0	-2	0	Run ER loop
E	A	17	Does the proposed building have any subgrade air intake wells?	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building. Water features require regular maintenance and testing to insure to	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Sub-grade air intake wells are prone to contamination with decaying plant material, moisture and bird droppings.	Sub-grade air intake wells should be avoided. Ducting air from well abov grade level is recommended.		Potential pathway fo microbial contaminants.	0	0	-2	0	0	Run ER loop

E	A	18	Does the proposed building have any penetrations between the plenum and the outdoor air?	a	no	The absence of openings in this location will help break the pathwa for pollutants to enter the building. Water features require regular maintenance and testing to insure to	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Return air plenums will be at negative pressure with respect to the outdoor air. Penetrations can act as unintentional air intakes, which can draw in unfiltered and possibly contaminated air, and will upset the pressure relationships within the building. If large quantities of air are entering via this pathway, then the intended outdoor air intake may end up functioning as an exhaust.	The building envelope should be detailed to prevent outside air leaking directly into the return air plenum.		Potential disturbance of air supply and exhaust system.	-1	-1	-1	-2	-2	
E	A	19	Can water pond near the air intakes or building openings?	a	no	This can lead to moisture and microbial contamination being drawn into the air supply	This will not cause any detriment to the quality of the indoor air.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can lead to moisture and microbial contamination being drawn into the air supply.	It is very important to prevent air from being drawn from reservoirs contaminated with microbial colonie or biocides.		Potential source of microbial contaminants.	0	0	-3	0	0	Run ER loop
E	A	20	Can the water be eliminated from this location?	a	yes	Elimination of moisture is a key component of controlling microbial growth.	Elimination of water is recommended rather than water treatment.		Potential elimination of microbiological source.	0	0	3	0	0	
				b	no	Elimination of moisture is a key component of controlling microbial growth.	Elimination of all moisture is recommended especially near air intakes or openings. This is preferable to chemical water treatment.			0	0	0	0	0	

			Pollutant Reduction and Isolation Loop (ER loop)												
E	R	1	Can either the opening or pollutant source be relocated?	a	yes	Physical separation is permanent and effective.	Physical separation is recommended wherever possible.		Potential isolation of a pollutant source.						
				b	no	Other means of isolation are required.	Other means of isolation are recommended such as sealed doors and maintaining correct air pressure relationships.			0	0	0	0	0	
E	R	2	Can the pollutant source be isolated from the occupied space by:	a	a vestibule with two sets of doors on door closers or revolving doors	These help form an air barrier to prevent the admissions of outdoor air pollutants and minimises the stack effect.	These are the recommended treatment of doors when exterior pollutants or the stack effect are potentially present. Doors need to be managed so they are not opened unduly.		Potential isolation of the pathway.						
				b	a vestibule with two sets of doors without door closers	Two sets of doors help to form an air lock, but are more efficient if door closers are installed.	These are the recommended treatment of doors when exterior pollutants or the stack effect are potentially present. Doors need to be managed so they are not opened unduly.		Potential isolation of the pathway.	0	0	1	0	0	
				c	a single set of doors on a door closer	A single set of doors can admit pollutants every time it is opened.	Vestibules with doors on door closers are strongly recommended.		Potential isolation of the pathway.						
				d	a single set of doors without a door closer	A single set of doors can admit pollutants every time it is opened.	Vestibules with doors on door closers are strongly recommended.			0	0	0	0	0	

E	R	3	Can the pollutant source be isolated from the occupied space by maintaining the occupied area at a higher air pressure relative to the pollutant source zone, except when the mechanical ventilation systems is not operating?	a	yes	Care needs to be taken to insure the correct pressure relationships can be maintained at all times when the pollutant is present.	Mechanisms, such as stack effect and wind pressure which could overwhelm the mechanical ventilation system should investigated.									
				b	no	Mechanical ventilation can generally control air pressure relationships to effectively to contain or isolate.	Dampers or other such devices need to be installed to automatically close the pathway between pollutant source and the building interior.									
E	R	4	Can the pollutant source be isolated from the occupied space by maintaining the occupied area at a higher air pressure relative to the pollutant source zone?	a	yes	Correct air pressure relationships can help to isolate pollutants from the occupied areas. Care needs to be taken to insure the correct pressure relationships can be maintained at all times when the pollutant is present.	Correct air pressure relationships are recommended if the source of the pollutants can not be eliminated									
				b	yes, except when the outside wind pressure upsets the interior air pressure relationships	Air pressure relationships can often be used effectively to contain or isolate, however wind pressure outside the building can overwhelm other pressure relationships	Dampers or other such devices need to be installed to close the pathway between the pollutants and the building interior during periods of high wind pressure									

				c	yes, except when the stack effect upsets the interior air pressure relationships	Correct air pressure relationships can help to isolate pollutants from the occupied areas. Care needs t be taken to insure the correct pressure relationships can be maintained at all times when the pollutant is present.	Careful management of air volume delivery to compensate for the stack effect is recommended.								
				d	no	Correct air pressure relationships can help to isolate pollutants from the occupied areas. Care needs t be taken to insure the correct pressure relationships can be maintained at all times when the pollutant is present.	Correct air pressure relationships are recommended if the source of the pollutants can not be eliminated								
			Windows												
E	W	1	Will the proposed building be installed with openable windows?	a	yes	Openable windows offer personal control of the thermal environment and are preferred by many buildin occupants. They are of limited value in high rise buildings, or on windy or noisy sites. Even in fully air-conditioned building they are useful as a backup system in case the HVAC system fails.	Installation of some measures of personal control over the interior thermal environment is recommended. In room filtration is recommended.	site pollutants, wind zone, in-room filtration	Potential pathway fo outdoor pollutants.	-2	-2	-2	-2	0	

				b	no	Openable windows offer personal control of the thermal environment and are preferred by many building occupants. They are of limited value in high rise buildings, or on windy or noisy sites. Even in fully air-conditioned building they are useful as a backup system in case the HVAC system fails.	Installation of some measures of personal control over the interior thermal environment is recommended.	site pollutants, wind zone, in-room filtration	No detriment to the indoor air quality	0	0	0	0	0	skip to EW5
E	W	2	Will the openable windows face in the direction of outdoor sources of air pollution?	a	no	Openable windows should face away from all source of pollution, such as major roadways.	Drawing outside air from the cleanest possible sources is recommended.	site pollutants, in-room filtration	No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Openable windows should face away from all source of pollution, such as major roadways.	Mechanical ventilation which allows for the outside air to be drawn from an area distant from outdoor sources of pollutants is recommended. Alternatively in-room air cleaning devices are also recommended.	site, air intakes, air cleaners, in-room filtration	Potential pathway for outdoor pollutants.	-2	-2	-2	-2	0	
E	W	3	Will the propose building be installed with the means to introduce outdoor air into the proposed building when the windows are closed?	a	yes	It is important to maintain a sufficient rate of air exchange at all times when the building is occupied or pollutants are present	The means to provide a sufficient rate of air exchange to dilute interior levels of bioeffluents, VOCs particulates and humidity at all times is recommended.	material selection, VOC interactions	No detriment to the indoor air quality.	0	0	0	0	0	

				b	no	Interior levels of bioeffluents, VOCs, particulates and possibly humidity can accumulate during periods when weather conditions or exterior noise levels are not conducive to opening windows.	Ventilation should be provided at all times to dilute interior levels of bioeffluents, VOCs particulates and humidity. This is especially important during the first year following new construction.	material selection, VOC interactions	Potential limitation o ventilation.	-2	-2	-2	-2	-2	
E	W	4	Are openable windows designed to prevent the ingress o rain under typical weather conditions.	a	yes	Preventing the ingress of rain water through open windows is important to prevent all construction materials from becoming wet as this can lead to microbial contamination.	It is recommended that every opportunity is taken to avoid the ingress of water as this can lead to microbial contamination	rainfall, wind zone	No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	It is important to prevent all construction materials from becoming wet as this can lead to microbial contamination.	It is recommended that windows are designed to prevent the ingress of rain water as this can lead to microbial contamination.	rainfall, wind zone	Potential ingress of moisture.	0	0	-2	0	0	
E	W	5	Are the windows:	a	single glazed	This leads to a greater likelihood o condensation and higher heat loss losses in winter. It also causes occupants located near the windows to emit long wave radiant heat to the cooler window surface. This is experienced by the occupants as radiant asymmetry which is very uncomfortable. High indoors temperatures will increase the emission rate of VOCs from construction and other materials.	Single glazing is not recommended in most climatic zones as it increases the likelihood of condensation and leads to higher temperature fluctuations.	indoor temperature, outside temperature, indoor RH	This can lead to microbial contamination in the occupied areas	-1	0	-2	0	-2	

				b	double glazed	This leads to a more stable interio temperature during winter and reduces the likelihood of condensation.	Double glazing is recommended in most climatic zones to reduce the likelihood of condensation, stabilize the thermal environment and provid sound insulation.	Indoor temperature, outside temperature, indoor RH	Reduction in microbial contamination near the envelope and increased thermal comfort.	1	0	1	0	2	
				c	triple	This leads to a more stable interio temperature during winter and reduces the likelihood of condensation.	Triple glazing is seldom warranted i New Zealand's climate. It will reduce the likelihood of condensation, stabilize the thermal environment and provide sound insulation.	Indoor temperature, outside temperature, indoor RH	Reduction in microbial contamination near the envelope and increased thermal comfort.	1	0	1	0	2	
E	W	6	Is there a possibility that condensation could form on the windows:	a	no	It is very important that condensation is avoided. Condensation can wet any adjacent construction materials, which can then lead to microbial contamination.	It is recommended that all measure are taken to prevent condensation wetting building materials	Indoor temperature, outside temperature, indoor RH	No detriment to the indoor air quality.	0	0	0	0	0	skip to EW8
				b	yes	It is important that condensation is avoided to prevent all constructio materials from becoming wet as this can lead to microbial contamination. Condensation should be collected before surrounding materials such as window treatments and sill could be wetted and discharged to the exterior. Drainage should be designed to operate even under the influence of positive pressure from high winds, and provisions should be made for cleaning dust and debris from the drainage channel during the life of the building.	It is recommended that all measure are taken to prevent condensation forming on cold surfaces. Drainage channels, to collect and remove condensation to the exterior of the building, even under high wind pressure should be incorporated int the window design.	Indoor temperature, outside temperature, indoor RH	This can lead to microbial contamination in the occupied areas	0	0	-2	0	0	

E	W	7	Are the windows designed to collect and drain any condensation?	a	yes, condensation drained to exterior	This is desirable as it helps prevent building materials from becoming wet.	Collection of condensation is recommended to avoid wetting of interior materials. It is recommended that condensation be drained away as quickly as possible to avoid microbial contamination. Drains should be shielded from high wind pressure so as to remain operational in all weather conditions.	indoor temperature, outside temperature, indoor RH	This can alleviate the risk of microbial contamination near the envelope.	0	0	2	0	0	
				b	yes, condensation collected but not drained	This is desirable to remove condensation as quickly as practical.	Collection of condensation is recommended to avoid wetting of interior materials. It is recommended that condensation be drained away as quickly as possible to avoid microbial contamination. Drains should be shielded from high wind pressure so as to remain operational in all weather conditions.	indoor temperature, outside temperature, indoor RH	This can alleviate the risk of microbial contamination near the envelope.	0	0	1	0	0	
				c	no	Condensation needs to be removed as quickly as practical to avoid interior materials becoming wet	Condensation drains to the exterior are recommended.	indoor temperature, outside temperature, indoor RH	This can lead to microbial contamination in the occupied areas.	0	0	-2	0	0	
E	W	8	Will in-room filtration be provided?	a	yes	Openable windows allow unfiltered air to enter the building. Filtration i recommended.	In-room filtration units are recommended to capture particulate matter that has entered via the windows or are generated from in room sources.	outdoor particle levels, openable windows	This will help to reduce in-room concentrations of particles	0	2	0	0	0	
				b	no	Openable windows allow unfiltered air to enter the building.	In-room filtration units are recommended to capture particulate matter that has entered via the windows.	outdoor particle levels, openable windows	This will not decrease or increase the indoor concentration of particulate matter.	0	0	0	0	0	

				b	R-2 or better	Low insulation performance of the wall will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the wall surfaces. It will reduce the thermal comfort levels and potentially lead to thermal asymmetry in the occupied areas. High indoor temperatures will also increase the emissions of VOCs from building materials and furnishings.	It is recommended that all walls are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas. R-3 insulation is recommended.	interior temperature, outdoor temperature, VOC interactions, material selection	This can contribute both to microbial contamination and VOC emissions.	1	0	1	0	1	
				c	less than R-2	Low insulation performance of the wall will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the wall surfaces. It will reduce the thermal comfort levels and potentially lead to thermal asymmetry in the occupied areas. High indoor temperatures will also increase the emissions of VOCs from building materials and furnishings.	It is recommended that all walls are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas. R-3 insulation is recommended.	interior temperature, outdoor temperature, VOC, material selection	This can contribute both to microbial contamination and VOC emissions.	0	0	-1	0	-2	
E	I	2	The insulation value of the roof is:	a	R-3 or better	This will significantly reduce the risk of condensation and cold surfaces, as well as solar heat gains.	R-3 insulation is recommended.	interior temperature, outdoor temperature, VOC, material selection	No detriment to the indoor air quality.	1	0	2	0	2	

				b	R-2 or better	Low insulation performance of the roof will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the roof surfaces. It will reduce the thermal comfort levels and potentially lead to thermal asymmetry in the occupied areas. High indoor temperatures will also increase the emissions of VOCs from building materials and furnishings.	It is recommended that all roofs are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas.	Interior temperature, outdoor temperature, VOC, material selection	This can contribute both to microbial contamination and VOC emissions.	1	0	1	0	1	
				c	less than R-2	Low insulation performance of the roof will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the roof surfaces. It will reduce the thermal comfort levels and potentially lead to thermal asymmetry in the occupied areas. High indoor temperatures will also increase the emissions of VOCs from building materials and furnishings. However where there is a full storey of plant room or non occupied space between the roof and occupied areas, then the insulation value of the roof becomes less critical.	It is recommended that all roofs are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas. R-3 insulation is recommended.	Interior temperature, outdoor temperature, VOC, material selection	This can contribute both to microbial contamination and VOC emissions	0	0	-1	0	-2	

E	I	3	Is the roof insulation scheme:	a	traditional, water proofing layer on top, with insulation below	This system when laid at a pitch greater than 12 deg will minimise the risk of sitting or ponding water and microbial contamination. It can increase the risk of interstitial condensation.	This system is recommended near air takes, but represents an increase the risk of condensation and microbial contamination in other areas.	interior temperature, outdoor temperature, roof slope	This can contribute both to microbial contamination.	0	0	2	0	0	
				b	inverted, insulation above waterproofing layer	This is beneficial for preventing interstitial condensation at roof level. However this system holds moisture and can lead to microbial contamination. Air for air intakes should not be drawn over sections of inverted roofing.	This system is not recommended near any air takes, but is recommended for preventing condensation at roof level.	interior temperature, outdoor temperature, location of air intakes	No detriment to the indoor air quality.	0	0	-1	0	0	
E	I	4	The insulation value of the external floor is:	a	R-3 or more	Low insulation performance of the floor will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the floor surfaces It will reduce the thermal comfort levels, where warm feet but cooler air in the breathing zone are desirable and can lead to thermal asymmetry. The insulation value of the floor is less critical where there is an occupied sub floor space.	It is recommended that all external floors are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas.	interior temperature, outdoor temperature, porous flooring materials	No detriment to the indoor air quality.	0	0	1	0	1	

				b	less than R-2	Low insulation performance of the floor will increase the risk of thermal bridging, condensation and microbial contamination either interstitial or on the floor surfaces It will reduce the thermal comfort levels, where warm feet but cooler air in the breathing zone are desirable and can lead to thermal asymmetry. The insulation value of the floor is less critical where there is an occupied sub floor space.	It is recommended that all external floors are well insulated to prevent condensation forming and to avoid having cold surfaces adjacent to occupied areas.	interior temperature, outdoor temperature, porous flooring materials	This can contribute to microbial contamination.	0	0	-1	0	-1	
E	I	5	Will the proposed building have any uninsulated steel structural components?	a	no	Insulation around steel components helps to break any thermal bridges.			No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can form a thermal bridge which can allow heat to escape and condensation to form. This can lead to materials becoming wet forming and ideal host environment for fungi.	It is recommended that all thermal bridges are avoided	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-2	0	-1	
E	I	6	Will the proposed building have any uninsulated metal fastening that are continuos from the exterior to the interior?	a	no	Insulation around steel components helps to break any thermal bridges.			No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	This can form a thermal bridge which can allow heat to escape and condensation to form. This can lead to materials becoming wet forming and ideal host environment for fungi.	It is recommended that all thermal bridges are avoided	Interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-1	0	0	
E	I	7	Will the proposed glazing framing have thermal breaks?		yes	Thermal breaks help prevent thermal bridging and condensation	Thermal breaks are recommended		No detriment to the indoor air quality.	0	0	0	0	0	
					no	This can form a thermal bridge which can allow heat to escape and condensation to form. This can lead to materials becoming wet forming and ideal host environment for fungi.	It is recommended that all thermal bridges are avoided	Interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-1	0	0	
E	I	8	Will the proposed building have any uninsulated gaps between cladding panels?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	This can form a thermal bridge which can allow heat to escape and condensation to form. This can lead to materials becoming wet forming a ripe environment for microbial contamination.	It is recommended that all thermal bridges are avoided	Interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-2	0	0	
E	I	9	Will the proposed building have any areas of the wall cladding with reduced thickness of insulation?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes	This can form a thermal bridge which can allow heat to escape and condensation to form. This can lead to materials becoming wet forming a ripe environment for microbial contamination.	It is recommended that all thermal bridges are avoided	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-2	0	0	
E	I	10	What is the extent of the thermal bridging?	a	small area	This can cause localised condensation problems, which car lead to materials becoming wet and forming a ripe environment foi microbial contamination.	Thermal bridging should be avoided	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-1	0	0	
				b	medium	This can cause significant condensation problems, which car lead to materials becoming wet and forming a ripe environment foi microbial contamination.	Thermal bridging should be avoidec	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-2	0	0	
				c	large	This can cause significant condensation problems, which car lead to materials becoming wet and forming a ripe environment foi microbial contamination.	Thermal bridging should be avoided	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-3	0	0	
E	I	11	If condensation forms, it will settle on	a	non-porous surfaces	If moisture is present, fungi can grow on non-porous surfaces. Non-porous surfaces are more readily dried and cleaned. Maintaining low levels of organic nutrient matter is also important means to limit microbial growth.	If it is impractical to avoid condensation then capturing the moisture on non-porous materials is the next best option. The moisture should be drained or removed from the environment within 24 hours of a surface being wetted.	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-1	0	0	

				b	porous surfaces	If moisture is present, fungi can readily grow on porous surfaces. Porous surfaces are slow to dry, which increases the opportunity fo propagation of fungi spores, hold more organic matter which provides nutrients for fungi and once contaminated are very difficult to remedy	The combination of porous surfaces and moisture should be avoided.	interior temperature, outdoor temperature, interior RH	This can contribute to microbial contamination.	0	0	-3	0	0	
E	I	12	Does the internal overnight temperature fall below the ambient dew point?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes, occasionally	This will occasionally lead to condensation forming on cold surfaces.	Surfaces which fall below the dew point temperature will need to be insulated or warmed to prevent moisture problems. Surfaces which could potentially be wetted with condensation should not be made from porous materials.	insulation, heating, materials selection	This can contribute to microbial contamination.	0	0	-2	0	0	
				c	yes, often	This will lead to condensation forming on cold surfaces.	Surfaces which fall below the dew point temperature will need to be insulated or warmed to prevent moisture problems. Surfaces which could potentially be wetted with condensation should not be made from porous materials.	insulation, heating, materials selection	This can contribute to microbial contamination.	0	0	-3	0	0	
			Moisture Ingress (M)												
E	M	1	Is the roof pitch:	a	over 11 deg	A steep roof pitch will rapidly shed rain water and reduce the risk of water ingress.	Steep roof pitches are recommended.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	4-10 deg	A shallow roof pitch will hold rain water for long periods, which can lead to leaks and microbial growths. Shallow pitched also ver reliant on high quality workmanshi to remain water tight.	Steep roof pitches are recommended.	Interior temperature, outdoor temperature, location of air intakes	This can contribute to microbial contamination.	0	0	-1	0	0	
				c	0-3 deg	A shallow roof pitch will hold rain water for long periods, which can lead to ponding, leaks and microbial growths. Shallow pitched are also very reliant on high quality workmanship to remain water tight.	Steep roof pitches are recommended	Interior temperature, outdoor temperature, location of air intakes	This can contribute to microbial contamination.	0	0	-3	0	0	
E	M	2	Is the building installed with internal gutters?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	skip to EM4
				b	yes	Internal gutters are prone to overflow rain water into the interior of the building, which can lead to saturation of interior materials and microbial contamination.	Interior gutters should be avoided where ever possible.		This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	3	If internal gutters are used, are they designed to accommodate the rainfall predicted in a:	a	50 year flood	Internal gutters are prone to overflow rain water into the interior of the building, which can lead to saturation of interior materials and microbial contamination.	It is recommended that internal gutters and rainwater heads are ove designed to reduce the risk of overflowing.	Site rainfall	This can contribute to microbial contamination.	0	0	-1	0	0	
				b	20 year flood	Internal gutters are prone to overflow rain water into the interior of the building, which can lead to saturation of interior materials and microbial contamination.	It is recommended that internal gutters and rain waterheads are ove designed to reduce the risk of overflowing.	Site rainfall	This can contribute to microbial contamination.	0	0	-2	0	0	

				c	10 year flood or less	Internal gutters are prone to overflow rain water into the interio of the building, which can lead to saturation of interior materials and microbial contamination.	It is recommended that internal gutters and rainwater heads are ove designed to reduce the risk of overflowing.	Site rainfall	This can contribute to microbial contamination.	0	0	-3	0	0	
E	M	4	Is the proposed building installed with sufficient gutters and rainwater heads to drain roof water during periods of ver heavy rain?	a	yes	It is important to drain water away as quickly as possible to prevent moisture ingress. Roof leaks can wet building materials and can als go undetected. These factors contribute , which can allow microbial colonies to propagate.	Rapid removal of all surface rainwater is recommended.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	It is important to drain water away as quickly as possible to prevent moisture ingress. Roof leaks can often wet building materials and can also go undetected, which car allow microbial colonies to propagate.	Rapid removal of all surface rainwater is recommended.	Site rainfall	This can contribute to microbial contamination.	0	0	-3	0	0	
E	M	5	Does the proposed building have a solid roof parapet?	a	no	Roof parapets are prone to collect and admit rain water into the building unless they are correctly drained.	Over design of the drainage, rainwater heads and tanking aroun the parapets roofs is recommended	Site rainfall	No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Roof parapets are prone to collect and admit rain water into the building unless they are correctly drained.	Over design of the drainage, rainwater heads and tanking aroun the parapets roofs is recommended	Site rainfall	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	6	Is the permeability of the proposed building's above grade exterior walls:	a	low	Walls with a low porosity will have a low penetration of rain water an risk of interstitial condensation an wetting of interior surfaces.	Exterior walls with a low porosity are recommended	Site rainfall	No detriment to the indoor air quality.	0	0	1	0	0	

				b	medium	Porous walls will admit some rainwater into the wall construction. This can lead to wetting of the wall materials, reduced performance of the wall insulation, interstitial condensation and possibly interstitial fungal propagation.	Exterior walls with a low porosity are recommended	Site rainfall	This can contribute to microbial contamination.	0	0	-2	0	0	
				c	high	Porous walls will admit some rainwater into the wall construction. This can lead to wetting of the wall materials, reduced performance of the wall insulation, interstitial condensation and possibly interstitial fungal propagation. Porous exterior wall surfaces will stay damp much longer than non-porous surfaces.	Exterior walls with a low porosity are recommended	Site rainfall	This can contribute to microbial contamination.	0	0	-3	0	0	
E	M	7	Does the wall cladding system include sills and/or detailing to deflect rain water off the drainage plane and face of the building?	a	yes	Deflecting rainwater off the face of the building, will reduce the potential for leakage through the cladding and microbial contamination.			This can help reduce the risk of microbial contamination.	0	0	2	0	0	
				b	no	Deflecting rainwater off the face of the building, will reduce the potential for leakage through the cladding and microbial contamination.	Shedding rainwater off the face of the building as quickly as possible is recommended	Site rainfall	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	8	Is the proposed building's cladding systems:	a	pressure equalised	High wind pressures are prone to drive rain into a building envelope, causing wetting of building materials which can lead to microbial contamination.	Specifically engineered systems such as pressure equalisation are recommended for medium and high rise buildings	Site rainfall, wind zone, building height	This can help reduce the risk of microbial contamination.	0	0	3	0	0	

				b	rain screen	High wind pressures are prone to drive rain into a building envelope, causing wetting of building materials which can lead to microbial contamination. Rain screen cladding systems are very beneficial in	Specifically engineered systems such as rain screen cladding systems are recommended.	Site rainfall, wind zone, building height	This can help reduce the risk of microbial contamination.	0	0	3	0	0	
				c	two stage drained and ventilated joints	High wind pressures are prone to drive rain into a building envelope, causing wetting of building materials which can lead to microbial contamination.	Two stage joints are preferable to single stage joints as they provide a second line of defence for rain that has bypassed the first seal	Site rainfall, wind zone, building height	This can help reduce the risk of microbial contamination.	0	0	2	0	0	
				d	single stage jointed	High wind pressures can drive rair though single stage joints into the building envelope. Rain that bypasses the front seal will wet building materials which can lead to microbial contamination.	Single stage joints are not recommended as they are very workmanship sensitive and have been found prone to leakage.	Site rainfall, wind zone, building height	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	9	Are the joints drainec and ventilated?	a	yes	Drainage and ventilated joints assist in removing and drying the residual dampness from rainwater that has penetrated beyond the front face of the envelope.	Drained and ventilated joints are recommended	Site rainfall, wind zone,	This can help reduce the risk of microbial contamination.	0	0	2	0	0	
				b	no	Drainage and ventilated joints assist in removing and drying the residual dampness from rainwater that has penetrated beyond the front face of the envelope.	Drained and ventilated joints are recommended	Site rainfall, wind zone,	This can contribute to microbial contamination.	0	0	-1	0	0	

E	M	10	Are the joint seals readily inspected?	a	yes	Cladding jointing compounds may fail, through UV light exposure and wear and tear many times during the life of a building. Fail will allow rain water ingress. Provisions need to be made for ease of inspection.	Access for inspection of joint seals is recommended	Site rainfall, wind zone, building height	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	no	Cladding jointing compounds may fail, through UV light exposure and wear and tear many times during the life of a building. Fail will allow rain water ingress. Provisions need to be made for ease of inspection.	Access for inspection of joint seals is recommended	Site rainfall, wind zone, building height	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	11	Are the joint seals readily replaceable?	a	yes	Cladding joints typically need replacing many times during the life of a building, to prevent rain water ingress. Provisions need to be made for ease of inspection and replacement.	Ease of access for replacement of joint seals is recommended	Site rainfall, wind zone, building height	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	no	Cladding joints typically need replacing many times during the life of a building, to prevent rain water ingress. Provisions need to be made for ease of inspection and replacement.	Ease of access for replacement of joint seals is recommended	Site rainfall, wind zone, building height	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	12	Are all windows and doors installed with adequate head and sill flashings	a	yes	Head and sill flashings are a very important mechanism to exclude rain water	Is recommended that the cladding be engineered to suit the climatic conditions of the site and building form. Adequate Head and sill flashings are recommended for all windows and doors unless sheltered by a canopy	Site rainfall, wind zone, building height	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	

				b	no, but they are sheltered by a canopy overhang	Head and sill flashings are a very important mechanism to exclude rain water. The degree of shelter proved from driving rain by the canopy should be calculated for adverse conditions	is recommended that the cladding be engineered to suit the climatic conditions of the site and building form. Adequate Head and sill flashings are recommended for all windows and doors unless sheltered by a canopy	Site rainfall, wind zone, building height	This can help reduce the long term risk of microbial contamination.	0	0	1	0	0	
				c	no	Head and sill flashings are a very important mechanism to exclude rainwater. The degree of shelter proved from driving rain by the canopy should be calculated for adverse conditions.	is recommended that the cladding be engineered to suit the climatic conditions of the site and building form. Adequate Head and sill flashings are recommended for all windows and doors unless sheltered by a canopy	Site rainfall, wind zone, building height	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	13	Are all components of the cladding designed to prevent wind action pumping water through the joints?	a	yes	Wind pumping can force water into or through the building envelope, this can lead to microbial contamination.	It is recommended that specific engineering design of the building envelope, especially the corners of the building is undertaken to prevent wind action pumping rainwater through the envelope.	Site rainfall, wind zone, building height	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	no	Wind pumping can force water into or through the building envelope, this can lead to microbial contamination.	It is recommended that specific engineering design of the building envelope, especially the corners of the building is undertaken to prevent wind action pumping rainwater through the envelope.	Site rainfall, wind zone, building height	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	14	Is the permeability of the proposed building's below grade walls (including non occupied areas):	a	100% water and damp tigh	It is important to keep sub-grade areas dry as moisture and contaminates that results from the moisture can be communicated with occupied areas.	100% water proofing of sub-grade areas is recommended.	ground water table height, site rainfall	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	

				b	slightly leaky and reliant on evaporative drying	Sub-grade dampness can lead to microbial contamination and dampness through out the building.	It is not recommended to have moisture in a sub-grade area.	ground water table height, site rainfall	This can contribute to microbial contamination.	0	0	-1	0	0	
				c	leaky, and reliant on pumping out excess water	Sub-grade dampness can lead to microbial contamination and dampness through out the building.	It is not recommended to have moisture in a sub-grade area.	ground water table height, site rainfall	This can contribute to microbial contamination.	0	0	-3	0	0	
E	M	15	Is the building installed with vapour barriers?	a	no	Vapour barriers are seldom 100% vapour proof, and moisture which penetrates the barrier can become trapped in the wall and cause microbial contamination.	Vapour barriers are generally not recommended in a temperate climate, unless specific modelling of the envelopes moisture sensitivity indicates a need.	indoor temperature, outdoor temperature, relative humidity	This will not cause a detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Vapour barriers are seldom 100% vapour proof, and moisture which penetrates the barrier can become trapped in the wall and cause microbial contamination.	Vapour barriers are generally not recommended in a temperate climate, unless specific modelling of the envelopes moisture sensitivity indicates a need.	indoor temperature, outdoor temperature, relative humidity	This can contribute to microbial contamination.	0	0	-1	0	0	
E	M	16	Can moisture vapour which enters the envelope from the interior be drained and/or ventilated away?	a	yes	During the life of the building moisture will inevitably enter the building envelope.	Drainage and ventilation of the building envelope is recommended to remove any moisture which enter the envelope.	indoor moisture sources	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	no	During the life of the building moisture will inevitably enter the building envelope.	Drainage and ventilation of the building envelope is recommended to remove any moisture which enter the envelope.	indoor moisture sources	This can contribute to microbial contamination.	0	0	-2	0	0	

E	M	17	Are the materials of the building envelope sensitive to moisture?	a	no	During the life of the building moisture will inevitably enter the building envelope.	Materials with low moisture absorbency and nutrient content are recommended.	indoor moisture sources, rainfall, cladding leakage potential	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	yes	During the life of the building moisture will inevitably enter the building envelope.	Materials with low moisture absorbency and nutrient content are recommended.	indoor moisture sources, rainfall, cladding leakage potential	This can contribute to microbial contamination.	0	0	-2	0	0	
E	M	18	Does the building have any balconies, terraces or podium roofs?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	skip to end of section.
				b	yes	Balconies, terraces, podium roofs and other such horizontal surfaces can allow water to pond or drain away slowly. This can lead to microbial contamination, which can be communicated readily with the indoor environment.	Balconies and other such horizontal surfaces should be provided with sufficient fall to facilitate the adequate drainage of water.	site rainfall	This can contribute to microbial contamination.	0	0	-1	0	0	
E	M	19	Are the balconies surrounded with:	a	open railings	Open railings will allow rain water to drain and air circulation to evaporate surface water faster.	Open railings to balconies are recommended.	site rainfall	This can help reduce the long term risk of microbial contamination.	0	0	0	0	0	
				b	solid low height wall	Solid low height walls can cause water to pond on the balconies. They will also inhibit air circulation which will cause surface water to dry slower.	Open railings to balconies are recommended.	site rainfall	This can contribute to microbial contamination.	0	0	-1	0	0	

E	M	20	Is the rain water off the balconies collected in a piped stormwater system?	a	yes	Balconies can be used to partially collect/deflect rain water off the face of the building and reduce the leakage potential. Rain water which is collected and piped rathe than free falling to the next lowest point will reduce the potential for water ingress through the envelope.	Piped stormwater systems are recommended.	site rainfall	This can help reduce the long term risk of microbial contamination.	0	0	2	0	0	
				b	no	Balconies can be used to partially collect/deflect rain water off the face of the building and reduce the leakage potential. Rain water which is collected and piped rathe than free falling to the next lowest point will reduce the potential for water ingress through the envelope.	Piped stormwater systems are recommended.	site rainfall	This can contribute to microbial contamination.	0	0	-1	0	0	
			Summary of envelope contribution to indoor air quality:							**-18**	**-24**	**-70**	**-28**	**-5**	

			Questions		Options	Justification	Recommendations	Linkages	Conclusions	VOCs	Particulates	Microbials	Gaseous	Thermal	
Infrastructure (N)															
			Stairs (S)												
N	S	1	Does the building have any internal stairwells?	a	no	Stairwells are a pathway for the transportation of contaminants from level to level. Stairwells ca also affect the air pressure relationships between spaces.			This will not cause any detriment to the indoor air quality.	0	0	0	0	0	skip to NL1
				b	yes	Stairwells are a pathway for the transportation of contaminants from level to level. Stairwells ca also affect the air pressure relationships between spaces. The stack effect is frequently the driving force for the movement o air & entrained pollutants through a stairwell, with this effect being most pronounced in tall buildings.	Where spaces which have pollutant sources adjacent or connected to a stairwell, foremost attention needs to be paid to eliminating or reducing the pollutants. Where this can not be achieved then attention needs to be paid to isolating the space which is the source of the pollution from the stairwell.	building height, internal sources of pollutants	This may allow pollutants to be communicated between spaces.	0	0	0	0	0	
N	S	2	Are the stairwells separated from occupied areas by:	a	a vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the occupied areas where there is the potential for contaminates to enter the stairwell.	building height, internal sources of pollutants	This will help to isolate the pathway between pollutants and clean spaces.	2	2	0	2	0	

				b	a single set of doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets o doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level.	If single doors are used to isolate the air pathway through the stairwell from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the stairwel or limiting the concentration of contaminants in the stairwell are employed.	building height, internal sources of pollutants	This will help to isolate the pathway between pollutants and clean spaces.	1	1	0	1	0	
				c	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates entering the stairwell and transportation to other levels.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.	building height, internal sources of pollutants	This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
N	S	3	Are the stairwells separated from the toilets and bathrooms by:	a	a ventilated vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent gases, odours, moisture and biological contaminate, which have bypassed the local extraction system from entering the stairwell and being communicated to other areas.	Vestibules are recommended to isolate the air pathway through the stairwell from the occupied areas where there is the potential for contaminates to enter the stairwel.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	0	0	2	2	0	

				b	a single set of self closing doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets o doors provide will partially isolat the pathway and prevent contaminates from entering the stairwell and transported it to another level. Other protective measures are recommended, such as localised extraction within the bathrooms, and extraction of the stairwell.	If single doors are used to isolate the air pathway through the stairwell from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the stairwel or limiting the concentration of contaminants in the stairwell are employed.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	0	0	-1	-1	0	
				c	they are physically separated	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets o doors provide will partially isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level. Other protective measures are recommended, such as localised extraction within the bathrooms, and extraction of the stairwell.	Physical separation will prevent the communication of contaminates between areas.		This will isolate the pathway between pollutants and clean spaces.	0	0	2	2	0	
N	S	4	Are the stairwells separated from the kitchens by:	a	a ventilated vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent moisture and odours from the kitchens and microbial material from spoiled food entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the occupied areas where there is the potential for contaminates to enter the stairwell.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	0	2	2	1	1	

				b	a single set of doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level.	If single doors are used to isolate the air pathway through the stairwell from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the stairwel or limiting the concentration of contaminants in the stairwell are employed, such as adequate localised extraction and rubbish containment.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	0	-1	-1	-1	-1	
				c	they are physically separated	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level.	Physical separation will prevent the communication of contaminates between areas.		This will isolate the pathway between pollutants and clean spaces.	0	2	2	1	1	
				d	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of moisture and odours from the kitchens and microbial material from spoiled food between the stairwell and other levels.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.	building height,	This may allow pollutants to be communicated between spaces.	0	-2	-2	-1	-1	

N	S	5	Are the stairwells which serve the occupied areas separated from the plant rooms and all HVAC components by:	a	a vestibule/ lobby	Plants rooms can contain many contaminants such as leaky fuels, chemicals and moisture. Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates from entering the stairwell and being transport to another level.	Vestibules are recommended to isolate the air pathway from the plant room through the stairwell to the occupied areas. Doors shoulc be installed with strong closing latches to resist air pressure fluctuations.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	2	2	2	0	0	
				b	a single set of self closing doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance, in infrequently used areas, to isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level. Plant rooms can become contaminated with leaked chemicals, fuels and moisture and should be isolated from the air stream.	Vestibules are recommended to isolate the air pathway from the plant room through the stairwell to the occupied areas. Doors shoulc be installed with strong closing latches to resist air pressure fluctuations.	building height,	This will help to isolate the pathway between pollutants and clean spaces.	-1	-1	-1	0	0	

				c	they are physically separated	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance, in infrequently used areas, to isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level. Plant rooms can become contaminated with leaked chemicals, fuels and moisture and should be isolated from the air stream.	Physical separation will prevent the communication of contaminates between areas.	building height,	This will isolate the pathway between pollutants and clean spaces.	2	2	2	0	0	
N	S	6	Are the stairwells separated from the plenums by:	a	a fully enclosed riser	Stairwells are a pathway for the transportation of contaminants from level to level. Fully enclosed risers help isolate the pathway and prevent contaminates from entering the stairwell and transported it to another level.	Fully enclosed risers are recommended where possible.	return air fan	This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				b	a single set of access doors/ hatches	Stairwells are a pathway for the transportation of contaminants from level to level. Access doors or hatches can allow the cross communication of contaminates, unless correctly sealed.	Sealing of access hatches and doors are recommended.	return air fan	This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	

				c	an air permeable barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates entering the stairwell and transportation to other levels.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.	return air fan	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	
N	S	7	Are the stairwells separated from the lifts by:	a	a vestibule/ lobby	Stairwells and lifts are both pathways for the transportation of contaminants from level to level. Vestibules help isolate the pathways and prevent contaminates being communicated to the occupied areas and between levels.	Vestibules or lobbies are only required between stairwells and lif wells in spaces were the heavy pollutants loads.		This will help to isolate the pathway between spaces with heavy pollutant loads and clean spaces.	2	2	2	2	0	
				b	a single set of doors	Stairwells and lifts are both pathways for the transportation of contaminants from level to level. Single doors offer sufficient resistance to air being communicated between the lift and stairwells and between levels.	Isolation of the air pathway via the stairwell between the lift well with single doors is recommended unless there are strong sources of pollution in the any areas adjacent to the stairs or lifts.		This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				c	they are physically separated	Physical separation will prevent the communication of contaminates between areas.	Physical separation will prevent the communication of contaminates between areas.		This will isolate the pathway between pollutants and clean spaces.	1	1	1	1	0	

				d	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates entering the stairwell and transportation to other levels.	Isolation of the air pathway via the stairwell between the lift well with single doors is recommended unless there are strong sources of pollution in the any areas adjacent to the stairs or lifts.		This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	
N	S	8	Are the stairwells separated from the carparks by:	a	a vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates from the carparking area, such as gaseous pollutants, VOCs and particulate matter from entering the stairwell and transported it to another level.	Vestibules or lobbies are recommended to isolate the air pathway through the stairwell from the carparks, circulation routes and occupied areas.	carpark ventilation	This will help to isolate the pathway between pollutants and clean spaces	2	2	2	2	0	
				b	a single set of doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates, such as gaseous pollutants, VOCs and particulate matter, from entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the carparks and occupied areas.	carpark ventilation	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	
				c	they are physically separated	Physical separation will prevent the communication of contaminates between areas.			This will isolate the pathway between pollutants and clean spaces	2	2	2	2	0	

				d	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates, such as gaseous pollutants, VOCs and particulate matter, to enter the stairwell and be transported it to another area of the building.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.	carpark ventilation	This may allow pollutants to be communicated between spaces.	-3	-3	-3	-3	0	
N	S	9	Are the stairwells separated from the loading docks by:	a	a vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates, such as gaseous pollutants, VOCs and particulate matter from entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the loading docks and occupied areas.	loading dock ventilation	This will help to isolate the pathway between pollutants and clean spaces	2	2	2	2	0	
				b	a single set of doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates, such as gaseous pollutants, VOCs and particulate matter, from entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the loading docks and occupied areas.	loading dock ventilation	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	

				c	a draught stop curtain	Stairwells are a pathway for the transportation of contaminants from level to level. Draught stop curtains provide minimal assistance to isolate the pathwa and prevent contaminates, such as gaseous pollutants, VOCs and particulate matter, from entering the stairwell and transported it to other areas.	Vestibules are recommended to isolate the air pathway through the stairwell from the loading docks and occupied areas.	loading dock ventilation	This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				d	they are physically separated	Physical separation will prevent the communication of contaminates between areas.		loading dock ventilation	This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				e	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates, such as gaseous pollutants, VOCs and particulate matter, to enter the stairwell and be transported it to another area of the building.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.	loading dock ventilation	This may allow pollutants to be communicated between spaces.	-3	-3	-3	-3	0	
N	S	10	Are the stairwells separated from the rubbish collection, compaction or disposal area by:	a	a vestibule/ lobby	Stairwells are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates, such as gaseous pollutants, microbiological matter, particulate matter, odours and VOCs from the rubbish area from entering the stairwell and being transported to other areas	Vestibules are recommended to isolate the air pathway through the stairwell from the rubbish collection areas and occupied areas.		This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	

				b	a single set of doors	Stairwells are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates such as gaseous pollutants, microbiological matter, particulate matter, odours and VOCs from entering the stairwell and transported it to another level.	Vestibules are recommended to isolate the air pathway through the stairwell from the rubbish collection areas and occupied areas.		This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				c	a draught stop curtain	Stairwells are a pathway for the transportation of contaminants from level to level. Draught stop curtains provide minimal assistance to isolate the pathway and prevent contaminates, such as gaseous pollutants, VOCs and particulate matter, from entering the stairwell and transported it to other areas.	Vestibules are recommended to isolate the air pathway through the stairwell from the rubbish collection areas and occupied areas.		This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				d	they are physically separated	Physical separation will prevent the communication of contaminates between areas.	Physical separation is recommended where possible.		This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				e	physical distance and an open air buffer zone	Physical separation including distance and an open air buffer zone will prevent the communication of contaminates between areas.	Physical separation with an open air buffer zone is highly recommended where possible.		This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	

				f	no barrier	Stairwells are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates, such as gaseous pollutants, microbiological matter, particulate matter, odours and VOCs, to enter the stairwell and be transported to areas of the building.	Isolation of the air pathway via the stairwell between the contaminate source and occupied areas is recommended.		This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	
			Lifts (L)												
N	L	1	Does the building have lifts?	a	yes, separate passenger and goods lifts.	Lift shafts are a pathway for the transportation of contaminants from level to level. The motion o the lifts will draw and force air including any entrained pollutants between zones. Goods lifts are useful to reduce the exposure to the occupied areas of rubbish, cleaners' chemicals, new and demolition building materials etc..	Care needs to be taken in the design of the infrastructure to locate pollutant sources away fron pathways such as lift shafts. Foremost attention should be paid to eliminating or reducing the pollutants at source. Where this can not be achieved then attentior needs to be paid to preventing the contaminates from entering the lift shaft. Goods lifts are however recommended to isolate pollutant sources, whilst in transit from the occupied areas.		This will isolate the pathway between lift passengers and pollutants from materials carried in lifts.	1	1	0	0	0	

				b	yes, passenger or goods lifts.	Lift shafts are a pathway for the transportation of contaminants from level to level. The motion of the lifts will draw and force air including any entrained pollutants between zones. Goods lifts are useful to reduce the exposure to the occupied areas of rubbish, cleaners' chemicals, new and demolition building materials etc..	Care needs to be taken in the design of the infrastructure to locate pollutant sources away from pathways such as lift shafts. Foremost attention should be paid to eliminating or reducing the pollutants at source. Where this is can not be achieved then attention needs to be paid to preventing the contaminates from entering the lift shaft.		This may allow pollutants to be communicated between spaces.	-1	-1	0	0	0	
				c	no					0	0	0	0	0	Skip to NK1
N	L	2	Are all the lifts separated from occupied areas by:	a	a vestibule/ lobby	Lift shafts are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates from entering the lift well and being transported it to another level.	Vestibules are recommended to isolate the air pathway through the lift shaft from the occupied areas where there is the potential for contaminates to enter the lift shaft		This will isolate the pathway between pollutants and clean spaces.	2	2	0	2	0	
				b	a single set of doors	Lift shafts are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates from entering the lift shaft and transported it to another level.	If single doors are used to isolate the air pathway through the lift shaft from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the lift shaft or limiting the concentration of contaminants in the lift shaft are employed.		This may allow pollutants to be communicated between spaces.	1	1	0	1	0	

				c	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. A lack of barrier will allow unrestricted movement of contaminates entering the lift shaft and transportation to other levels.	Isolation of the air pathway via the lift shaft between the contaminate source and occupied areas is recommended.		This may allow pollutants to be communicated between spaces.	-1	-1	0	-1	0	
N	L	3	Are the lifts separated from the kitchens by:	a	a vestibule/ lobby	Lift shafts are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent gases, odours, moisture and microbial contaminants, which have bypassed the local extraction system from entering the lift shaft and being communicated to other areas.	Vestibules are recommended to isolate the air pathway through the lift shaft from the occupied areas where there is the potential for contaminates to enter the lift shaft	Local extraction	This will isolate the pathway between pollutants and clean spaces	0	2	2	1	1	
				b	a single set of doors	Lift shafts are a pathway for the transportation of contaminants from level to level. Single sets of doors provide will partially isolate the pathway and prevent contaminates such as gases, odours, moisture and microbial contaminants from entering the lift shaft and transported it to another level. Other protective measures are recommended, such as localised extraction or containment of all sources of moisture, steam or pollutants.	If single doors are used to isolate the air pathway through the lift shaft from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the lift shaft or limiting the concentration of contaminants in the lift shaft are employed.	Local extraction	This may allow pollutants to be communicated between spaces.	0	-1	-1	-1	-1	

				c	they are physically separated	Physical separation will prevent the communication of contaminates between areas.		Local extractior	This will isolate the pathway between pollutants and clean spaces.	0	2	2	1	1	
				d	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. A lack of barrier will permit the free passage of pollutants generated within the kitchen such as gases, odours, moisture and microbial contaminants to enter the lift shaft and be transported to other levels of the building. Source control measures are recommended, such as localised extraction or containment of all sources of moisture, steam or pollutants.	Isolation of the air pathway via the lift shaft between the contaminate source and occupied areas is recommended.		This may allow pollutants to be communicated between spaces.	0	-2	-2	-1	-1	
N	L	4	Are the lifts which open onto the occupied areas, separated from the plant rooms and all HVAC components by:	a	a vestibule/ lobby	Plant rooms can contain many contaminants such as leaky fuels, chemicals and moisture. Lift shafts are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent gases, odours, moisture and microbial contaminants, which have bypassed the local extraction system from entering the lift shaft and being communicated to other areas.	Vestibules are recommended to isolate the air pathway through the lift shaft from the occupied areas where there is the potential for contaminates to enter the lift shaft Doors should be installed with strong closing latches to resist air pressure fluctuations.		This will isolate the pathway between pollutants and clean spaces	0	2	2	2	1	

				b	a single set of doors	Plant rooms can contain many contaminants such as leaky fuels, chemicals and moisture. Lift shafts are a pathway for the transportation of contaminants from level to level. Single sets of doors provide some assistance in infrequently used areas to isolate the pathway and prevent contaminates from entering the lift shaft and transported it to another level.	If single doors are used to isolate the air pathway through the lift shaft from the occupied areas then it is recommended that other means of limiting the potential for contaminates to enter the lift shaft or limiting the concentration of contaminants in the lift shaft are employed, such as adequate localised extraction and rubbish containment. Doors should be installed with strong closing latches to resist air pressure fluctuations.		This may allow pollutants to be communicated between spaces.	0	1	1	1	0	
				c	they are physically separated	Physical separation will prevent the communication of contaminates between areas.	Physical separation is recommended where feasible.		This will isolate the pathway between pollutants and clean spaces	0	2	2	2	0	
				d	no barrier	Plants rooms can contain many contaminants such as leaky fuels, chemicals and moisture. Lift shafts are a pathway for the transportation of contaminants from level to level. Barriers are required to isolate the pathway and prevent contaminates from entering the lift shaft and being transport to another level.	Isolation of the air pathway via the lift shaft between the contaminate source and occupied areas is recommended.		This may allow pollutants to be communicated between spaces.	0	-2	-2	-2	0	

N	L	5	Are the lifts separated from the plenums and risers by:	a	a fully enclosed riser	Lift shafts, risers and plenums are all pathways for the transportation of contaminants from level to level. Fully enclosing the plenums and risers will isolate the pathways and prevent contaminates from entering the lift shaft and transported it to another level. Plenums and risers are connected to the plants rooms which in turn can become contaminated with leaked chemicals, fuels and moisture and should be isolated from the air stream.	Full enclosure of risers and plenums is recommended to isolate the air pathway from the plant room via the lift shaft to the occupied areas.		This will isolate the pathway between pollutants and clean spaces	1	1	1	1	0	
				b	they are physically separated	Physical separation will prevent the communication of contaminates between areas.	Physical separation is recommended where possible.		This will isolate the pathway between pollutants and clean spaces	1	1	1	1	0	
				c	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. Vestibules help isolate the pathway and prevent contaminates from entering the lift shaft and transported it to another level.	Isolation of the air pathway via the lift shaft between the contaminate source and occupied areas is recommended.		This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	

N	L	6	Are the lifts separated from the carparks by:	a	a vestibule/ lobby	Lift shafts are a pathway for the transportation of contaminants from level to level. Carparking areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Vestibules can help to prevent these pollutants from entering the lift shaft and be communicated to other areas	Vestibules are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of carparking area	This will help to isolate the pathway between pollutants and clean spaces	2	2	2	2	0	
				b	a single set of doors	Lift shafts are a pathway for the transportation of contaminants from level to level. Carparking areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Single doors can reduce but not eliminate the quantity of these pollutants from entering the lift shaft and be communicated to other areas.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of carparking area	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	

				c	they are physically separated	Lift shafts are a pathway for the transportation of contaminants from level to level. Carparking areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Physical separation can help to prevent these pollutants from entering the lift shaft and be communicated to other areas.	Physical separation will prevent the communication of contaminates between areas.	ventilation and local extraction of carparking area	This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				d	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. Carparking areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars, and microbial contaminants. A lack of barrier will allow these contaminates to enter the lift shaft and be transported to other levels.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of carparking area	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	

N	L	7	Are the lifts separated from the loading docks by:	a	a vestibule/ lobby	Lift shafts are a pathway for the transportation of contaminants from level to level. Loading dock areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet vehicles and microbial contaminants. Vestibules can help to prevent these pollutants from entering the lift shaft and be communicated to other areas	Vestibules are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of loading dock area	This will help to isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				b	a single set of doors	Lift shafts are a pathway for the transportation of contaminants from level to level. Loading dock areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Single doors can reduce but not eliminate the quantity of these pollutants from entering the lift shaft and be communicated to other areas.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of loading dock area	This may allow pollutants to be communicated between spaces.	-2	-2	-2	-2	0	

				c	a draught stop curtain	Lift shafts are a pathway for the transportation of contaminants from level to level. Loading dock areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Draught stop curtains can slightly reduce but not eliminate the quantity of these pollutants from entering the lift shaft and be communicated to other areas.	Vestibules are recommended to isolate the air pathway through the lift shaft from the carparks and occupied areas.	ventilation and local extraction of loading dock area	This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				d	they are physically separated	Lift shafts are a pathway for the transportation of contaminants from level to level. Loading dock areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars and microbial contaminants. Physical separation can help to prevent these pollutants from entering the lift shaft and be communicated to other areas.	Physical separation will prevent the communication of contaminates between areas.	ventilation and local extraction of loading dock area	This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	

				e	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. Loading dock areas are a source of toxic vehicle emissions, particulates, gases, odours, moisture from rain wet cars, and microbial contaminants. A lack of barrier will allow these contaminates to enter the lift shaft and be transported to other levels.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of loading dock area	This may allow pollutants to be communicated between spaces.	-3	-3	-3	-3	0
N	L	8	Are the lifts separated from the rubbish collection or disposal by:	a	a vestibule/ lobby	Lift shafts are a pathway for the transportation of contaminants from level to level. Rubbish collection areas are a source of particulates, gases, odours, microbial contaminants. Vestibules can help to prevent these pollutants from entering the lift shaft and be communicated to other areas.	Vestibules are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of rubbish collection area, containment of rubbish	This will help to isolate the pathway between pollutants and clean spaces.	2	2	2	2	0
				b	a single set of doors	Lift shafts are a pathway for the transportation of contaminants from level to level. Rubbish collection areas are a source of particulates, gases, odours, and microbial contaminants. Single doors can reduce but not eliminate the quantity of these pollutants from entering the lift shaft and be communicated to other areas.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of rubbish collection area, containment of rubbish	This may allow pollutants to be communicated between spaces.	1	1	1	1	0

				c	a draught stop curtain	Lift shafts are a pathway for the transportation of contaminants from level to level. Rubbish collection areas are a source of particulates, gases, odours and microbial contaminants. Draught stop curtains can slightly reduce but not eliminate the quantity of these pollutants from entering the lift shaft and be communicated to other areas	Vestibules are recommended to isolate the air pathway through the lift shaft from the carparks and occupied areas.	ventilation and local extraction of rubbish collection area, containment of rubbish	This may allow pollutants to be communicated between spaces.	-1	-1	-1	-1	0	
				d	they are physically separated	Lift shafts are a pathway for the transportation of contaminants from level to level. Rubbish collection areas are a source of particulates, gases, odours and microbial contaminants. Physical separation can help to prevent these pollutants from entering the lift shaft and be communicated to other areas.	Physical separation will prevent the communication of contaminates between areas.	ventilation and local extraction of rubbish collection area, containment of rubbish	This will isolate the pathway between pollutants and clean spaces.	2	2	2	2	0	
				e	no barrier	Lift shafts are a pathway for the transportation of contaminants from level to level. Rubbish collection areas are a source of particulates, gases, odours and microbial contaminants. A lack of barrier will allow these contaminates to enter the lift shaft and be transported to other levels.	Vestibules or physical separation are highly recommended to isolate the air pathway through the lift shaft from the occupied areas.	ventilation and local extraction of rubbish collection area, containment of rubbish	This may allow pollutants to be communicated between spaces.	-3	-3	-3	-3	0	

N	L	9	Is there access to clean out the lift pit ?	a	yes	Lift pits can accumulate debris and dust, which can be sucked throughout the building in the wake of the lift.	Access for cleaning out the lift pit and programmed maintenance are recommended.		This can potentially reduce a source particulate matter.	0	2	0	0	0	
				b	no	Lift pits can accumulate debris and dust, which can be sucked throughout the building in the wake of the lift.	Access for cleaning out the lift pit and programmed maintenance are recommended.		Potential internal source of particulate matter.	0	-2	0	0	0	
N	L	10	Will the lift pits be continuously dry?	a	yes	Lift pits can accumulate sufficient organic material to support microbial colonies if there is moisture present. Microbial matter can be sucked throughout the building in the wake of the lift.	Adequate damp proofing and external tanking to prevent the ingress of moisture is recommended. Sites with a high water table may require dewatering.		No detriment to the indoor air quality.	0	2	0	0	0	
				b	no	Lift pits can accumulate sufficient organic material to support microbial colonies if there is moisture present. Microbial matter can be sucked throughout the building in the wake of the lift.	Adequate damp proofing and external tanking to prevent the ingress of moisture is recommended. Sites with a high water table may require dewatering.		Potential internal source of fungi and bacteria.	0	-2	0	0	0	
			Kitchens and Cafeterias (K)												
N	K	1	Are local extracts located above all sources of steam?	a	yes	Steam will contribute to elevated humidity which can readily migrate throughout the building. This can increase the availability of moisture and lead to microbial contamination.	Local extraction of all steam is recommended.		This will help to reduce a source of microbial contamination.	0	1	2	0	0	

				b	no	Steam will contribute to elevatec humidity which can readily migrate throughout the building. This can increase the availability of moisture and lead to microbia contamination.	Local extraction of all steam is recommended.	pathways connected to kitchen/ cafeterias	Potential internal source of fungi and bacteria.	0	-1	-2	0	0	
N	K	2	Are all extraction units and associated ducting over cooking appliances readily accessed for cleaning?	a	yes	Organic material and moisture will be sucked into the extraction units and ducting which can provide sufficient nutrients and environment for microbial growth.	All extraction units and associatec ducting over cooking appliances should be readily accessible for cleaning.		This will help to reduce a source of microbial contamination.	0	1	2	0	0	
				b	no	Organic material and moisture will be sucked into the extraction units and ducting which can provide sufficient nutrients and environment for microbial growth.	All extraction units and associatec ducting over cooking appliances should be readily accessible for cleaning.		Potential internal source of fungi and bacteria.	0	-1	-2	0	0	
N	K	3	Is the shutoff of the local extraction automatically delayed until humidity levels have dropped below ambient conditions via:	a	humidity sensor in the extraction duc	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Humidity sensors within the ducts will assist in preventing inter-duct moisture.		This will help to reduce a source of microbial contamination.	0	0	2	0	0	

				b	humidity sensor in the room	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Humidity sensors within the room will assist preventing inter-room moisture, but will not control humidity levels within the ducts.		This will help to reduce a source of microbial contamination.	0	0	1	0	0	
				c	time delay linked to operation of steam generator	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Time delay can assist in controlling within room or with duc humidity levels if the delay period is calibrated to decay of actual humidity levels		This will help to reduce a source of microbial contamination	0	0	1	0	0	
				d	time controller	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Time controllers on the extraction system can assist in reducing humidity levels if operation times of humidity sources are regular and the time controller is correctly commissioned and regularly verified		This will help to reduce a source of microbial contamination	0	0	1	0	0	

				e	not controlled	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Means to ensure the moisture extraction systems are maintained as dry as possible are recommended.		Potential internal source of fungi and bacteria	0	0	-2	0	0	
N	K	4	Is sufficient clean make-up air supplied to off set the pressure drop from the localised extraction?	a	yes	Replacement air can be drawn from undesirable sources, such as through the rubbish shute, unless a clean reliable supply is provided.	A clean source of make-up air supply should be accompany all local exhausts.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	Replacement air can be drawn from undesirable sources, such as through the rubbish shute, unless a clean reliable supply is provided.	A clean source of make-up air supply should be accompany all local exhausts.		Potential internal source of fungi, bacteria, particulates & gaseous pollutants.	0	-1	-1	-1	0	
N	K	5	Does the kitchen have any gas combustion appliances?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Gas cooking is frequently a source of gaseous contaminants and moisture.	Gas cooking appliances with low emissions should only be selected. Localised extracts should be installed over all gas cooking appliance with mandatory operation of the extract when the gas appliance is used.	localised extraction, connected pathways	Potential internal source of fungi, bacteria, particulates & gaseous pollutants.	0	0	-1	-2	0	

N	K	6	Are all wall and ceiling surfaces where there is the potential for high humidity finished with vapour barrier materials?	a	yes	Vapour barriers installed on the wall or ceiling surface closest to the source of humidity will prevent humidity from entering the construction and migrating throughout the building.	Vapour barriers are recommended on the humid side of walls and ceilings near cooking and food warming appliances, dish washers and sterilisers, other moisture generating areas.		No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Vapour barriers installed on the wall or ceiling surface closest to the source of humidity will prevent humidity from entering the construction and migrating through out the building.	Vapour barriers are recommended on the humid side of walls and ceilings near cooking and food warming appliances, dish washers and sterilisers, other moisture generating areas.		Potential internal source of fungi and bacteria.	0	0	-2	0	0	
N	K	7	Are the floors in the wet areas sloped to drain spilled moisture to floor drains?	a	yes	Spilled moisture should be drained away via floor drains.	Floors sloped towards floor drains are recommended.		No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Spilled moisture should be drained away via floor drains.	Floors sloped towards floor drains are recommended.		Potential internal source of fungi and bacteria.	0	0	-2	0	0	
N	K	8	Are all surfaces which could come into contact with organic matter or moisture, smooth, readily scrubbed, seamless and impervious?	a	yes	Smooth, impervious and readily scrubbed surfaces will assist in maintaining high levels of hygiene and reduce habitats for bacteria and fungi.	It is recommended that all surfaces which come into contact with food or waste products are smooth, impervious, readily scrubbed an seamless as possible to avoid habitats for bacteria and fungi.		No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Smooth, impervious and readily scrubbed surfaces will assist in maintaining high levels of hygiene and reduce habitats for bacteria and fungi.	It is recommended that all surfaces which come into contact with food or waste products are smooth, impervious and readily scrubbed.		Potential internal source of fungi and bacteria.	0	0	-2	0	0	

N	K	9	Are all corners of surfaces which could come into contact with food or waste products rounded?	a	yes	Rounded corners assists in the cleaning of surfaces and reduces the habitats for bacteria and fungi.	All corners of surfaces which come into contact with food or waste products should be rounded to facilitate cleaning.		No detriment to the indoor air quality.	0	0	1	0	0	
				b	no	Rounded corners assists in the cleaning of surfaces and reduces the habitats for bacteria and fungi	All corners of surfaces which come into contact with food or waste products should be rounded to facilitate cleaning.		Potential internal source of fungi and bacteria.	0	0	-1	0	0	
N	K	10	Is the floor finished with a seamless or sealed seams resilient material?	a	yes	Bacteria, fungi, organic matter and moisture can habour in small cracks in the flooring or under the flooring material. This can provide a ripe environment for propagation of microbial contaminants.	All surfaces which could come into contact with organic matter or moisture should be as seamless as possible to facilitate cleaning.	VOC emissions	No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Bacteria, fungi, organic matter and moisture can habour in small cracks in the flooring.	All surfaces which could come into contact with organic matter or moisture should be as seamless as possible to facilitate cleaning.		Potential internal source of fungi and bacteria.	0	0	-2	0	0	
N	K	11	Is all rubbish stored in contained in sealed bins until disposed of?	a	yes	Pests attracted by waste food can be a significant source of contaminants. Bacteria and fungi can rapidly propagate in organic waste, and dispersal of spores can be reduced with containment of the waste.	All organic wastes should be stored in sealed bins until removed from site to reduce pests, microbiological contamination and odours.		No detriment to the indoor air quality.	0	0	2	1	0	

				b	no	Pests attracted by waste food can be a significant source of contaminants. Bacteria and fungi can rapidly propagate in organic waste, and dispersal of spores can be reduced with containment of the waste.	All organic wastes should be stored in sealed bins until remove[d] from site to reduce pests, microbiological contamination and odours.		Potential internal source of fungi and bacteria.	0	0	-2	-1	0	
N	K	1	Is the air supply of the general ventilation systems set to delivery high volumes of supply air in response to intermittent periods of high occupancy concentrations in the cafeteria?	a	yes	High concentrations of people will introduce high levels of bioeffluents, odours and bacteria.	Sufficient dilution ventilation at peak times is required to dilute bioeffluents from high concentrations of people.		No detriment to the indoor air quality.	0	1	2	2	0	
				b	no	High concentrations of people will introduce high levels of bioeffluents, odours and bacteria.	Sufficient dilution ventilation is required to dilute bioeffluents from high concentrations of people.		Potential internal source of fungi and bacteria.		-1	-2	-2	0	
			Is the flooring material installed around all drinking water dispensers and coffee serving stations for at least 1m beyond the unit:	a	resilient	Drinking water dispensers and coffee serving stations have the potential to flood and have spilled drinks. This can increase the potential for microbiological contamination.	Resilient flooring is recommended in these areas.		No detriment to the indoor air quality.	0	0	2	0	0	

				b	carpet	Drinking water dispensers and coffee serving stations have the potential to flood and have spilled drinks. This can increase the potential for microbiological contamination.	Resilient flooring is recommended in these areas.		Potential internal source of fungi and bacteria.	0	0	-2	0	0	
			Toilets and Bathrooms (T)												
N	T	1	Are showers installed in the bathrooms?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	skip to NT5
				b	yes	Showers area strong point source of both vapour and liquid moisture, both of which need to be removed to avoid microbial contamination.	Care needs to be taken in the design of shower rooms to contain and remove steam and overflowed or dripped water.		Potential source of microbial contamination.	0	0	-3	0	0	
N	T	2	Are local extracts located above the showers?	a	yes	Steam will contribute to elevated humidity levels which can readily migrate though out the building	Local extraction of steam is recommended.		This will reduce the risk of bacteria and fungi propagation.	0	0	2	0	0	
				b	no	Steam will contribute to elevated humidity which can readily migrate though out the building.	Local extraction of steam is recommended.	vestibules	Potential source of microbial contamination.	0	0	-2	0	0	
N	T	3	Is the shutoff of the local extraction automatically delayed until humidity levels have dropped below ambient conditions via:	a	humidity sensor in the extraction duct	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Humidity sensors within the ducts will assist in preventing inter-duct moisture and microbial problems.		This will help to isolate the pathway between pollutants and clean spaces.	0	0	1	0	0	

				b	humidity sensor in the room	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Humidity sensors within the room will assist preventing inter-room moisture, but will not control humidity levels within the ducts.		This will help to isolate the pathway between pollutants and clean spaces.	0	0	1	0	0	
				c	time delay linked to operation of steam generator	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Time delay can assist in controlling within room or with duc humidity levels if the delay period is calibrated to decay of actual humidity levels.		This will help to isolate the pathway between pollutants and clean spaces	0	0	1	0	0	
				d	time controller	Maintaining the flow of air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter duct microbial growths, which could communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Time controllers on the extraction system can assist in reducing humidity levels if operation times of humidity sources are regular and the time controller is correctly commissioned and regularly verified.		This will help to isolate the pathway between pollutants and clean spaces.	0	0	1	0	0	

				e	not controlled	Maintaining the flow of extractec air until after the humidity levels within the duct have declined to ambient conditions will assist in drying out the duct. This will reduce the risk of inter-duct microbial growths, which could be communicated with occupied areas of the building during reversed air flows or via leaks in the duct.	Mechanisms to dry the residual moisture from the duct are recommended.		Potential source of moisture and microbial contamination.	0	0	-1	0	0	
N	T	4	Is the extraction system above the showers accessible for cleaning?	a	yes	High moisture levels with the extraction system can lead to microbial contamination.	Access for cleaning of shower extract system is highly recommended		This can potentially help reduce a source of microbial contamination.	0	0	2	0	0	
				b	no	High moisture levels with the extraction system can lead to microbial contamination.	Access for cleaning of shower extract system is highly recommended		Potential source of microbial contamination	0	0	-2	0	0	
N	T	5	Is sufficient clean make-up air available to off set the pressure drop from the localised extraction?	a	yes	Replacement air can be drawn from undesirable sources, such as through the waste stack or vertical risers, unless a clean reliable supply is provided.	A clean source of make-up air supply should accompany all local exhausts.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	Replacement air can be drawn from undesirable sources, such as through the waste stack or vertical risers, unless a clean reliable supply is provided.	A clean source of make-up air supply should accompany all local exhausts.		Potential source of particulates, gaseous pollutants and VOCs	-1	-1	0	-2	0	

N	T	6	Are all wall and ceiling surfaces where there is the potential for high humidity finished with vapour barrier materials?	a	yes	Vapour barriers installed on the wall or ceiling surface closest to the source of humidity will prevent humidity from entering the construction and migrating through out the building.	Vapour barriers are recommended on the humid side of walls and ceilings near all sources of moisture.	VOCs	No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Vapour barriers installed on the wall or ceiling surface closest to the source of humidity will prevent humidity from entering the construction and migrating through out the building.	Vapour barriers are recommended on the humid side of walls and ceilings near all sources of moisture.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	7	Are the floors in the wet areas sloped to drain spilled moisture to floor drains?	a	yes	Spilled moisture should be drained away via floor drains.	Floors sloped towards floor drains are recommended.		No detriment to the indoor air quality.	0	0	1	0	0	
				b	no	Spilled moisture should be drained away via floor drains.	Floors sloped towards floor drains are recommended.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	8	Are all surfaces which could come into contact with organic matter and moisture, smooth, readily scrubbed, seamless and impervious?	a	yes	Smooth, impervious and readily scrubbed surfaces will assist in maintaining high levels of hygiene and reduce habitats for bacteria and fungi.	It is recommended that all surfaces which come into contact with organic or waste products are smooth, impervious, readily scrubbed and as seamless as possible.		No detriment to the indoor air quality.	0	0	2	0	0	
				b	no	Smooth, impervious and readily scrubbed surfaces will assist in maintaining high levels of hygiene and reduce habitats for bacteria and fungi.	It is recommended that all surfaces which come into contact with organic or waste products are smooth, impervious, readily scrubbed and as seamless as		Potential source of microbial contamination	0	0	-3	0	0	

N	T	9	Are all internal corners of surfaces which could come into contact with organic matter or moisture coved?	a	yes	Coved internal corners assists ir the cleaning of surfaces and reduces the habitats for bacteria and fungi.	All internal corners of surfaces which come into contact with food or waste products should be cove to facilitate cleaning.		No detriment to the indoor air quality.	0	0	1	0	0	
				b	no	Coved internal corners assists ir the cleaning of surfaces and reduces the habitats for bacteria and fungi.	All internal corners of surfaces which come into contact with food or waste products should be cove to facilitate cleaning.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	10	Is the floor finished with one seamless material?	a	yes	Bacteria, fungi, organic matter and moisture can habour in small cracks in the flooring.	All surfaces which could come intc contact with organic matter or moisture should be as seamless as possible to facilitate cleaning.		No detriment to the indoor air quality.	0	0	1	0	0	
				b	no	Bacteria, fungi, organic matter and moisture can habour in small cracks in the flooring.	All surfaces which could come intc contact with organic matter or moisture should be as seamless as possible to facilitate cleaning.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	11	Is all rubbish, such as damp towels, contained in bins of sufficient capacity for the intended use until removal?	a	yes	Moisture from damp towel etc, can be transferred to adjacent porous materials. This can lead to microbial contamination.	Damp materials should not come into contact with other porous surfaces and should be removed within 24 hours of becoming damp.		No detriment to the indoor air quality.	0	0	1	0	0	
				b	no	Moisture from damp towel etc, can be transferred to adjacent porous materials. This can lead to microbial contamination.	Damp materials should not come into contact with other porous surfaces and should be removed within 24 hours of becoming damp.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	12	Are the vanities designed to drain spilled water back into a drainage fixture?	a	yes	Spilled moisture can lead to microbial contamination.	Spilled moisture should be collected and drained away within 12 hours.		No detriment to the indoor air quality.	0	0	1	0	0	

				b	no	Spilled moisture can lead to microbial contamination.	Spilled moisture should be collected and drained away within 12 hours.		Potential source of microbial contamination.	0	0	-2	0	0	
N	T	13	Are all sanitary fittings, such as urinals and toilets pans, wall hung?	a	yes	Wall hung sanitary fittings have fewer niches and difficult to clean corners around the fitting which can assist in the sanitation of the bathroom facility. Uninterrupted floors are easier to clean.	Sanitary fittings with few corners or interruptions to adjacent surfaces are recommended.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	Wall hung sanitary fittings have fewer niches and difficult to clean corners around the fitting which can assist in the sanitation of the bathroom facility. Uninterrupted floors are easier to clean.	Sanitary fittings with few corners or interruptions to adjacent surfaces are recommended.		Potential source of microbial contamination.	0	0	-3	0	0	
			Entrances (E)												
N	E	1	Is the area immediately outside the building's foot-traffic entrances	a	hard paved for at least 4.5 m in all directions of foot traffic	Hard paving will help clean organic matter and dirt of the sole of shoes, and prevents this material from being walked into the building. A distance of 4.5 m allows approximately 3 strides, which will help clean moderately dirty shoes.	Hard paving on all foot traffic routes for at least 4.5m is recommended	site pollutants, site water, entrance mats	No detriment to the indoor air quality.	0	1	1	0	0	
				b	hard paved for at less than 4.5 m	Hard paving will help clean organic matter and dirt of the sole of shoes, and prevents this material from being walked into the building. A distance of 4.5 m of hard paving is required to help clean moderately dirty shoes.	Hard paving on all foot traffic routes for at least 4.5m is recommended	site pollutants, site water, entrance mats	Potential source of microbial contamination	0	-1	-1	0	0	

				c	loose paved	Loose paving provides little assistance is capturing dirt of shoes and can be a source of organic matter.	Hard paving on all foot traffic routes for at least 4.5m is recommended.	site pollutants, site water, entrance mats	Potential source of particulate matter	0	-2	-2	0	0	
				d	grassed or soft landscaped	Grass and soft landscaping will contribute to organic matter being walked in on shoes. This can include residues of the herbicides and pesticides used in maintaining gardens.	Hard paving on all foot traffic routes for at least 4.5m is recommended.	site pollutants, site water, entrance mats	Potential source of microbial contamination, particulate matter and garden chemicals.	0	-3	-3	0	0	
N	E	2	Is it easy for pedestrians to take a short cut walk over soft landscaped rather than the hard paved areas?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Grass and soft landscaping will contribute to organic matter being walked in on shoes. This can include residues of the herbicides and pesticides used in maintaining gardens.	Strategically placed elevated landscape features maybe recommended to keep pedestrians on the hard paved surfaces.	site pollutants, site water, entrance mats	Potential source of microbial contamination, particulate matter and garden chemicals.	0	-2	-2	0	0	
N	E	3	Is the texture of the paving:	a	rough	Rough textures are most beneficial for cleaning dirt of shoes.	Rough surfaces are recommended.	site pollutants, site water, entrance mats	No detriment to the indoor air quality.	0	0	0	0	0	
				b	smooth	Smooth surfaces provide little assistance in removing dirt of the soles of shoes.	Rough surfaces are recommended.	site pollutants, site water, entrance mats	Potential source of microbial contamination, particulate matter and garden chemicals	0	-1	-1	0	0	

				c	polished	Polished surfaces provide very little assistance in removing dirt or moisture of the soles of shoes.	Rough surfaces are recommended.	site pollutants, site water, entrance mats	Potential source of microbial contamination, particulate matter and garden chemicals	0	-3	-1	0	0	
N	E	4	Is the area immediately outside the building's foot traffic entrances sheltered from the rain?	a	covered for 5m or more	Covered areas will help dry surface moisture of the sole of shoes and allow some space for wet umbrellas and clothing to drip which helps prevent rainwater from being carried into the building. A distance of 5m allows approximately 3 strides, which will help dry moderately wet shoes. This can reduce the moisture and microbial activity with the vacinity of the entrances.	Shelter from the rain for at least 5m is recommended.	site water, entrance mats	Potential reduction in moisture and microbial contamination.	0	0	2	0	0	
				b	covered for 2-5m	Covered areas will help dry surface moisture of the sole of shoes and allow some space for wet umbrellas and clothing to drip which helps prevent rainwater from being carried into the building. A distance of 5m allows approximately 3 strides, which will help dry moderately wet shoes. This can reduce the moisture and microbial activity with the vacinity of the entrances.	Shelter from the rain for at least 5m is recommended.	site water, entrance mats	Potential source of microbial contamination.	0	0	1	0	0	

				c	covered for less than 2m	Covered areas will help dry surface moisture of the sole of shoes and allow some space for wet umbrellas and clothing to drip which helps prevent rainwater from being carried into the building. A distance of 5m allows approximately 3 strides, which will help dry moderately wet shoes. This can reduce the moisture and microbial activity with the vacinity of the entrances.	Shelter from the rain for at least 5m is recommended.	site water, entrance mats	Potential source of microbial contamination.	0	0	-2	0	0	
				d	no	Covered areas will help dry surface moisture of the sole of shoes and allow some space for wet umbrellas and clothing to drip which helps prevent rainwater from being carried into the building. A distance of 5 m is required to help dry moderately wet shoes.	Shelter from the rain for at least 5m is recommended.	site water, entrance mats	Potential source of microbial contamination, particulate matter anc garden chemicals	0	0	-3	0	0	
N	E	5	Is the covered area used for vehicle set down or carparking?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Vehicle emissions can be concentrated under the shelter and enter the building.	Vestibules and air curtains over the doors are recommended to prevent pollutants from entering the building.	vestibules	Potential source of particulate matter anc gaseous pollutants.	0	-2	0	-2	0	
N	E	6	Do all the pedestrian entrances have vestibules?	a	yes	Vestibules help exclude exterior generated pollutants.	Vestibules are recommended to prevent pollutants from entering the building.	site pollutants	Potential to isolate th entrance areas from outdoor pollutants.	2	2	2	2	2	

				b	no	Vestibules help exclude exterior generated pollutants.	Vestibules are recommended to prevent pollutants from entering the building.	site pollutants	Potential to pathway for outdoor pollutants to enter the building.	-2	-3	-3	-3	-3	
N	E	7	Are dirt trapping entrance mats installed immediatel inside or outside all entrance doors?	a	yes	Pedestrians can contribute to th levels of dirt and moisture from shoes, trolley wheels etc which are tracked into the building. This can increase the levels of microbiological activity in the entrance area and beyond. Dirt from shoes can include residues of pesticides, fungi spores typically found in gardens and lead. Dirt trapping mats can help to reduce the amount of dir and water tracked into the building.	Installation of dirt trapping mats at least 3 m long immediately inside or outside the entrance are recommended.	site water	Potential to isolate the entrance areas from outdoor water and particulate matter.	0	2	2	0	0	
				b	no	Pedestrians can contribute to th levels of dirt and moisture from shoes, trolley wheels etc which are tracked into the building. This can increase the levels of microbiological activity in the entrance area and beyond. Dirt trapping mats can help to reduce the amount of dirt and water tracked into the building.	Installation of dirt trapping mats at least 3 m long immediately inside or outside the entrance are recommended.	site water, landscaping	Potential source of microbial contamination and particulate matter.	0	-2	-2	0	0	

N	E	8	Are the entrance mats readily replaceable?	a	yes	During rainy weather, moisture i tracked into the building. Entrance mats should be installed to remove this moisture from shoes and the mats should be replaced with dry mats throughout the day to remove th moisture from the building.	Changeable mats are recommended.		Potential to isolate the entrance areas from outdoor water and particulate matter.	0	1	0	0	0	
				b	no	During rainy weather, moisture i tracked into the building. Entrance mats should be installed to remove this moisture from shoes and the mats should be replaced with dry mats throughout the day to remove th moisture from the building.	Changeable mats are recommended.		Potential source of microbial contamination and particulate matter.	0	-2	-2	0	0	
			Cleaners (C)												
N	C	1	Are surfaces used that are required to be vacuumed?	a	yes	Vacuum cleaning can remove and/or resuspend settled particles from indoor surfaces.	Careful management of vacuuming cleaning practices are required to capture rather than resuspended particles. Consideration should be given to operation of air cleaners during and after vacuuming, filtration of vacuum cleaners, suction capacity of vacuum cleaners and hours of cleaning in relation to hours of occupancy.	filtration, ventilation	Potential source of particulate matter.	0	-3	0	0	0	
				b	no	Vacuum cleaning can remove and/or resuspend settled particles from indoor surfaces.			No detriment to the indoor air quality.	0	0	0	0	0	

N	C	2	Is the filtration system designed to operate when the vacuuming is undertaken?	a	yes, in-room filtration	Vacuum cleaning can remove and/or resuspend particles back into the air from indoor surfaces. Filtration will reduce the concentration of particles from the air which passes through the filters.	In-room filtration is more efficient for internally generated sources than central filtration, and can significantly reduce room particle concentrations.	indoor sources of particles, outdoor sources of particles	Potential opportunity to remove resuspended particulate matter.	0	3	0	0	0	
				b	yes, central filtration	Vacuum cleaning can resuspenc particles which have settled on indoor surfaces back into the indoor air. Filtration will reduce the concentration of particles from the air which passes through the filters.	Central filtration will significantly reduce particle counts from the air that is circulated through the filters.	indoor sources of particles, outdoor sources of particles.	Potential opportunity to remove resuspended particulate matter.	0	2	0	0	0	
				c	no	Vacuum cleaning can resuspenc particles which have settled on indoor surfaces back into the indoor air. Filtration will reduce the concentration of particles from the air which passes through the filters.	Filtration will significantly reduce particle counts from the air that is circulated through the filters.	indoor sources of particles, outdoor sources of particles	Potential source of particulate matter.	0	-3	0	0	0	
N	C	3	Is an area provided where vacuum cleaners can be emptied without redistributing particles back into the building?	a	yes	Disturbance of vacuum cleaner dust collector bags can redistribute particles back into the air.	Isolated areas with good ventilatio are recommended as designated zones for emptying vacuum cleaner bags.	indoor sources of particles, outdoor sources of particles	No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	Disturbance of vacuum cleaner dust collector bags can redistribute particles back into the air.	To prevent particles from re-entering the occupied areas, vacuum cleaner bags should be emptied away from all occupied areas and pathways to occupied areas.	indoor sources of particles, outdoor sources of particles	Potential source of particulate matter	0	-3	0	0	0	

N	C	4	Is the ventilation system designed to operate when vacuum cleaning is undertaken?	a	yes	Vacuum cleaning can resuspenc particles which have settled on surface back into the indoor air. Ventilation during and after vacuum cleaning with clean fresh air can dilute indoor concentrations of particles.	Ventilation with clean fresh air is recommended during vacuum cleaning		Potential reduction in particulate matter.	0	3	0	0	0	
				b	no	Vacuum cleaning can resuspenc particles which have settled on surface back into the indoor air. Ventilation during and after vacuum cleaning with clean fresh air can dilute indoor concentrations of particles.	Ventilation with clean fresh air is recommended during vacuum cleaning.		Potential source of resuspended particulate matter.	0	-3	0	0	0	
N	C	5	Are surfaces used that will require cleaning with floor polishes?	a	no				No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes	Floor polishes release high concentrations of VOCs during and after their application at high then diminishing concentrations respectively.	Application of floor polishes shoul be minimised to reduce the emissions of VOCs and the area should be ventilated during and after floor polishing to dilute VOCs. Floor polishing should not be undertaken during or prior to occupation of the building.		Potential source of VOCs	-2	0	0	0	0	
N	C	6	Is the ventilation system designed to operate when floor polishing is undertaken?	a	yes, with no recirculation o air	Ventilation, with no recirculation of indoor air, can dilute indoor concentrations of VOCs and limit the adsorption of VOCs into porous materials.	Ventilation with no recirculation of indoor air is recommended during and after floor polishing.		Potential opportunity to reduce the indoor concentration of VOCs.	3	0	0	0	0	

				b	yes, but with recirculation o air	Ventilation, with no recirculation of indoor air, can dilute indoor concentrations of VOCs and limit the adsorption of VOCs into porous materials.	Ventilation with no recirculation of indoor air is recommended during and after floor polishing.		This will distribute VOCs between areas	-2	0	0	0	0	
				c	no	Ventilation, with no recirculation of indoor air, can dilute indoor concentrations of VOCs and limit the adsorption of VOCs into porous materials.	Ventilation with no recirculation of indoor air is recommended during and after floor polishing.		This will distribute VOCs between areas	-3	0	0	0	0	
N	C	7	Is the ventilation system designed to operate during the application of all disinfectants and other cleaning chemicals which can release VOCs?	a	yes, with no recirculation o air	Cleaning chemicals can release large quantities of VOCs into the room air. Inappropriate storage and handling of surplus chemicals can allow VOCs to be emitted into the room air.	Reduction of the quantities of cleaning chemicals used and ventilation with no recirculation of the air is recommended during and after application of VOC emitting chemicals.		Potential opportunity to reduce the indoor concentration of VOCs.	3	0	0	0	0	
				b	yes, but with recirculation o air	Ventilation, with no recirculation of indoor air, can dilute indoor concentrations of VOCs and limit the adsorption of VOCs into porous materials.	Ventilation with no recirculation of indoor air is recommended during and after floor polishing.		This will distribute VOCs between areas	-2	0	0	0	0	
				c	no	Cleaning chemicals can release large quantities of VOCs into the room air. Inappropriate storage and handling of surplus chemicals can allow VOCs to be emitted into the room air.	Reduction of the quantities of cleaning chemicals used and ventilation with no recirculation of the air is recommended during and after application of VOC emitting chemicals.		This will distribute VOCs between areas	-3	0	0	0	0	

N	C	8	Is an isolated area provided for cleaning products to be mixed and decanted without distributing VOCs into the building?	a	yes	Mixing, diluting and decanting of cleaning chemicals can release strong point concentrations of VOCs into the air.	To prevent VOCs from entering the occupied areas, cleaning chemicals should be mixed, diluted and decanted away from a occupied areas and pathways to occupied areas.		Potential isolation of VOCs.	2	0	0	0	0	
				b	no	Mixing, diluting and decanting of cleaning chemicals can release strong point concentrations of VOCs into the air.	Mixing, diluting and decanting of cleaning chemicals can release strong point concentrations of VOCs into the air.		Potential source of VOCs	-3	0	0	0	0	
N	C	9	Is the air from the cleaners cupboard extracted:	a	directly to exterior	VOCs can be emitted from stored, spilled or leaky containers of cleaning chemicals. Measures should be taken to remove these VOCs at source and prevent them being communicated to the occupied areas. Exhausting the air from the cleaners cupboard through the central exhaust can circulate chemical emissions around the building unless there is 0% return air.	Exhausting the air from the cleaners cupboard directly to the exterior is recommended.		Potential opportunity to reduce the indoor concentration of VOCs and particulate matter.	2	2	0	0	0	
				b	exhausted to return air system	VOCs can be emitted from stored, spilled or leaky containers of cleaning chemicals. Measures should be taken to remove these VOCs at source and prevent them being communicated to the occupied areas. Exhausting the air from the cleaners cupboard through the central exhaust can circulate chemical emissions around the building unless there is 0% return air.	Exhausting the air from the cleaners cupboard directly to the exterior is recommended.		This will distribute VOCs between areas	-1	-1	0	0	0	

				c	no	VOCs can be emitted from stored, spilled or leaky containers of cleaning chemicals. Measures should be taken to remove these VOCs at source and prevent them being communicated to the occupied areas. Exhausting the air from the cleaners cupboard through the central exhaust can circulate chemical emissions around the building unless there is 0% return air.	Exhausting the air from the cleaners cupboard directly to the exterior is recommended.		This will distribute VOCs between areas	-3	-2	0	0	0	
N	C	10	Is the cleaners cupboard kept under negative pressure at all times?	a	yes	VOCs can be emitted from stored, spilled or leaky containers of cleaning chemicals. Measures should be taken to remove these VOCs at source and prevent them being communicated to the occupied areas.	Maintaining the air pressure in the cleaners cupboard at a lower pressure relative to the surrounding spaces at all times will assist in preventing VOCs from cleaning products entering other parts of the building.		Potential opportunity to reduce the indoor concentration of VOCs and particulate matter.	2	1	0	0	0	
				b	no	VOCs can be emitted from stored, spilled or leaky containers of cleaning chemicals. Measures should be taken to remove these VOCs at source and prevent them being communicated to the occupied areas.	Maintaining the air pressure in the cleaners cupboard at a lower pressure relative to the surrounding spaces at all times will assist in preventing VOCs from cleaning products entering other parts of the building.		This will distribute VOCs between areas	-3	-2	0	0	0	
N	C	11	Are the cleaners' cupboards of sufficient size to hold all necessary chemicals and equipment?	a	yes	Cleaning chemicals can release large quantities of VOCs into the room air. Inappropriate storage and handling of surplus chemicals can allow VOCs to be emitted into the room air.	Cleaning chemicals should all be stored in designated areas which have appropriate measures to prevent stray VOCs from entering other parts of the building.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	no	Cleaning chemicals can release large quantities of VOCs into the room air. Inappropriate storage and handling of surplus chemicals can allow VOCs to be emitted into the room air.	Cleaning chemicals should all be stored in designated areas which have appropriate measures to prevent stray VOCs from entering other parts of the building.		Potential source of VOCs.	-2	-1	0	0	0	
N	C	12	Does the water sealed trap in cleaners sink have a recharge mechanism with fresh water?	a	yes	The water seal in intermittently used water sealed traps can dry out and allow foul air gases from the sewer pipes to enter the building via the traps.	Water seals which are intermittently used should some method of recharging the water seal to maintain the air seal.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	no	The water seal in intermittently used water sealed traps can dry out and allow foul air gases from the sewer pipes to enter the building via the traps.	Water seals which are intermittently used should some method of recharging the water seal to maintain the air seal.		Potential source of gaseous pollutants.	0	0	0	-2	0	
N	C	13	Are construction, finishes or furnishing materials used in the building that are required to be cleaned with wet processes?	a	no	Cleaning of non-porous materials with water is often less detrimental to the healthiness of the indoor environment than the use of neat cleaning chemicals.	Materials that can be cleaned with water are generally recommendec Care should be taken to limit the amount residual moisture left on the materials and ventilation durin and after cleaning to remove remaining moisture.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	yes, non-porous materials	Cleaning of non-porous materials with water is often less detrimental to the healthiness of the indoor environment than the use of neat cleaning chemicals. All residual moisture is required to be dried as soon as possible after wetting and within 24 hours to prevent creating an environment suitable for contamination with microbiological organisms.	Materials that can be cleaned with water are generally recommended. Care should be taken to limit the amount residual moisture left on the materials and ventilation durin and after cleaning to remove remaining moisture.		Potential source of microbiological contamination.	0	0	-1	0	0	
				c	yes, porous materials	Porous materials which have become wet need to be thoroughly dried as soon as possible after wetting and within 24 hours to prevent creating an environment suitable for contamination with microbiological organisms.24 hours to prevent formation of microbial colonies.	It is highly recommended that porous materials which require we cleaning are restricted or replaced with resilient materials. If porous materials are necessary, then measures should be taken to dry porous materials within 24 hours.		Potential source of microbiological contamination.	0	0	-3	0	0	
			Services (S)												
N	S	1	Are all cold water pipes externally insulated?	a	yes, all chilled water	Condensation can form on the outside of pipes and wet adjacent surfaces.	Insulation of all chilled water pipes is recommended.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	yes, but only cold water pipes which run through warm spaces	Condensation can form on the outside of pipes and wet adjacent surfaces.	Insulation of all cold water pipes in warm spaces is recommended.		Potential source of microbiological contamination.	0	0	-1	0	0	

				c	no	Condensation can form on the outside of pipes where ever the temperature of the medium inside the uninsulated pipe is lower the dew temperature of th air outside the pipe. The resulting condensation can wet adjacent surfaces and create a ripe environment for propagatior of microbiological organisms.	Insulation of all cold water pipes ir warm spaces is recommended.		Potential source of microbiological contamination.	0	0	-2	0	0	
			Atriums (A)												
N	A	1	Will the proposed building use engineered strategies to provide passive ventilation?	a	atriums	When correctly engineered these can provide very good ventilation of the space. Correctly designed natural ventilation systems can provide very good quality indoor air on clean sites. They constitute a large volume of indoor air with which to dilute indoor generated pollutants, but require regular flushing with clean outdoor air. Incorrectly design atriums can lead to overheating in summer and excessive draughts in winter. Atriums provide a conduit for the communication o air between levels.	Correctly engineered atriums can contribute to effective passive ventilation systems in clean environments. Care needs to be taken with control of thermal gains negative stack effect reversing air flows at night and acoustic reverberations and sound routes. Backup mechanical ventilation may be required to provide sufficient outdoor air during all weather conditions.	outdoor pollutants	Potential for ingress of outdoor pollutants.	-2	-2	-2	-2	-2	

				b	ventilation chimneys	When correctly engineered these can provide very good ventilation of the space. Correctly design natural ventilation systems can provide very good quality indoor air on clean sites.	Correctly engineered ventilation chimneys can contribute to effective passive ventilation systems in clean environments. Care needs to be taken with negative stack effect reversing air flows at night . Backup mechanica ventilation may be required to provide sufficient outdoor air during all weather conditions.	outdoor pollutants	Potential for ingress of outdoor pollutants.	-2	-2	-2	-2	-2	
				c	jack roofs	When correctly engineered these can provide very good ventilation of the space. Correctly design natural ventilation systems can provide very good quality indoor air on clean sites.	Correctly engineered jack roofs can contribute to effective passive ventilation systems in clean environments. Care needs to be taken with negative stack effect reversing air flows at night . Backup mechanical ventilation may be required to provide sufficient outdoor air during all weather conditions.	outdoor pollutants	Potential for ingress of outdoor pollutants.	-2	-2	-2	-2	-2	
				d	clerestory vents	When correctly engineered these can provide very good ventilation of the space. Correctly design natural ventilation systems can provide very good quality indoor air on clean sites.	Correctly engineered clerestory vents can contribute to effective passive ventilation systems in clean environments. Care needs t be taken with negative stack effec reversing air flows at night. Backup mechanical ventilation may be required to provide sufficient outdoor air during all weather conditions.	outdoor pollutants	Potential for ingress of outdoor pollutants.	-2	-2	-2	-2	-2	

				e	no	Naturally ventilated buildings car provide very good indoor air quality on clean sites. Sites with high concentrations of outdoor pollutants should be mechanically ventilated as the provides the opportunity to draw outdoor air from the cleanest possible location as well as central filtration and conditioning of the air.	Some means of natural ventilation are recommended to allow the building to be ventilated in the advent of power or mechanical failures during the life of the building.	outdoor pollutants	Potential for ingress of outdoor pollutants.	-2	-2	-2	-2	-2	
			Carparking (C)												
N	C	1	Is the carparking located:	a	parking is not permitted close to the building	Carbon monoxide, other gaseous contaminants and particles can be introduced into the occupied areas from vehicle activity. Pollutants from carparks adjacent to the building can be transported through openings in the building envelope.			No detriment to the IAQ.	0	0	0	0	0	
				b	adjacent to the building	Carbon monoxide, other gaseous contaminants and particles can be introduced into the occupied areas from vehicle activity. Pollutants from carparks adjacent to the building can be transported through openings in the building envelope.	Care needs to taken in the design of openings to avoid creating pathways for vehicle emissions to enter through the envelope.	air intakes, entrances	Potential source of VOCs, gaseous pollutants and particulate matter.	-1	-1	0	-2	0	

				c	under or on intermediate levels within the building	Carbon monoxide, other gaseous contaminants and particles can be introduced into the occupied areas from vehicle activity. Wind blowing into underground carparks can provide the driving force to push vehicle emissions through small penetrations unless there is an alternative opening with less resistance. During rainy weathe wet vehicles can also bring in excess moisture to the building.	The entrances to the carparking areas should be sheltered from wind forces to prevent wind blowing into the underground area and increasing the air pressure in this zone relative to other parts of the building. This includes a canopy roof over the entrances to the carparks to reduce the ingress of wind facing down the face of th building. Openings opposite to th entrance should be provided to relieve the wind pressure.	entrances, extraction, air intakes,	Potential source of VOCs, gaseous pollutants, particulate matter and microbial contamination.	-2	-2	-2	-3	0	
N	C	2	Is there a barrier strip to prevent vehicle parking hard up against any openings into the building?	a	yes	Carbon monoxide, other gaseous contaminants and particles can be introduced into the occupied areas from vehicle activity. Pollutants from carparks adjacent to the building can be transported through openings in the building envelope.	A barrier strip of 1m or more can prevent vehicle emissions being discharged directly on to the face of the building and allow the emissions to disperse.		No detriment to the IAQ.	1	1	0	2	0	
				b	no	Carbon monoxide, other gaseous contaminants and particles can be introduced into the occupied areas from vehicle activity. Pollutants from carparks adjacent to the building can be transported through openings in the building envelope.	A barrier strip of 1m or more can prevent vehicle emissions being discharged directly on to the face of the building and allow the emissions to disperse.	air intakes, entrances	Potential pathway for VOCs, gaseous pollutants and particulate matter to enter the building	-1	-1	0	-2	0	

N	C	3	Will the construction joints and cracks in the floor and roof slabs which separate the carparking area from other parts of the building be sealed?	a	yes	Gaseous pollutants can leaks from carparking to the occupied areas through construction joints and cracks in the floor.	Construction joints should be sealed to prevent migration of gaseous pollutants.		No detriment to the IAQ.	1	1	0	2	0	
				b	no	Gaseous pollutants can leaks from carparking to the occupied areas through construction joints and cracks in the floor.	Construction joints should be sealed to prevent migration of gaseous pollutants.		Potential pathway for VOCs, gaseous pollutants and particulate matter to enter the building.	-1	-1	0	-2	0	
N	C	4	Is the carparking area:	a	open air	Wind pressure can help dilute and remove vehicle emissions.	Natural air movement can assist the dilution of vehicle emissions before they enter the building.		Potential dilution of VOCs, gaseous pollutants and particulate matter.	1	1	0	2	0	
				b	partially enclosed	Wind pressure can provide the driving force to push vehicle emissions from into occupied areas.	Consideration needs to be given t design of openings so that emissions entrained in the wind flow will flow out through openings other than those which connect directly or indirectly to the occupied areas.	entrances, extraction, air intakes	Potential dilution of VOCs, gaseous pollutants and particulate matter.	1	1	0	1	0	
				c	fully enclosed	Fully enclosed carpark areas ca accumulate high concentrations of vehicle emissions and require separate extractions systems to remove these. All pathways between the carparking areas and occupied areas need carefu attention to prevent the communication of pollutants.	Careful attention needs to be paid to the design of the extraction system to reduce the accumulatio of vehicle emissions. All connecting circulation routes should be installed with ventilated vestibule lobbies. The carpark area should have a completely separate ventilation and extractior system.	entrances, extraction, air intakes	No improvement to the IAQ.	0	0	0	0	0	

N	C	5	Is the air exiting from carparks via vents, air extracts and openings directed away from all other openings in the building envelope?	a	yes	Re-entrainment of exhausted air can readily occur if exhausts etc are not correctly sited and sized in relation to the building.	Correct siting and design of all exhausts, vent and openings is required to provide physical separation and avoid air pathways into the building.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	1	0	
				b	no	Re-entrainment of exhausted air can readily occur if exhausts etc are not correctly sited and sized in relation to the building.	Correct siting and design of all exhausts, vent and openings is required to provide physical separation and avoid air pathways into the building.		Potential pathway for VOCs, gaseous pollutants and particulate matter to enter the building.	-1	-1	0	-1	0	
N	C	6	Will the occupied areas and connecting spaces be maintained at a higher air pressure relative to the carparking areas at all times?	a	yes	Maintaining the occupied areas at a higher air pressure then the carparking area will help to prevent the migration of vehicle emissions into the building.	Buildings should be maintained at a higher air pressure than surrounding carparking areas.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	1	0	

				b	no	Maintaining the occupied areas at a higher air pressure then the carparking area will help to prevent the migration of vehicle emissions into the building.	Buildings should be maintained at a higher air pressure than surrounding carparking areas.	building height, ventilation system	Potential pathway for VOCs, gaseous pollutants and particulate matter to enter the building.	-1	-1	0	-1	0	
			Print Shops (P)												
N	P	1	Does the building have a print shop?	a	no	Print shops are strong sources of VOCs from the printing processes and particles from the paper handling.	Print shops should be isolated from office type operations.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Print shops are strong sources of VOCs from the printing processes and particles from the paper handling.	Print shops should be isolated from office type operations.		Potential source of VOCs and particulate matter.	-3	-3	0	0	0	
N	P	2	Has printing equipment with low emissions of VOCs been selected?	a	yes	Many print processes generate high concentrations of VOCs. Attention should be paid to reducing the concentration of pollutants.	Low emitting process should be selected to reduce the concentrations of VOCs.			0	0	0	0	0	
				b	no	Many print processes generate high concentrations of VOCs. Attention should be paid to reducing the concentration of pollutants.	Low emitting process should be selected to reduce the concentrations of VOCs.		Potential source of VOCs.	-3	0	0	0	0	

N	P	3	Is the print shop area extracted separately to surrounding areas?	a	yes	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates. Attention should be paid to removing pollutants at source.	Print rooms should be installed with an independent air extract system to remove VOCs at source.	localised extraction	Potential for removal of VOCs and particulate matter.	1	1	0	0	0	
				b	no	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates. Attention should be paid to removing pollutants at source.	Print rooms should be installed with an independent air extract system to remove VOCs at source.	localised extraction	Potential pathway for VOCs and particulate matter to enter the occupied areas.	-2	-2	0	0	0	
			Will the extract system be run:	a	whenever VOCs are present	Residual high concentrations of VOCs can be present for periods longer than the operation of the printing equipment. This could lead to contamination of other areas if the air pressure relationships are reversed.	Operation of the extraction equipment is recommended whenever VOCs are present.	localised extraction	Potential for removal of VOCs and particulate matter.	2	2	0	0	0	
N	P	4		b	whenever the printing equipment is operated	Residual high concentrations of VOCs can be present for periods longer than the operation of the printing equipment. This could lead to contamination of other areas if the air pressure relationships are reversed and can prolong the residence of the VOCs due to adsorption/ desorption with other materials.	It is recommended that the extraction system is operated during the printing processes and until the concentration of VOCs have decayed to below acceptable levels.	localised extraction	Potential for removal of VOCs and particulate matter.	1	1	0	0	0	

				c	intermittently	Residual high concentrations of VOCs can be present for periods longer than the operatio of the printing equipment. This could lead to contamination of other areas if the air pressure relationships are reversed and can prolong the residence of the VOCs due to adsorption/ desorption with other materials.	It is recommended that the extraction system is operated during the printing processes and until the concentration of VOCs have decayed to below acceptable levels.	localised extraction	Potential pathway for VOCs and particulate matter to enter the occupied areas.	-1	-1	0	0	0	
N	P	5	Is the entrance to the print shop isolated from surrounding areas?	a	yes	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates.	The area should be isolated from other adjacent spaces including a ventilated lobby entrance. This is especially important if the door is frequently opened.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	0	0	
				b	no	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates.	The area should be isolated from other adjacent spaces including a ventilated lobby entrance. This is especially important if the door is frequently opened.		Potential pathway for VOCs and particulate matter to enter the occupied areas.	-1	-1	0	0	0	
N	P	6	Will the print shop area be maintained at a lower air pressure than the surrounding spaces?	a	yes	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates.	To prevent the spread of VOCs to surrounding areas, the printing area should be maintained at a negative air pressure relative to surrounding spaces.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	0	0	
				b	no	Many print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates.	To prevent the spread of VOCs to surrounding areas, the printing area should be maintained at a negative air pressure relative to surrounding spaces.		Potential pathway for VOCs and particulate matter to enter the occupied areas.	-1	-1	0	0	0	

N	P	7	Will air from the print shop be able to infiltrate the return air plenum?	a	no	As return air plenums are leaky, air from undesirable sources can frequently infiltrate into the return air stream. This can lead to entrained contaminants being recirculated around the building.	Sealing of print room's walls and ceiling is recommended to prevent cross contamination.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	0	0	
				b	yes	As return air plenums are leaky, air from undesirable sources can frequently infiltrate into the return air stream. This can lead to entrained contaminants being recirculated around the building.	Sealing of print room's walls and ceiling is recommended to prevent cross contamination.		Potential pathway for VOCs and particulate matter to enter the occupied areas.	-1	-1	0	0	0	
N	P	8	Will the walls which enclose the print shop be installed from slab to slab?	a	yes	VOCs can migrate over the top of walls and through small openings.	Containment of VOCs requires that all pathways from the print room to other areas are avoided. This can include installing walls from slab to slab. However care needs to be taken not to block off the ventilation to other areas of the building when installing slab to slab walls.		Potential to prevent VOCs, gaseous pollutants and particulate matter from entering the building.	1	1	0	0	0	
				b	no	VOCs can migrate over the top of walls and through small openings.	Containment of VOCs requires that all pathways from the print room to other areas are avoided. This can include installing walls from slab to slab. However care needs to be taken not to block off the ventilation to other areas of the building when installing slab to slab walls.		Potential pathway for VOCs and particulate matter to enter the occupied areas.	-1	-1	0	0	0	

N		9	Will the print shop be furnished with fleecy surfaces such as carpet?	a	no	Carpet and other such porous wall, floor, ceiling or furniture surfaces can absorb and re-release VOCs, which can prolong the concentration of VOCs.	Porous surfaces are not recommended for print rooms. However to avoid problems with sound absorption, other non porous sound absorbers should b installed.			0	0	0	0	0	
				b	yes	Carpet and other such porous wall, floor, ceiling or furniture surfaces can absorb and re-release VOCs, which can prolong the concentration of VOCs.	Porous surfaces are not recommended for print rooms. However to avoid problems with sound absorption, other non porous sound absorbers should b installed.	VOC interactions	Potential sink for VOCs and particulates.	-1	-1	0	0	0	
N	P	10	Will the raw products, ink etc. and finished goods be stored in areas subject to the same isolation and containment practices as the remainder of the print shop?	a	yes	Raw materials and finished product can also release VOCs and particulate matter into the air.	Raw products and finished products should be stored within the print shop or an adjacent area with equivalent provisions for extraction and containment.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Raw materials and finished product can also release VOCs and particulate matter into the air.	Raw products and finished products should be stored within the print shop or an adjacent area with equivalent provisions for extraction and containment.		Potential source of VOCs.	-2	0	0	0	0	
N	P	11	Is the extraction and air supply air of the print shop readily accessible for rebalancing throughout the life of the facility?	a	yes	Correct air pressure relationships are necessary to prevent other areas becoming cross contaminated.	Access for rebalancing of the extraction and air supply system i recommended.		No detriment to the IAQ.	2	2	0	0	0	

				b	no	Correct air pressure relationships are necessary to prevent other areas becoming cross contaminated.	Access for rebalancing of the extraction and air supply system is recommended.		Potential source of VOCs and particulate matter.	-2	-2	0	0	0	

			Questions		Options	Justification	Recommendations	Linkage	Conclusion	VOCs	Particulates	Microbials	Gaseous	Thermal
			Interiors (I)											
			Specialist use areas (U)											
I	U	1	In addition to "desk based" office activities, will the proposed building accommodate:	a	gymnasium	The activities in gyms and associated showering facilities can generate larg quantities of moisture and bioeffluents.	Gymnasiums and associated showering facilities should be installed with ventilation in excess o 10L/sec/person and an independen air extract system. The area shoul be isolated from other adjacent spaces including a ventilated lobby entrance and maintained at a negative air pressure.	bathrooms, localised extraction	Potential internal source of microbial contamination.	0	0	-3	0	0
				b	print rooms	Print processes generate high concentrations of VOCs and paper handling generates high concentrations of particulates.	Print rooms should be installed with sufficient ventilation to dilute the pollutant load rather than the occupant load and an independent air extract system. The area shoul be isolated from other adjacent spaces including a ventilated lobby entrance and maintained at a negative air pressure.	printrooms	Potential internal source of VOCs and particulate matter.	-3	-2	0	0	0
				c	food court	Food courts generate high concentrations of odours, steam and particles. If hygiene practices are below standard then microbial activity can also increase. If tobacco smokin is permitted than the concentration of particles and VOCs will also increase	Food courts should be installed wit sufficient ventilation to dilute the pollutant load rather than the occupant load and an independent air extract system. The area shoul be isolated from other adjacent spaces including a ventilated lobby entrance and maintained at a negative air pressure.	kitchens	Potential internal source of microbial contamination, gaseous pollutants and particulate matter.	0	-1	-3	-2	0

				d	commercial kitchens	Kitchens generate high concentration of odours, steam, heat, gaseous pollutants and particles. If hygiene practices are below standard then microbial activity can also increase.	Commercial kitchens should be installed with sufficient ventilation to dilute the pollutant load and an independent air extract system. Localised extraction should be installed immediately overhead all cooking appliances and steam sterilising units. The kitchen area should be isolated from other adjacent spaces including a ventilated lobby entrance and maintained at a negative air pressure.	kitchens	Potential internal source of microbial contamination, gaseous pollutants and particulate matter.	0	-1	-3	-2	0
				e	auditorium and meeting rooms	High concentrations of people generate high concentrations of bioeffluents and moisture.	Auditoriums and meeting rooms should be installed with adequate demand ventilation to dilute and remove the bioeffluents and moisture generated by the occupants during and immediately after the period of occupancy. Ventilation should be controlled with CO2 sensors.	ventilation systems	Potential internal source of microbial contamination, gaseous pollutants and particulate matter.	0	-2	-2	-2	0
				f	atriums	Atrium can be a ventilation challenge. Indoor plants in atriums need consideration to limit microbial contamination.	Atrium spaces need careful design of the ventilation system.	living plants	Potential internal source of microbial contamination and particulate matter.	0	-2	-3	0	0
				g	carparking	Carparking attached, under or adjacent to the building can introduce particles and gaseous pollutants into the building.	Carparking areas should be isolated from all other areas of the building.	carparking	Potential internal source of VOCs, gaseous pollutants and particulate matter.	-3	-3	0	-3	0

I	U	2	Will the building be designed to accommodate:	a	open plan space	Open plan spaces typically have a higher density of occupants than cellular offices, which can lead to stronger sources of contaminants generated from the occupants & their activities. Due to the higher density o furniture items, the contribution of emissions from these components can be significant and require careful consideration. Open plan offices where the height of all dividing screens and furniture items is below 1500mm can have better air exchang as there are fewer obstructions to the circulation of air.	Ventilation rates adequate to remov all pollutants associated with a high concentration of occupants and thei associated activities are recommended. Cellular offices are the preferred means of accommodation.	furniture, ventilation type	Potential internal source of VOCs, microbial organisms, gaseous pollutants and particulate matter.	-2	-2	-2	-2	0
				b	cellular offices	Cellular offices typically have a lower occupant density and lower concentrations of occupant generatec contaminants, than open plan offices. Emissions from the partitions and finishes need to be accounted for in the design. However effective air exchange is more difficult to achieve without the installation of additional al supply, return air grills and registers.	Cellular offices are the preferred means of office accommodation.	ventilation type		0	0	0	0	0

				c	combinations of open plan and cellular offices	Open plan spaces typically have a higher density of occupants than cellular offices, which can lead to stronger sources of contaminants generated from the occupants & their activities. Due to the higher density o furniture items, the contribution of emissions from these components can be significant and require careful consideration. Open plan offices where the height of all dividing screens and furniture items is below 1500mm can have better air exchang as there are fewer obstacles to the proper circulation of air.	Ventilation rates adequate to remov all pollutants associated with a high concentration of occupants and thei associated activities are recommended.		Potential internal source of VOCs, microbial organisms, gaseous pollutants and particulate matter.	-1	-1	-1	-1	0
I	U	3	Are the occupants accommodation requirements known and able to be incorporated at the design stage?	a	yes	Incorporation of the occupants requirements into the design of the building can potentially create an ideal environment. Care needs to be taken to project forward the future needs and parameters which will affect the indoor environment, such as future sources of contaminants etc. The basic premises of selection of low emitting materials, control of all sources of free moisture etc need to be maintained.	Establishing appropriate goals at th project outset and working towards the fulfilment of these goals is recommended.	documentation		2	2	2	2	2

				b	no	Care needs to be taken to project forward the current and future needs and parameters which will affect the indoor environment, such as sources of contaminants etc. The basic premises of selection of low emitting materials, control of all sources of free moisture etc need to be maintained.				-2	-2	-2	-2	-2
			Subgrade (S)											
I	S	1	Will the subgrade area be occupied?	a	permanently	The air quality can often be compromised in subgrade areas due to dampness, low air exchange and low temperatures.	It is not recommended that occupants are accommodated in subgrade areas. Strict provisions for preventing moisture penetrations through the envelope and adequate mechanical ventilation are highly recommended.							
				b	frequently visited for shor periods eg. carparking	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Vehicle activity can be a significant source of particulate matter, gaseous pollutants and VOCs and these pollutants should not be allowed to migrate to other parts of th building. Extraction of contaminated air is required to remove contaminates and maintain the subfloor area at a negative air pressure. Care should be taken to ensure the extracted air is discharged away from all air pathways back into the building.	Provisions for preventing moisture migration through the envelope, condensation and extraction of stale air and moisture are recommended.							

				c	occasionally visited eg. servicing of plant or access to storage	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Extraction of contaminated air is required to remove contaminates and maintain the subfloor area at a negative air pressure. Care should b taken to ensure the extracted air is discharged away from all air pathway back into the building.	Provisions for preventing moisture penetrations through the envelope and extraction are recommended.							
I	S	2	Will the subgrade areas be isolated from the remainder of the building?	a	completely sealed off from occupied areas.	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Sealing off the subfloor area wi help prevent communication of moisture and microbial contaminants from other areas of the building.	Isolation of air from the subgrade to prevent it cross contaminating other parts of the building is recommended.			0	2	2	0	0
				b	sealed off except for lifts shafts, duct penetrations and stair wells.	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Lift shafts, ducts and stairwells are pathways through which airborne contaminates can readily flow from a source to occupied areas.	Isolation of air from the subgrade to prevent it cross contaminating other parts of the building is recommended. Vestibule lobbies around lifts and stair wells and air tight hatches to ducts are recommended.		Potential pathway for VOCs and particulate matter to migrate to other areas.	0	-1	-1	0	0

				c	duct openings connecting the subgrade area with the exhaust directly to the outside.	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Lift shafts, ducts and stairwells are pathways through which airborne contaminates can readily flow from a source to occupied areas.	Isolation of air from the subgrade to prevent it cross contaminating other parts of the building is recommended. Vestibule lobbies around lifts and stair wells and air tight hatches to ducts are recommended. Care needs to be taken to prevent reverse air movement when the air supply is idle.		Potential pathway for VOCs and particulate matter to migrate to other areas.	0	2	2	0	0
				d	duct openings connecting the subgrade area with other occupied areas	Air quality can often be compromised in subgrade areas. Microbial contamination can be present if moisture migrates through the walls o floor. Lift shafts, ducts and stairwells are pathways through which airborne contaminates can readily flow from a source to occupied areas.	Isolation of air from the subgrade to prevent it cross contaminating other parts of the building is recommended. Vestibule lobbies around lifts and stair wells and air tight hatches to ducts are recommended. Care needs to be taken to prevent reverse air movement when the air supply is idle.		Potential pathway for VOCs and particulate matter to migrate to other areas.	0	-2	-2	0	0
I	S	3	Are all the walls of occupied subgrade spaces:	a	tanked & protected with a drained and ventilated external wrap	Subgrade moisture can be forced through external walls due to pore pressure within the soils and cause lead to microbial growth within the walls or the interior spaces.	A drained and ventilated external wrap over the top of tanking is highl recommended to help prevent the wall sweating and reduce the moisture burden on the tanking. Some materials will also provide physical protection to the tanking.		Opportunity to prevent the ingress of moisture.	0	0	3	0	0
				b	tanked & protected with a protective layer	Subgrade moisture can be forced through external walls due to pore pressure within the soils and cause lead to microbial growth within the walls or the interior spaces.	A external protective layer over the top of tanking is recommended to help prevent physical damage to the tanking.		Opportunity to prevent the ingress of moisture.	0	0	2	0	0

				c	tanked	Subgrade moisture can be forced through external walls due to pore pressure within the soils and cause lead to microbial growth within the walls or the interior spaces.	Tanking without other protective measures is not recommended unless the soil is very free draining and the soil has a very low water table all year.		Potential source of moisture and microbial contamination.	0	0	1	0	0
				d	installed with an internal vapour barrier	Subgrade moisture can be forced through external walls due to pore pressure within the soils and cause lead to microbial growth within the walls or the interior spaces. Internal vapour barriers can prevent moisture within the wall cavity from drying, and allow increase the risk of interstitial dampness and microbial contamination.	Internal vapour barriers are not recommended.		Potential source of moisture and microbial contamination.	0	0	-2	0	0
I	S	4	In the subgrade area, is concrete used for the construction of the:	a	floors	A concrete takes at least 3 months to dry out every 25mm of thickness/depth of concrete. This can be longer in less well ventilated and cooler areas such as subgrade areas.	Subgrade areas should be very wel ventilated for at least the first 12 months after construction. It is recommended that porous materials should not be installed or stored, in contact with the concrete during the drying out period.	ventilation						
				b	walls	A concrete takes at least 3 months to dry out every 25mm of thickness/depth of concrete. This can be longer in less well ventilated and cooler areas such as subgrade areas	Subgrade areas should be very wel ventilated for at least the first 12 months after construction. It is recommended that porous materials should not be installed or stored, in contact with the concrete during the drying out period.	ventilation						

				c	structure	A concrete takes at least 3 months to dry out every 25mm of thickness/depth of concrete. This can be longer in less well ventilated and cooler areas such as subgrade areas.	Subgrade areas should be very wel ventilated for at least the first 12 months after construction. It is recommended that porous materials should not be installed or stored, in contact with the concrete during the drying out period.	ventilation						
		5	Is there sufficient time allowed for in the construction schedule for the concrete to thoroughly dry out prior to finishing?		yes	A concrete takes at least 3 months to dry out every 25mm of thickness/depth of concrete. This can be longer in less well ventilated and cooler areas such as subgrade areas.	Subgrade areas should be very wel ventilated for at least the first 12 months after construction. It is recommended that porous materials should not be installed or stored, in contact with the concrete during the drying out period.	ventilation		0	0	2	0	0
					no	A concrete takes at least 3 months to dry out every 25mm of thickness/depth of concrete. This can be longer in less well ventilated and cooler areas such as subgrade areas.	Precast concrete with sufficient scheduled drying is recommended.		Potential source of moisture and microbial contamination.	0	0	-2	0	0
i	S	6	Are porous materials installed on the:	a	floor	Subgrade moisture can be forced through external floors due to pore pressure within the soils and cause lead to microbial growth within the flooring finishes or the interior spaces	Porous materials such as carpet are not recommended for the floors of subgrade areas for at least the first 12 months after new construction and until there is certainty that the floor structure has no available moisture. Adequate insulation and heating to avoid condensation and ventilation to remove moisture are recommended.	construction drying, ventilation, insulation, heating	Potential source of moisture and microbial contamination.	0	0	-2	0	0

				b	external walls	Subgrade moisture can be forced through external walls due to pore pressure within the soils and cause lead to microbial growth within the walls or the interior spaces.	Porous materials such as plaster board are not recommended for the external walls of subgrade areas for at least the first 12 months after new construction and until there is certainty that the walls have no available moisture. Strapping and lining the walls with a vapour barrier under the wall lining is recommended. Adequate insulation and heating to avoid condensation and ventilation to remove moisture are recommended.	construction drying, ventilation, insulation, heating	Potential source of moisture and microbial contamination.	0	0	-2	0	0
				c	internal walls	Subgrade moisture can become damp due to infiltration of moisture from outside and low air temperatures. This can lead to microbial growth within the porous wall materials, especially around the exterior perimeter.	Adequate insulation and heating to avoid condensation and ventilation to remove moisture are recommended.	ventilation, insulation, heating						
				d	ceiling	Subgrade moisture can become damp due to infiltration of moisture from outside and low air temperatures. This can lead to microbial growth within the porous ceiling materials, especially around the exterior perimeter.	Adequate insulation and heating to avoid condensation and ventilation to remove moisture are recommended.	ventilation, insulation, heating						
i	S	7	Is the subgrade area dehumidified?	a	yes	Dehumidification can assist to remove moisture from damp enclosed areas. Attention should be paid to the collection and drainage of the condensate. This should be plumbed rather than collected in a reservoir to avoid creating a host environment for microbiological organisms to propagate.	Dehumidification is recommended in damp enclosed areas.			0	0	2	0	0

				b	no	Dehumidification can assist to remove moisture from damp enclosed areas. Attention should be paid to the collection and drainage of the condensate. This should be plumbed rather than collected in a reservoir to avoid creating a host environment for microbiological organisms to propagate.	Dehumidification is recommended i damp enclosed areas.			0	0	2	0	0
			The time lapsed between pouring of new concrete and installation of porous materials be:	a	90 days or more	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous finishes, such as carpet, if these are laid befor the concrete has dried. Moisture absorbed into the floor finishes can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to installation of porous finishes is recommended.			0	0	3	0	0
				b	60 - 90 days	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous finishes, such as carpet, if these are laid befor the concrete has dried. Moisture absorbed into the floor finishes can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to installation of porous finishes is recommended.			0	0	2	0	0

				c	less than 60 days	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous finishes, such as carpet, if these are laid before the concrete has dried. Moisture absorbed into the floor finishes can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to installation of porous finishes is recommended.			0	0	-1	0	0
			Floors, Raised Floor and Floor Void (FI)											

I	FI	1	Will the floor structure be constructed from:	a	precast concrete	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. A 200mm thick slab of normal grade concrete contains about 18 litres of water per m2 that needs to dry out before the concrete is in a state of equilibrium. The bulk of the moisture will have evaporated in 60 days given dry, warr weather conditions and will be speeded up if the concrete can dry from two main faces. Precast concrete has a lower moisture content when installed than insitu concrete. The alkaline nature of concrete, in combination with moisture and organi matter in the finishing materials can lead to deterioration of the finishing materials and the release of VOCs. Moisture absorbed into the concrete can lead to favorable habitats for fungi, dustmites etc..	Precast concrete is recommended. Concrete should be thoroughly drie to a moisture content less than 18% prior to the application of finishing materials. High thermal mass structures are recommended.			0	0	2	0	2

				b	concrete cast insitu	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. A 200mm thick slab of normal grade concrete contains about 18 litres of water per m2 that needs to dry out before the concrete is in a state of equilibrium. The bulk of the moisture will have evaporated in 60 days given dry, warm weather conditions. The alkaline nature of concrete, in combination with moisture and organic matter in the finishing materials can lead to deterioration of the finishing materials and the release of VOCs. Moisture absorbed into the concrete can lead to favorable habitats for fungi, dustmites etc..	Concrete should be thoroughly dried to a moisture content less than 18% prior to the application of finishing materials. High thermal mass structures are recommended.	ventilation, construction drying		0	0	-1	0	2
				c	timber	Newly milled timber can take up to 12 months to release all moisture. However the bulk of the moisture will have dried within 60 days given dry, warm weather conditions. Moisture within the timber can form a favourable habitat for fungi, and can conduct moisture to adjacent materials.	Timber should be thoroughly dried to less than 18% moisture content prior to being brought into the building. Finishing materials should not be applied over wet timber.			0	0	0	0	0

				d	wood or cellulose particle board	Particle board, ply wood and other cellulose based products are usually bound with urea formaldehyde based resins, They are strong sources of VOCs for at least the first 12 months of the life of the material. As the floor constitute a very large surface area of the building they represent a strong source of VOC emissions. Pre-conditioning of the material can help to reduce the strength of the emissions.	Particle board is not recommended	ventilation, pre-conditioning, construction ventilation	Potential indoor source of VOCs	-3	0	0	0	0
	Fl	2	Will the floor structure be exposed to rain or water other than curing water after it has been cast?	a	no	Rain water on porous materials such as concrete and timber will readily be absorbed into the material. Approximately four additional days drying should be allowed for every 1mm of precipitation that falls on the porous floor prior to finishing.	Protection from rain and other sources of water is recommended.			0	0	2	0	0
				b	yes	Rain water on porous materials such as concrete and timber will readily be absorbed into the material. Approximately 4 additional days drying should be allowed for every 1mm of precipitation that falls on the porous floor prior to finishing.	Protection from rain and other sources of water is recommended.		Potential source of microbial contamination.	0	0	-3	0	0
I	Fl	3	Will the floor be finished with:	a	coloured concrete	The dyes and polymers used in the production of coloured concrete which can release some VOCs. Coloured concrete is a benign product and has a low risk of microbiological contamination if thoroughly dried. Exposed concrete also adds thermal mass which moderates the indoor temperature fluctuations.	Coloured concrete is recommended	construction ventilation		-1	0	0	0	2

				b	masonry tiles	Kiln fired or natural masonry tiles are free of emissions of VOCs. Masonry tiles have a low risk of supporting microbiological contaminants if the joints are correctly sealed and flush with the tile surface to allow for cleaning. The source of imported stones needs to selected from a geographical area which is free from radon. An adhesive system with low emissions of VOCs should be selected. Masonry tiles adds thermal mass which moderates the internal temperature swings.	Masonry tiles are recommended.	construction ventilation		-1	0	0	0	2
				c	carpet	Porous materials, such as carpet, should not be laid over concrete until the concrete is thoroughly dried. Carpet can harbour microbiological contaminants such as fungi and dustmites if moisture is present. Carpet should not be used in situations where there is a risk of dampness or spills. Carpet with low VOC emissions should only be selected. Pre-conditioning can help t reduce the strength of the emissions. Adequate ventilation should be continuously provided until emissions of VOCs have reduced to acceptable levels.	Carpet which has been pre-conditioned and is not laid with mechanical fixings rather than adhesives is recommended.	finishes, construction ventilation, pre-conditioning		-3	-2	-2	0	0

				d	linoleum	Vapour impervious materials should not be laid over concrete until the concrete is thoroughly dried as this can trap moisture under the floor cover. This can lead both to the propagation of fungi and deterioration of the finishing material and release o VOCs. Linoleum will release significantly less VOCs have PVC based resilient floor finishing materials. Pre-conditioning of the materials can help to reduce VOC emissions. However adequate ventilation is still required until the emissions of VOCs have reduced to acceptable levels. Floor polishing products will emit VOCs after application and provision within the building's ventilation system should b made for at least 2 air changes per hour coincidental with floor polishing.	Linoleum is recommended for situations requiring a resilient floor material. Care is required to protec linoleum from excessive wetting.	finishes, construction ventilation, pre-conditioning	Potential indoor source of VOCs.	-2	0	-1	0	0

				e	PVC sheet or tile	PVC is a significant source of VOCs including formaldehyde. Materials witl low emissions of VOCs should only b selected. Pre-conditioning can also help to reduce the strength of the emissions. Adequate ventilation should be provided continuously until the release of VOCs have reduced to acceptable levels. Floor polishing products will emit VOCs after application and provisions in within th building's ventilation system should b made for at least 2 air changes per hour coincidental with floor polishing.	PVC flooring is not recommended.	construction ventilation, pre-conditioning	Potential indoor source of VOCs.	-3	0	0	0	0
I	Fl	4	Will the floor finishing material be laid directly over a concrete substrate?	a	over a raised floor	A ventilated cavity will allow the concrete substrate to continue to dry.	Raised floors are recommended.		No detriment to the IAQ	0	0	2	0	0
				b	directly over the structural slab	Moisture from green concrete under floor finishing materials is a risk of deterioration of the materials which can lead to the release of VOCs and microbiological contamination.	Thorough drying of the concrete prior to laying of floor finishes is recommended.	construction ventilation	Potential source of microbial contamination.					
				c	concrete slab with a casein screed topping.	The casein binder in screeds can react with the alkaline environment and moisture from the concrete substrate and release ammonia. As screeds cover a very large area they are proportionately a significant sourc of pollutants and should be avoided. Laser levelling and other construction techniques to level neat concrete floors are preferred.	Screeds are not recommended	construction ventilation	Potential source of VOCs and gaseous pollutants.	-2	0	0	-3	0

				d	concrete with a polymer screed topping.	Most polymer screed materials are strong sources of VOCs. As screeds cover a very large area they are proportionately a significant source of pollutants and should be avoided. Laser levelling and other construction techniques to level neat concrete floors are preferred.	Screeds are not recommended	construction ventilation	Potential source of VOCs and gaseous pollutants.	-3	0	0	-2	0
I	FI	5	The time lapsed between pouring of new concrete and laying the carpet will be:	a	90 days or more	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous floor finishes, such as carpet, if these are laid before the concrete has dried. Moisture absorbed into the floor finishes can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to laying of floor finishes is recommended.		No detriment to the IAQ.	0	0	3	0	0
				b	60 - 90 days	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous floor finishes, such as carpet, if these are laid before the concrete has dried. Moisture absorbed into the concrete can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to laying of floor finishes is recommended.		No detriment to the IAQ.	0	0	2	0	0

				c	less than 60 days	Newly poured concrete takes up to 7-10 years to fully release the construction moisture. However the bulk of the moisture will have evaporated in 60 days given dry weather conditions. Free moisture can be absorbed into porous floor finishes, such as carpet, if these are laid before the concrete has dried. Moisture absorbed into the concrete can lead to favorable habitats for fungi, dustmites etc..	Thorough drying of the concrete prior to laying of porous finishes is recommended.	construction ventilation	Potential source of moisture and microbial contamination.	0	0	-1	0	0
		6	Will the carpet fibre be:	a	wool	Wool fibres can adsorb and lock in formaldehyde from the room air and are preferable to synthetic fibres.	Wool or wool rich carpets are recommended.		Potential reduction in VOCs	2	0	0	0	0
				b	synthetic	Wool fibres can adsorb and lock in formaldehyde from the room air and are preferable to synthetic fibres.	Wool or wool rich carpets are recommended.		Potential source of VOCs.	-1	0	0	0	0
		7	Will the floor finishing material be fixing with:	a	mechanical fixings	Mechanical mixing systems should be specified rather than adhesives. The carpet should be covered for the remainder of the construction period t prevent the absorption and eventual r release of VOCs from other construction sources.	Mechanical fixings systems are recommended.	carpet protection	No detriment to the IAQ.	0	0	0	0	0
				b	adhesives	Adhesives are a strong source of VOCs by both the area and strength of emissions.	Adhesives are not recommended.		Potential source of VOCs.	-3	0	0	0	0

		8	Will the carpet be pre-conditioned prior to installation?	a	yes, unrolled and aired for 6 weeks in a well ventilated and dry warehouse	Carpet is a strong source of VOCs such as 4-PC and formaldehyde. Solvents are emitted from the backing and adhesives at higher concentrations than the fibres. Most VOCs from carpets typically decay to 1/10 of their initial concentration withi 6 weeks of exposure to the air. The carpet should be covered for the remainder of the construction period t prevent the absorption and eventual r release of VOCs from other construction sources.	Pre-conditioning of carpet is highly recommended.	carpet protection	Reduction in VOCs	3	0	0	0	0
				b	no	Carpet is a strong source of VOCs such as 4-PC and formaldehyde. Solvents are emitted from the backing and adhesives at higher concentrations than the fibres. Most VOCs from carpets typically decay to 1/10 of their initial concentration withi 6 weeks of exposure to the air. These emissions will be released into the room space unless pre-conditioned off site.	Pre-conditioning of carpet is highly recommended.	carpet protection	Potential source of VOCs.	-3	0	0	0	0

		9	Will the carpet be covered with protective plastic sheeting during the remainder of the construction period.	a	yes	Covering the carpet will trap in emissions of free VOCs from the carpet fibre, backing and fixing. However it will also protect it from construction dirt and moisture which could lead to microbial contamination. Carpet has been found to be a stronger sink of VOCs than most other building materials. As carpets have a very large surface area per un mass, VOCs from other construction sources can readily be absorbed into the intrafibre spaces and adsorbed into the voids between the fibres. Sorbed VOCs can be released at a latter date into the room air. Covering the carpet during the construction period can isolate the carpet from some of the short term high emissions of VOCs from other construction materials.	Covering the carpet is recommended.	pre-conditioning		3	0	0	0	0

				b	no	Covering the carpet will trap in emissions of free VOCs from the carpet fibre, backing and fixing. However it will also protect it from construction dirt and moisture which could lead to microbial contamination Carpet has been found to be a stronger sink of VOCs than most other building materials. As carpets have a very large surface area per un mass, VOCs from other construction sources can readily be absorbed into the intrafibre spaces and adsorbed into the voids between the fibres. Sorbed VOCs can be released at a latter date into the room air. Covering the carpet during the construction phase can isolate the carpet from some of the short term high emission of VOCs from other materials.	Covering the carpet is recommended.			-3	0	0	0	0
I	Fl	10	Will the carpet be laid ove underlay?	a	no	Underlays can be an additional sourc of VOCs from both the additional materials and the adhesive fixing. This can be a significant source of VOCs as the floor represent s a large surface area. Increased softness underfoot can alternatively be achieved by increasing the depth and density of carpet pile. Emitting a laye of foam underlay can reduce the VOC emissions from the flooring material.	Installation of carpet without underlay is recommended.		No detriment to the IAQ	0	0	0	0	0

				b	yes, natural fel or jute underlay	Felt or jute underlays can give some softness and increased sound adsorption to carpeting, without strong emissions of VOCs. These should only be installed over a subfloor with a very low moisture content.	Felt or jute underlay is recommended.	construction ventilation, concrete drying	Potential indoor source of VOCs	1	0	0	0	0
				c	yes, synthetic foam underlay	Most synthetic foam underlays are significant sources of VOCs. They also generally need to be adhesive fixed to prevent movement which will also contribute significantly to the emissions of VOCs. Increased softness underfoot can alternatively b achieved by increasing the depth and density of carpet pile.	Synthetic foam underlays are not recommended.	construction ventilation, concrete drying	Potential indoor source of VOCs.	3	0	0	0	0
I	FI	11	Will the carpet be fixed with:	a	mechanical fastenings, such as Velcro or magnetic strips	Mechanical fastenings do not emit VOCs of other pollutants into the roon air.	Mechanical fastenings are recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	adhesive	Carpet adhesives are a very strong source of VOCs emissions. They can react with the plasticiser in some carpet backing's and cause some undesirable compounds. Carpet adhesives emit VOCs high concentrations for about 6 weeks, then at a declining rate for up to 24 months. The emission rate increases when indoor temperature rise and when the carpet is warmed by direct solar radiation.	Adhesive fixing of carpet is not recommended.	construction ventilation, ventilation	Potential indoor source of VOCs.	-3	0	0	0	0

				c	double glued, ie. a adhesive fixed layer of underlay with an adhesive fixed layer of carpet	Carpet adhesives are a very strong source of VOCs emissions. They can react with the carpet backing and cause some undesirable compounds. Carpet adhesives emit VOCs high concentrations for about 6 weeks, then at a declining rate for up to 24 months. The emission rate increases when indoor temperature rise and when the carpet is warmed by direct solar radiation.	Double stuck carpet is not recommended	construction ventilation, ventilation	Potential indoor source of VOCs.	-3	0	0	0	0
		12	Will the carpet be installed in entrance areas:	a	no	Carpet can collect tracked in soil and which can contain, pesticides, lead and other toxic compounds. These can be subsequently released into the indoor air. Moisture can also be tracked in.	Installation of non-porous, easily cleaned materials in all entrance ways is recommended.	entrances, walk off mats	No detriment to the IAQ.	0	0	0	0	0
				b	yes	Carpet can collect tracked in soil and which can contain, pesticides, lead and other toxic compounds. These can be subsequently released into the indoor air.	Installation of porous materials in the entrance ways is not recommended.	entrances, walk off mats	Potential sink for particulate matter.	0	-2	-3	0	0
		13	Will the carpet be installed around refreshment areas?	a	no	Overflowed or split water and refreshments in combination with organic material can create a very favourable environment for fungi, bacteria etc to propagate. Areas which are prone to moisture should be installed with non-porous, easily cleaned materials.	Installation of non-porous, easily cleaned materials around all refreshment areas is recommended		No detriment to the IAQ.	0	0	0	0	0

				b	yes	Overflowed or split water and refreshments in combination with organic material can create a very favourable environment for fungi, bacteria etc to propagate. Areas which are prone to moisture should b installed with non-porous, easily cleaned materials.	Installation of non-porous, easily cleaned materials around all refreshment areas is recommended.		Potential source of microbiological contamination.	0	0	-2	0	0
			Walls and Partitions (W)											
I	W	1	Are the walls constructed from:	a	steel stud	Steel stud does not emit VOCs, particles or readily harbour microbes.	Steel stud is recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	timber framing	Newly milled timber can take up to 12 months to release all moisture. However the bulk of the moisture will have dried within 60 days given dry, warm weather conditions. Moisture within the timber can form a favourable habitat for fungi, and can conduct moisture to adjacent materials.	Timber should be thoroughly dried to less than 18% moisture content prior to being brought into the building. Linings, insulation or finishing materials should not be applied over wet timber.		No detriment to the IAQ.	0	0	0	0	0
				c	plywood, wood particles or cellulose fibre panels	Particle board, ply wood and other cellulose based products are usually bound with urea formaldehyde based resins, They are strong sources of VOCs for at least the first 12 months of the life of the material. As the walls constitute a very large surface area o the building they represent a strong source of VOC emissions. Pre-conditioning of the material can help t reduce the strength of the emissions.	Particle board is not recommended.	ventilation, pre-conditioning	Potential indoor source of VOCs	-3	0	0	0	0

I	W	2	Are the walls lined with:	a	Gypsum plaster board	Gypsum plaster board has negligible emissions of VOCs. As it is oven cured it has a very low moisture content at the time of manufacture. Care needs to be taken to ensure it is kept dry during construction. It will absorb moisture from adjacent materials such as wet framing. Handling of the sheets, plastering and sanding can produce high concentrations of particle matter during the construction period and the area should be well ventilated directly to the outdoors during this period. Plaster wall board is a moderate strength sink for VOCs from other construction products and adequate ventilation should be provided to remove these VOCs from the room air and interrupt the sink/ re-release process.	Gypsum linings are recommended.	construction ventilation	Potential indoor source of particulate matter. Potential sink of VOCs.	-1	-1	0	0	0
				b	solid wood panels	Newly milled timber can take up to 12 months to release all moisture. However the bulk of the moisture will have dried within 60 days given dry, warm weather conditions. Moisture within the timber can form a favourable habitat for fungi, and can conduct moisture to adjacent materials.	Timber should be thoroughly dried to less than 18% moisture content prior to being brought into the building. Linings, insulation or finishing materials should not be applied adjacent to wet timber as these will absorb free moisture from the timber. Timber finishes should have low VOC emissions.	finishes	Potential source of VOCs.	-1	0	0	0	0

				c	wood particle boards or cellulose fibre panels	Particle board, ply wood and other cellulose based products are usually bound with urea formaldehyde based resins, They are strong sources of VOCs for at least the first 12 months of the life of the material. As the walls constitute a very large surface area of the building they represent a strong source of VOC emissions. Pre-conditioning of the material can help to reduce the strength of the emissions.	Particle boards and cellulose fibre panels are not recommended.	ventilation, pre-conditioning	Potential indoor source of VOCs.	-3	0	0	0	0
				d	high pressure plastic laminate	High pressure plastic laminate boards can release moderate emissions of mainly phenol compounds. They are a moderate source of VOCs for at least the first 12 months of the life of the material. As the walls constitute a large surface area of the building, they represent a significant source of VOC emissions. Pre-conditioning of the material can help to reduce the strength of the emissions.	High pressure plastic laminated panels are not recommended except in wet areas.	ventilation, pre-conditioning	Potential indoor source of VOCs.	-2	0	0	0	0
I	W	3	Are the architraves made from:	a	self facing windows and doors				No detriment to the IAQ.	0	0	0	0	0
				b	powder coated aluminium	The powder coating process drives of most of the emissions from the paint finish, consequently there are very low emissions of VOCs.	Powder coated aluminium is recommended.		No detriment to the IAQ.	0	0	0	0	0

				c	wood	Newly milled timber can take up to 12 months to release all moisture. However the bulk of the moisture will have dried within 60 days given dry, warm weather conditions. Moisture within the timber can form a favourable habitat for fungi, and can conduct moisture to adjacent materials.	Timber should be thoroughly dried to less than 18% moisture content prior to being brought into the building. Linings, insulation or finishing materials should not be applied adjacent to wet timber as these will absorb free moisture from the timber. Timber finishes should have low VOC emissions.	construction ventilation, finishes	No detriment to the IAQ.	0	0	0	0	0
				d	medium density fibre board	Medium density fibre board is usually bound with urea formaldehyde based resins, They are strong sources of VOCs for at least the first 12 months of the life of the material. Although the architraves are only a small surface area of the building, they can represent a significant source of VOC emissions. Pre-conditioning of the material can help to reduce the strength of the emissions.	Medium density fibre board architraves are not recommended.	ventilation, pre-conditioning	Potential indoor source of VOCs.	-3	0	0	0	0
I	W	4	Are the skirtings made from:	a	powder coated aluminium	The powder coating process drives off most of the emissions from the paint finish, consequently there are very low emissions of VOCs.	Powder coated aluminium is recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	wood	Newly milled timber can take up to 12 months to release all moisture. However the bulk of the moisture will have dried within 60 days given dry, warm weather conditions. Moisture within the timber can form a favourable habitat for fungi, and can conduct moisture to adjacent materials.	Timber should be thoroughly dried to less than 18% moisture content prior to being brought into the building. Linings, insulation or finishing materials should not be applied adjacent to wet timber as these will absorb free moisture from the timber. Timber finishes should have low VOC emissions.	finishes	No detriment to the IAQ.	0	0	0	0	0

				c	medium density fibre board	Medium density fibre board is usually bound with urea formaldehyde based resins, They are strong sources of VOCs for at least the first 12 months of the life of the material. Although th skirtings are only a small surface area of the building, they can represent a significant source of VOC emissions. Pre-conditioning of the material can help to reduce the strength of the emissions.	Medium density fibre board architraves are not recommended.	ventilation, pre-conditioning	Potential indoor source of VOCs.	-3	0	0	0	0
I	W	5	Are the wall linings fixed with:		mechanical means eg screws, nails or hot pressing	Mechanical fixings emit only negligible quantities of VOCs.	Mechanical means of fixings wall linings is recommended.		No detriment to the IAQ.	0	0	0	0	0
					glue	Glue fixing systems will emit VOCs into the room air and contribute to the total internal VOC concentration.	Mechanical means of fixings wall linings is recommended.	ventilation, construction ventilation	Potential indoor source of VOCs.	-2	0	0	0	0
I	W	6	Are the walls insulated with:	a	wool or dacron batts or blanke	Wool and dacron insulation provides an emission free insulation product. Mechanical fixings, eg stapling to the structure is necessary to prevent the insulation from slumping and reducing the performance.	Wool or dacron insulation is recommended.			0	0	0	0	3
				b	fibreglass batts or blanket	Fibreglass insulation is frequently impregnated with phenol or urea-formaldehyde resins to improve rigidit and handling properties. These can be released, especially if moisture is present. Insulation can represent a significant source of indoor VOCs as they constitute a large surface area.			Potential indoor source of VOCs.	-1	0	0	0	3

				c	mineral wool batts or blanke	Mineral fibre insulation is frequently impregnated with phenol or urea-formaldehyde resins to improve rigidit and handling properties. Some fibres are also coated with oils to improve moisture resistance. These can released VOCs into the room air, especially if moisture is present. Insulation can represent a significant source of VOCs as they constitute a large surface area.			Potential indoor source of VOCs.	-2	0	0	0	3
				d	blown mineral wool	Mineral fibre insulation is frequently impregnated with phenol or urea-formaldehyde resins to improve rigidit and handling properties. Some fibres are also coated with oils to improve moisture resistance. These can released VOCs into the room air, especially if moisture is present. Insulation can represent a significant source of VOCs as they constitute a large surface area. Blown mineral wool sheds large quantities of particulate matter. Stray mineral woo particles can be communicated to the room areas via small gaps in and around the wall joints and penetration	Blown mineral wool is not recommended		Potential indoor source of VOCs and particulate matter.	-2	0	0	0	3
I	W	7	Do the partitions extend through the return air plenum for acoustic privacy?	a	no	Partitioning the return air plenum can restrict the removal of return air and consequently limit the quantity of supply air that can be delivered to the space.	Partitioning systems which don't interfere with the return or supply ai reticulation systems are recommended.		No detriment to the IAQ.	0	0	0	0	0

				b	yes	Partitioning the return air plenum can restrict the removal of return air and consequently limit the quantity of supply air that can be delivered to the space.	Partitioning systems which don't interfere with the return or supply ai reticulation systems are recommended.	air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
I	W	8	Will the interior partitions be designed so they can be relocated without making or leaving holes in between the return air plenum and occupied space?	a	yes	Holes between the occupied space and return air plenum will draw air through these openings at the expense of more distance return air grills. This will deprive spaces more distance from the core from the intended quantity of supply air.	Partitioning systems which don't interfere with the return or supply ai reticulation systems are recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	no	Holes between the occupied space and return air plenum will draw air through these openings at the expense of more distance return air grills. This will deprive spaces more distance from the core from the intended quantity of supply air.	Partitioning systems which don't interfere with the return or supply ai reticulation systems are recommended.	air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
I	W	9	Will the wall partitions extend from slab to slab?	a	no	Walls within the return air plenum restrict the flow of air and reduce the quantity of air that can be supplied to the occupied areas.	Slab to slab partitions are not recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	yes	Walls within the return air plenum restrict the flow of air and reduce the quantity of air that can be supplied to the occupied areas.	Slab to slab partitions are not recommended.	air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
			Ceiling and Ceiling Void (CI)											

I	CI	1	Is the floor to ceiling height:	a	above 3.5m	A floor to ceiling height above 3.5m can lead to problem with stratification of the room air and poor mixing of the air supply. Locating the air supply at floor level will help to prevent stratification of the room air. It does however have a large volume of air to allow contaminants to dissipate.	A floor to ceiling height between 2.7 and 3.5m is recommended. Locating the air supply at floor level is also recommended.	air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants, but opportunities for dissipation of pollutants.	1	1	1	1	-1
				b	2.7m - 3.5m	A floor to ceiling height between 2.7m and 3.5m has sufficient volume of air to allow for some dissipation of contaminants. It is not so high that stratification of the room air is generally a significant problem.	A floor to ceiling height between 2.7 and 3.5m is recommended.		Opportunity for dissipation of pollutants.	3	3	3	3	3
				c	less than 2.7m	Ceiling heights less than 2.7m have been associated with SBS. There is frequently insufficient volume of room air to allow for the dissipation of contaminants. Further the affect which tall furniture items, such as screens and shelving, have on disabling room air mixing tends to be more pronounced than for rooms with a higher stud, which can result in stale air and difficulties with air exchange.	A floor to ceiling height between 2.7 and 3.5m is recommended. However if a lower stud height is necessary then care should be taken to ensure air exchange efficiency is high.	air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2

I	CI	2	Will the ceiling void be installed with:	a	wet fire protection devices	Wet fire protection devices can leak during the life of the building. Small leaks can go undetected for prolonge periods and wetted materials can create a ripe environment for microbia contamination. Care should be taken to install or form all joints between components with utmost care. Thorough pressure testing of all joints should be undertaken before the building is commissioned.	Care should be taken in the installation and testing of all wet fire protection systems.		Potential indoor source of microbial contaminants.	0	0	-2	0	0
				b	uncoated insulation materials	Fine particles can be liberated from loose insulation material and enter the occupied areas.	Loose insulation material is not recommended in suspended ceilings.		Potential indoor source of particulate matter and VOCs. Potential sink for VOCs.	-1	-3	0	0	0
I	CI	3	Will the ceiling tiles be made from:	a	gypsum plaster	Gypsum plaster has negligible emissions of VOCs. As it is oven cured it has a very low moisture content at the time of manufacture. Care needs to be taken to ensure it is kept dry during construction. It will absorb moisture from adjacent materials. Handling of the tiles or sheets, plastering and sanding can produce high concentrations of particle matter during the construction period and the area should be well ventilated directly to the outdoors during this period. Factory finished tiles are recommended. As they cove a large area they can represent a larg pollutant load	Gypsum plaster ceilings are recommended.	construction ventilation	Potential indoor source of particulates. Potential sink for VOCs.	-2	-2	0	0	0

				b	powder coated aluminium	The powder coating process drives off most of the emissions from the paint finish, consequently there are very low emissions of VOCs.	Powder coated aluminium ceiling panels/ tiles are recommended.		No detriment to the IAQ.	0	0	0	0	0
				c	fibreglass tiles or panels	Fibreglass ceiling tiles and panels are frequently impregnated with phenol or urea-formaldehyde resins to improve rigidity and handling properties. These can be released, especially if moisture is present. The ceiling materials can represent a significant source of indoor VOCs as they constitute a large surface area. Fibreglass tiles are light weight and prone to vibration with fluctuations in the room or plenum air pressure. This can release particles from the tiles themselves or particles settled on the tiles.	Fibreglass panels are not recommended below ceiling plenums.	ventilation, pre-conditioning, VOC sink, plenums	Potential indoor source of VOCs and particulates. Potential sink for VOCs.	-3	-3	0	0	0
				d	cellulous fibre boards or tiles	Cellulous fibre board is usually bound with urea formaldehyde based resins. They are strong sources of VOCs for at least the first 12 months of the life of the material. The ceiling materials can represent a significant source of indoor VOCs as they constitute a large surface area. Pre-conditioning of the material can help to reduce the strength of the emissions.	Cellulous fibre board ceiling tiles or panels are not recommended.	ventilation, pre-conditioning, VOC sink, plenums	Potential indoor source of VOCs and particulates. Potential sink for VOCs.	-3	-3	0	0	0

I	CI	4	Will the ceiling tiles be installed prior to all concentrations of VOCs from other construction materials such as finishes and furnishings decaying to below acceptable levels?	a	no	Plaster, fibreglass and wood fibre tiles are a moderate sink for VOCs emitted from other construction products. If the ceiling void is used as a return air plenum, then the tiles can be exposed to the VOCs in the return air stream. Sealing the top face of porous tiles will reduce the potential for VOC sorbtion. Careful selection of low VOC emitting materials and adequate ventilation are required to dilute these VOCs and interrupt the sorbtion/re-release process.			No detriment to the IAQ.	0	0	0	0	0
				b	yes	Plaster, fibreglass and wood fibre tiles are a moderate sink for VOCs emitted from other construction products. If the ceiling void is used as a return air plenum, then the tiles can be exposed to the VOCs in the return air stream. Sealing the top face of porous tiles will reduce the potential for VOC sorbtion. Careful selection of low VOC emitting materials and adequate ventilation are required to dilute these VOCs and interrupt the sorbtion/re-release process.	Sealing all faces of the ceiling tiles to prevent sorption of VOCs from other materials is recommended.	construction ventilation, ventilation, VOC interactions	Potential sink for VOCs.	-3	0	0	0	0

I	CI	5	Will spare ceiling tiles be purchased and stored in the building at the time of construction?	a	yes	Ceiling tiles which become damp through out the life of the building can rapidly incubate fungi. As well as addressing the source of the moisture water damaged tiles should be immediately replaced. Also tiles whic become damaged, perforated or cut due to relocation of partitions or services can create imbalances and short circuiting of the ventilation system. Incomplete tiles should be replaced immediately.	Maintaining a stock of spare matching tiles within the building to replace water damaged tiles is recommended.			0	0	2	0	0
	CI			b	no	Ceiling tiles which become damp through out the life of the building can rapidly incubate fungi. As well as addressing the source of the moisture water damaged tiles should be immediately replaced. Also tiles whic become damaged, perforated or cut due to relocation of partitions or services can create imbalances and short circuiting of the ventilation system. Incomplete tiles should be replaced immediately.	Maintaining a stock of spare matching tiles within the building to replace water damaged tiles is recommended.			0	0	-2	0	0
			Finishes (FI)											

I	FI	1	Will interior surfaces be finished with:	a	water- based paint	Water-based paints do not emit major quantities of organic substances, however their emissions can continue at low levels for 12 months. Continuous ventilation directly to the outdoors is required until all emissions have decayed to acceptable levels. A paint finishes typically cover a large surface area, they constitute a significant source of VOCs. Adequate ventilation is required during the construction period to protect the construction personnel and interrupt the adsorption of VOCs by other materials, especially in the first 30 days following application. Moisture in the paint can support fungi growth and the paint should be dried out as soon as possible.	Water based paints are recommended.	construction ventilation, ventilation, VOC interactions	Potential source of VOCs and microbial contamination.	-2	0	0	0	0

					b	solvent-based paint	Solvent-based paints release large quantities of VOCs within approximately two weeks of application. Emissions rapidly decay after the first 6 weeks. As paints can cover a large surface area, they constitute a significant source of VOCs. Adequate ventilation during the construction period is required to protect the construction personnel, and interrupt the adsorption of VOCs to other materials. Joinery and furnuiture components which are to be finished with these materials should be finished offsite and pre-conditioned prior to delivery.	Solvent based paints with adequate ventilation directly to the outdoors are recommended.	construction ventilation, VOC interactions	Potential source of VOCs.	-3	0	0	0	0
					c	epoxy paints	Epoxy paints can have low chemical emissions once cured, however they can trigger allergic reactions in sensitive people during application. As paint finishes typically cover a large surface area, they constitute a significant source of VOCs. Adequate ventilation is required during the construction period to protect the construction personnel and interrupt the adsorption of VOCs to other materials. Joinery and furnuiture components which are to be finished with these materials should be finished offsite and pre-conditioned prior to delivery.	Epoxy paints are not recommended.	Construction ventilation, moisture sources, ventilation, pre-conditioning	Potential source of VOCs.	-3	0	0	0	0

				d	vinyl wall covering	Vinyl wall covering can act as a vapou barrier and prevent construction moisture and moisture which has migrated into the wall from escaping. This frequently causes fungi growth within the wall structure. Vinyl wall coverings and their adhesives can also release VOCs for the first 12 months of the product being exposed to the air. Pre-conditioning can be useful in reducing the strength of the VOC emissions.	Vinyl wall coverings are not recommended except over well dry substrates in humid areas.	Construction ventilation, moisture sources, ventilation, pre-conditioning	Potential source of VOCs and microbial contamination.	-2	0	0	0	0
				e	two part conversion varnishes	Conversion varnishes have been shown to emit 2-8 times more formaldehyde than present in the original formulation. Net production of formaldehyde can result from the chemical reactions during curing and aging. These emissions have a prolonged decay rate. Joinery and furnulture components which are to b finished with these materials should be finished offsite and pre-conditione prior to delivery.	Conversion varnishes are not recommended.	Construction ventilation, moisture sources, ventilation, pre-conditioning	Potential source of VOCs.	-3	0	0	0	0
				f	isocyanide paints	Isocyanide paints release large quantities of VOCs including cyanide vapours. These represent a considerable risk to the construction personnel and to a much lesser exten the occupants. Joinery and furnulture components which are to be finished with these materials should be finished offsite and pre-conditioned prior to delivery.	Isocyanide paints are not recommended.	Construction ventilation, moisture sources, ventilation, pre-conditioning	Potential source of VOCs.	-3	0	0	0	0

I	Fi	2	Will wet process finishing materials be used?	a	wall paper with water based adhesives	Wet construction processes should be thoroughly dried as soon as possible. Free water could create a favourable habitat for fungi etc to proliferate. As they cover a large area they can represent a large pollutant load. Adequate ventilation should be provided during this period, especially the first 30 days following application.	Thorough drying of the affected materials immediately after each stage of the process is recommended. Adequate dilution ventilation should be provided durin this period, especially the first 30 days following application.	Construction ventilation	Potential source of moisture and microbial contamination.	0	0	-2	0	0
				b	site applied plaster	Wet construction processes should be thoroughly dried as soon as possible. Free water could create a favourable habitat for fungi etc to proliferate. As they cover a large area they can represent a large pollutant load. Adequate ventilation should be provided during this period, especially the first 30 days following application.	Thorough drying of the affected materials immediately after each stage of the process is recommended.	Construction ventilation	Potential source of moisture and microbial contamination.	0	0	-2	0	0
			Pre-conditioning (Pc)											
I	Pc	1	Are these products pre-conditioned prior to delivery and installation in the building?	a	yes	The largest concentrations of VOCs are emitted from most products within the first six weeks of exposure to air. Pre-conditioning the products away from the building can significantly reduce the concentration of VOCs released into the building by new construction materials and furnishings. Materials should be pre-conditioned in a well ventilated warehouse prior to delivery to site.	Pre-conditioning is recommended.		Potential reduction in VOCs.	3	0	0	0	0

				b	no	The largest concentrations of VOCs are emitted from most products within the first six weeks of exposure to air. Pre-conditioning the products away from the building can significantly reduce the concentration of VOCs released into the building by new construction materials and furnishings.	Pre-conditioning is recommended.			-3	0	0	0	0
I	Pc	2	Are the products unpacked and separated so that all surfaces can be exposed to air prior to delivery to the site?	a	yes, products exposed on all sides to the air	Increasing the surface area of the products exposed to the air will increase the rate of VOC emissions. Exposing products on all major faces to the air will significantly increase the rate of emissions.	Exposing the product to the air on a faces is recommended.		Potential to reduce VOCs.	3	0	0	0	0
					yes, one large face of the product exposed to the air	Increasing the surface area of the products exposed to the air will increase the rate of VOC emissions.	Exposing the product to the air on a faces is recommended.		Potential to reduce VOCs.	1	0	0	0	0
				b	no	Pre-conditioning will not be as effective for products which are stacked or only partially exposed to th air.	Exposing the product to the air on a faces is recommended.		No reduction in VOCs.	0	0	0	0	0
I	Pc	3	Are the products pre-conditioned in a clean and dry area?	a	yes	Pre-conditioning should be undertake in clean and dry premises to prevent to products from dampness or soiling. As this could lead to microbial contamination of the product.	Clean and dry premises are recommended.			2	0	0	0	0
				b	no	Pre-conditioning should be undertake in clean and dry premises to prevent to products from dampness or soiling. As this could lead to microbial contamination of the product.	Clean and dry premises are recommended.		Potential source of moisture and microbial contamination.	0	0	-2	0	0

I	Pc	4	Will the temperature of the storage area be above 24 deg C.?	a	yes	Increasing the temperature of the pre-conditioning area to above 24 deg C. for the majority of the airing period will significantly increase the rate at which VOC are emitted from the product.	Maintaining a temperature above 24 deg C is recommended.		Potential reduction o VOCs.	3	0	0	0	0
				b	no	Increasing the temperature of the pre-conditioning area to above 24 deg C. for the majority of the airing period will significantly increase the rate at which VOC are emitted from the product.	Maintaining a temperature above 24 deg C is recommended.			0	0	0	0	0
I	Pc	5	Will the air exchange rate in the storage area be in excess of the equivalent of 2 ACH at 100% fresh air?	a	yes	Ventilation with fresh air will remove VOCs from the pre-conditioning area as they are emitted. A low concentration of VOCs in the surrounding air will significantly increase the rate at which VOCs are emitted from the product.	Ventilation equivalent to 2ACH with 100% fresh air is recommended.		Potential reduction o VOCs.	3	0	0	0	0
				b	no	Ventilation with fresh air will remove VOCs from the pre-conditioning area as they are emitted. A low concentration of VOCs in the surrounding air will significantly increase the rate at which VOCs are emitted from the product.	Ventilation equivalent to 2ACH with 100% fresh air is recommended.			0	0	0	0	0
I	Pc	6	Will the products be pre-conditioned for:	a	4 or more weeks	The largest concentrations of VOCs are emitted from most products within the first six weeks of exposure to air. Pre-conditioning the products for four or more weeks can significantly reduce the concentration of VOCs remaining in the materials.	Pre-conditioning in excess of 4 weeks is recommended.		Potential reduction o VOCs.	3	0	0	0	0

				b	2-4 weeks	The largest concentrations of VOCs are emitted from most products within the first six weeks of exposure to air. Pre-conditioning the products for four or more weeks can significantly reduce the concentration of VOCs remaining in the materials.	Pre-conditioning in excess of 4 weeks is recommended.		Potential reduction o VOCs.	2	0	0	0	0
				c	less than 2 weeks	The largest concentrations of VOCs are emitted from most products within the first six weeks of exposure to air. Pre-conditioning the products for four or more weeks can significantly reduce the concentration of VOCs remaining in the materials.	Pre-conditioning in excess of 4 weeks is recommended.			0	0	0	0	0
I	Pc	7	Are the products shipped in gas permeable materials?	a	yes	Gas permeable materials will allow th VOC off-gassing process to continue during shipping.	Gas permeable packaging is recommended.		Potential reduction o VOCs.	2	0	0	0	0
				b	no	Gas permeable materials will allow th VOC off-gassing process to continue during shipping.	Gas permeable packaging is recommended.			0	0	0	0	0
			Furniture & Fittings (Ft)											
I	Ft	1	Is furniture designed to prevent dust and debris accumulating under and behind units?	a	yes	Accumulated dust and debris can be sink for VOCs, absorb moisture and create a host environment for microbial colonies. Dust particles ca be resuspended into the breathing zone.	Furniture should be designed for easy cleaning around and under.			0	3	0	0	0

				b	no	Accumulated dust and debris can be a sink for VOCs, absorb moisture and create a host environment for microbial colonies. Dust particles can be resuspended into the breathing zone.	Sites where dust and debris can accumulate should be avoided			0	-2	0	0	0
I	Ft	2	Shelving typically covers the equivalent of 50-100% of the total floor area. Will the total area of shelving be:	a	less than 50%	Shelving can be a source of VOCs of concern for both the quantity and strength of the source and proximity to the breathing zone of the occupants'. In most cases the quantity of shelving can not realistically be reduced so attention should be paid to reducing the strength of the toxic emissions. A total system approach needs to be taken to the reduction and mitigation of VOCs emissions.	Materials and finishes with low VOC emissions are recommended.	pre-conditioning, ventilation	Potential source of VOCs.	-2	0	0	0	0
				b	more than 50%	Shelving can be a source of VOCs of concern for both the quantity and strength of the source and proximity to the breathing zone of the occupants'. In most cases the quantity of shelving can not realistically be reduced so attention should be paid to reducing the strength of the toxic emissions. A total system approach needs to be taken to the reduction and mitigation of VOCs emissions.	Materials and finishes with low VOC emissions are recommended.	pre-conditioning, ventilation	Potential source of VOCs.	-3	0	0	0	0

I	Ft	3	Are books and papers stored on open shelves?	a	no, enclosed cabitents only	The "Shelf Factor", the ratio of open shelving to room area has been found to be an indicator of building health problems, possibly due to sorption/re-release of VOCs or shedding/resuspension of particles.	Enclosed cabinets are recommended.		No detriment to IAQ	0	0	0	0	0
				b	some	The "Shelf Factor", the ratio of open shelving to room area has been found to be an indicator of building health problems, possibly due to sorption/re-release of VOCs or shedding/resuspension of particles.	Enclosed cabinets are recommended.		Potential source and sink for VOCs and particles.	-1	-2	0	0	0
				c	yes, open shelves	The "Shelf Factor", the ratio of open shelving to room area has been found to be an indicator of building health problems, possibly due to sorption/re-release of VOCs or shedding/resuspension of particles.	Open shelving units are not recommended.		Potential source and sink for VOCs and particles.	-2	-3	0	0	0
I	Ft	4	Is the shelving made from:	a	solid timber	Some solid wood products can emit naturally occurring VOCs, however these tend to be at low concentrations and are generically not of concern. VOCs can be emitted from their finishes which can contribute to concentrations in the room air.	Solid wood components and furniture are recommended if they are finished with low VOCs finishes. The area should also be well ventilated to dilute any VOCs for the first 12 months following installation.	finishes	No detriment to IAQ.	0	0	0	0	0
				b	steel	Steel products emit no VOCs from the base material but VOCs may be released from the finishes depending on the product/system used. Paint finishes which have been baked on, have lower emisisons compared to w applications.	Steel components and furniture are recommended if they are finished with low VOCs finishes. The area should also be well ventilated to dilute any VOCs for the first 12 months following installation.		No detriment to IAQ.	0	0	0	0	0

				c	plywood	Plywood is made from thin sheets and veneers of wood adhered together wit either phenol or urea formaldehyde glues (2-4% by weight). These can emit VOCs including formaldehyde into the room air.	Plywood products are preferable to other types of reconstituted timber products. They should be finished with low VOCs materials and the area should also be well ventilated t dilute any VOCs for the first 12 months following installation.	pre-conditioning, ventilation	Potential source of VOCs.	-2	0	0	0	0
				d	particle board	Particle board is made from wood chips adhered together with urea-formaldehyde resins and other chemical additives (6-10% by weight) The resins emit high concentrations o VOCs for the first 12 months of the products life and low background levels for prolonged periods thereafter	Shelves made from reconstituted wood fibber are not recommended. Alternative products which don't emit VOCs such as steel are preferred.	pre-conditioning, ventilation	Potential source of VOCs.	-3	0	0	0	0
				e	medium density wood fibber board	Medium density fibber board is made from wood fibres adhered together with urea-formaldehyde resins and other chemical additives (8-12% by weight). The resins emit high concentrations of VOCs for the first 12 months of the products life and low background levels for prolonged periods thereafter.	Shelves made from reconstituted wood fibber are not recommended. Alternative products which don't emit VOCs such as steel are preferred.	VOC source control	Potential source of VOCs.	-3	0	0	0	0
I	Ft	5	Will the shelving units be taller than 1500mm?	a	no	Bookshelves above 1500mm high car interfere with the air circulation within the room, especially when the air is supplied from ceiling level. This can lead to "dead" zones of stale air and encourage the supply air to short circuit the occupants' breathing zone.	Shelving units should be 1500mm or lower.		No detriment to the IAQ.	0	0	0	0	0

				b	yes	Bookshelves above 1500mm high can interfere with the air circulation within the room, especially when the air is supplied from ceiling level. This can lead to "dead" zones of stale air and encourage the supply air to short circuit the occupants' breathing zone.	Shelving units should be 1500mm or lower.	ventilation type, air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
I	Ft	6	Workstations typically cover 15-50% of the total floor area. Will the total area of workstations be:	a	less than 30%	Workstations can represent 15-50% of the floor space of an office depending on the occupant density, layout and construction of the furniture. Emissions from workstations are a pollutant of concern for both the quantity and strength of the source and proximity to the breathing zone of the occupants'. In most cases the quantity of workstations can not realistically be reduced so attention should be paid to reducing the strength of the toxic emissions.	Materials and finishes with low VOC emissions are recommended.	ventilation, pre-conditioning	Potential source of VOCs.	-1	0	0	0	0

				b	more than 30%	Workstations can represent 15-50% of the floor space of an office depending on the occupant density, layout and construction of the furniture. Emissions from workstations are a pollutant of concern for both the quantity and strength of the source and proximity to the breathing zone of the occupants'. In most cases the quantity of workstations can not realistically be reduced so attention should be paid to reducing the strength of the toxic emissions.	Materials and finishes with low VOC emissions are recommended.	venitlation, pre-conditioning	Potential source of VOCs.	-2	0	0	0	0
I	Ft	7	Is the furniture made from:	a	solid timber	Some solid wood products can emit naturally occurring VOCs, however these tend to be at low concentrations and are generically not of concern. VOCs can be emitted from their finishes which can contribute to concentrations in the room air.	Solid wood components and furniture are recommended if they are finished with low VOCs finishes. The area should also be well ventilated to dilute any VOCs for the first 12 months following installation	venitlation, pre-conditioning	Potential source of VOCs.	-1	0	0	0	0
				b	steel	Steel products emit no VOCs from the base material but VOCs may be released from the finishes depending on the product/system used.	Steel components and furniture are recommended if they are finished with low VOCs finishes. The area should also be well ventilated to dilute any VOCs for the first 12 months following installation.	venitlation, pre-conditioning	Potential source of VOCs.	-1	0	0	0	0
				c	plywood	Plywood is made from thin sheets and veneers of wood adhered together with either phenol or urea formaldehyde glues (2-4% by weight). These can emit VOCs including formaldehyde into the room air.	Plywood products are preferable to other types of reconstituted timber products. They are should be finished with low VOCs materials and the area should also be well ventilated to dilute any VOCs for the first 12 months following installation	venitlation, pre-conditioning	Potential source of VOCs.	-2	0	0	0	0

				d	chip board	Chipboard is made from cellulose fibber pressed together with small amounts of formaldehyde resin. Chip board often forms the inner layer of desk partitions, and has low emission but low strength.	Chip board products are preferable to other types of reconstituted timber products. The area should also be well ventilated to dilute any VOCs for the first 12 months following installation.	VOC source control	Potential source of VOCs.	-3	0	0	0	0
				e	particle board	Particle board is made from wood chips adhered together with urea-formaldehyde resins and other chemical additives (6-10% by weight) The resins emit high concentrations o VOCs for the first 12 months of the products life and low background levels for prolonged periods thereafte	Shelves made from reconstituted wood fibber are not recommended. Alternative products which don't emit VOCs such as steel are preferred.	VOC source control	Potential source of VOCs.	-3	0	0	0	0
				f	medium density wood fibber board	Medium density fibber board is made from wood fibres adhered together with urea-formaldehyde resins and other chemical additives (8-12% by weight). The resins emit high concentrations of VOCs for the first 12 months of the products life and low background levels for prolonged periods thereafter.	Shelves made from reconstituted wood fibber are not recommended. Alternative products which don't emit VOCs such as steel are preferred.	VOC source control	Potential source of VOCs.	-3	0	0	0	0
I	Ft	8	Will the workstation screens be taller than 1500mm?	a	yes	Workstation screens above 1500mm high can interfere with the air circulation within the room, especially when the air is supplied from ceiling level. This can lead to "dead" zones of stale air and encourage the supply air to short circuit the occupants' breathing zone.	Workstation screens should be 1500mm or lower.		No detriment to the IAQ.	0	0	0	0	0

				b	no	Workstation screens above 1500mm high can interfere with the air circulation within the room, especially when the air is supplied from ceiling level. This can lead to "dead" zones of stale air and encourage the supply air to short circuit the occupants' breathing zone.	Workstation screens should be 1500mm or lower.	ventilation type, air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
I	Ft	9	Do the workstation screens extend to the floor?	a	no	A 100mm or greater gap at the bottom of workstation screens has been found to give a small increase in air circulating around workstations, compared to screens without a gap. A gap at floor level is not as crucial to ventilation effectiveness as correct location of the air supply.	A 100mm gap at the bottom of workstation screens can give a slight increase in air circulation.		No detriment to the IAQ.	0	0	0	0	0
				b	yes	A 100mm or greater gap at the bottom of workstation screens has been found to give a small increase in air circulating around workstations, compared to screens without a gap. A gap at floor level is not as crucial to ventilation effectiveness as correct location of the air supply.	A 100mm gap at the bottom of workstation screens can give a slight increase in air circulation.	ventilation type, air exchange	Potential disturbance of the supply of fresh air and extraction of pollutants.	-2	-2	0	-2	-2
I	Ft	10	Will the furniture items be able to be effectively maintained without the need for cleaning products which emit solvents?	a	yes	Cleaning products can add significant peaks to the indoor concentration levels of VOCs through out the life of the building. Where these cleaning products are applied to the workstations they can slow to dissipate and dilute adding to the concentration of VOCs within the occupant's breathing zone.	Materials which can be cleaned and maintained without solvent emitting cleaning products are recommended.		No detriment to the IAQ.	0	0	0	0	0

				b	no	Cleaning products can add significant peaks to the indoor concentration levels of VOCs through out the life of the building. Where these cleaning products are applied to the workstations they can slow to dissipate and dilute adding to the concentration of VOCs within the occupant's breathing zone.	Materials which can be cleaned and maintained without solvent emitting cleaning products are recommended.		Potential source of VOCs.	-2	0	0	0	0
I	Ft	11	Will textiles be used to cover desk screens or upholster soft furniture?	a	no	Many textiles are treated with chemicals to increase their soiling and wrinkle resistance. These fabric treatments emit formaldehyde and other VOCs.	Textiles without chemical treatment which emit VOCs are recommended.		No detriment to the IAQ.	0	0	0	0	0
				b	yes	Many textiles are treated with chemicals to increase their soiling and wrinkle resistance. These fabric treatments emit formaldehyde and other VOCs.	Textiles without chemical treatment which emit VOCs are recommended.	air change rates, pre-conditioning	Potential source of VOCs.	-2	0	0	0	0
I	Ft	12	Will the VOCs levels from other construction materials have decayed to acceptable levels before the furniture items with textiles are installed in the offices?	a	yes	Textiles, like other porous materials, will adsorb VOCs from the room air and released them back into the room at a later date. This sink process can prolong the occupants' exposure to chemicals especially during the first 12 months of installation of new materials when concentrations can be very high. This also increases the difficulty in removing VOCs from the building.	Textiles should not be installed into the building until VOCs from all sources have decayed to acceptable levels.		No detriment to the IAQ.	0	0	0	0	0

				b	no	Textiles, like other porous materials, will adsorb VOCs from the room air and released them back into the room at a later date. This sink process can prolong the occupants' exposure to chemicals especially during the first 12 months of installation of new materials when concentrations can be very high. This also increases the difficulty in removing VOCs from the building.	Textiles should not be installed into the building until VOCs from all sources have decayed to acceptabl levels.	air change rates, pre-conditioning, VOC interactions	Potential source of VOCs.	-2	0	0	0	0
I	Ft	13	Will VOCs and chemicals levels from other sources, such as inks, correction fluids, environmental tobacco smoke, and pesticides be eliminated or controlled at very low levels throughout the life of the building?	a	yes	Textiles, like other porous materials, will adsorb VOCs from the room air and released them back into the room at a later date. This sink process can prolong the occupants' exposure to chemicals and increase the difficulty in removing VOCs from the building. A continious supply of ventilation can help to reduce the concentration of released VOCs and break the sink cycle.	A continios supply of ventilation is recommended to reduce the concentration of VOCs.		No detriment to the IAQ.	0	0	0	0	0
				b	no	Textiles, like other porous materials, will adsorb VOCs from the room air and released them back into the room at a later date. This sink process can prolong the occupants' exposure to chemicals and increase the difficulty in removing VOCs from the building. A continious supply of ventilation can help to reduce the concentration of released VOCs and break the sink cycle.	A continios supply of ventilation is recommended to reduce the concentration of VOCs.	air change rates, VOC interactions	Potential source of VOCs.	-2	0	0	0	0

I	Ft	14	Will wool be the predominant fibre in the textile.	a	yes	Wool can absorb and permanently lock up formaldehyde, which can reduce the indoor concentrations of one the predominant VOCs of concern.	Woollen textiles are recommended.		Opportunity to reduce VOCs.	2	0	0	0	0
				b	no	Wool can absorb and permanently lock up formaldehyde, which can reduce the indoor concentrations of one the predominant VOCs of concern.	Woollen textiles are recommended.		No detriment to the IAQ.	0	0	0	0	0
I	Ft	15	Can these furniture items be unwrapped and pre-conditioned off site until VOC emissions have decayed to acceptable levels?	a	yes	Pre-conditioning of VOC emitting materials and items in well ventilated areas outside of the subject building can substantially reduce the pollutant load when the materials are eventually installed within the occupied area.	Pre-conditioning of all VOC emitting materials is highly recommended.	pre-conditioning	Opportunity to reduce VOCs.	3	0	0	0	0
				b	no	Pre-conditioning of VOC emitting materials and items in well ventilated areas outside of the subject building can substantially reduce the pollutant load when the materials are eventually installed within the occupied area.	Pre-conditioning of all VOC emitting materials is highly recommended.		Potential source of VOCs.	-3	0	0	0	0
I	Ft	16	Is a suitable quantity of storage provided so that floors and desk tops are not cluttered with files etc.?	a	yes	Papers represent both a source of particulate matter and a sink for VOCs. Clutter also prevents cleaners from being able to discharge their duties effectively.	Adequate storage is recommended		No detriment to the IAQ.	0	0	0	0	0

				b	no	Papers represent both a source of particulate matter and a sink for VOCs. Clutter also prevents cleaners from being able to discharge their duties effectively.	Adequate storage is recommended.		Potential impediment to the removal of particulate matter.	0	-2	0	0	0
			Office Equipment (O)											
I	O	1	Are the photocopiers, fax machines and laser printers located:	a	in rooms separted from other occupied areas	Photocopiers, laser printers, fax machines etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone and heat. To remove localised heat and a contaminants, additional air should be supplied to the surrounding occupied area and return air registers and air extracts should be located above the point source. Air should be extracted at all times when the equipment is operated to maintain this area at a negative pressure relative to surrounding areas. Separation of photocopiers, fax machines and laser printers from other areas of the building can make it easier to contain and remove contaminants at the source.	Laser printers, fax machines and photocopiers should be clustered together and isolated from other occupied parts of the building.		No detriment to IAQ	0	0	0	0	0

				b	clustered in designated areas	Photocopiers, laser printers, fax machines etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone an heat. To remove localised heat and a contaminants, additional air should be supplied to the surrounding occupied area and return air registers and air extracts should be located above the point source. Air should be extracted at all times when the equipment is operated to maintain this area at a negative pressure relative to surrounding areas. Central location o photocopiers, fax machines and laser printers can make it easier to contain and remove contaminants at the source.	Laser printers, fax machines and photocopiers should be clustered together and isolated from other occupied parts of the building.		Potential source of particate matter, VOCs and gaseous pollutants.	-1	-2	0	-1	0

				c	distributed through out the floor	Photocopiers, laser printers, fax machines etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone an heat. To remove localised heat and a contaminants, additional air should be supplied to the surrounding occupied area and return air registers and air extracts should be located above the point source. Air should be extracted at all times when the equipment is operated to maintain this area at a negative pressure relative to surrounding areas. Distribution of photocopiers and laser printers can make it more difficult to contain and remove the contaminants emitted fron these machines and associated activities	Laser printers, fax machines and photocopiers should be clustered together and isolated from other parts of the building.		Potential source of particate matter, VOCs and gaseous pollutants.	-2	-3	0	-2	0
I	O	2	Are the designated photocopier/ fax/ laser printer areas installed with:	a	separate extraction	Photocopiers, fax machines and laser printers etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone an heat. Locating these pieces of office equipment together allows for isolatio and removal of their contaminants. Installation of extracts close to the source will prevent the dissipation of the pollutants.	Containment and extraction of the air from pollutant generating equipment is recommended. The extraction should be as close to the source as practical.		Opportunity to remove particlates, VOCs and gaseous pollutanst at source	1	2	0	1	0

				b	additional return air grills	Photocopiers, laser printers etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone and heat. Additional extraction will contain and remove contaminants at the source but will entrain these into the return ai stream and from where they can be recirculated throughout the building.	Containment and extraction of the air from pollutant generating equipment is recommended.	return air recirculation	Opportunity to remove particiates, VOCs and gaseous pollutanst at source	0	1	0	0	0
				c	no additional provisions for air removal	Photocopiers, fax machines & laser printers etc and associated paper handling can emit VOCs, particulates, gaseous pollutants such as ozone an heat. No additional provision for air extraction will allow contaminants to cross contaminate other occupied areas. A percentage will find their wa back into the return air stream, from where they can be recirculated throughout the building.	Containment and extraction of the air from pollutant generating equipment is recommended.		Potential pathway of pollutants from the office equiptment to the occupants.	-1	-2	0	-1	0
I	O	3	Is the photocopier/fax/laser printer area or other large point sources maintained at negative air pressure:	a	separate extraction, and no air supply	A combination of a separate extractio and no air supply will remove contaminants at the source and maintain the area at a negative air pressure relative to surrounding areas This will help prevent contaminants being dissipated to other occupied areas.	Office equipment areas should be maintained at negative air pressure relative to their surrounds.		Opportunity to remove particiates, VOCs and gaseous pollutanst at source	1	2	0	1	0

				b	additional return air grills and no air supply	A combination of return air grills and no air supply will remove contaminant at the source and maintain the area at a negative air pressure relative to surrounding areas. This will help prevent contaminants being dissipated to other occupied areas. Contaminants entrained in the return air can be recirculated through the building unless there is adequate air filtration and air exchange with fresh air.	Office equipment areas should be maintained at negative air pressure relative to their surrounds.		Opportunity to remove particlates, VOCs and gaseous pollutanst at source	0	1	0	0	0
				c	no	Maintaining the office equiptment area at negative air pressure relative to the occupied areas and surroundign spaces will help prevent the sisslation of pollutants.	Office equipment areas should be maintained at negative air pressure relative to their surrounds.		Potential pathway of pollutants from the office equiptment to the occupants.	-1	-2	0	-1	0
			Living Plants (L)											
I	L	1	Will indoor living plants be put into the occupied areas?		yes	Certain types of living plants have been identified as having the ability to absorb VOCs from the air, thus helping to reduce indoor concentrations. However estimates on the number of plants required to affect a substantial reduction in VOCs vary from a few to a room full.	Plants should not be depended upon to significantly reduce indoor concentrations of VOCs.							
					no	Certain types of living plants have been identified as having the ability to absorb VOCs from the air, thus helping to reduce indoor concentrations. However estimates on the number of plants required to affect a substantial reduction in VOCs vary from a few to a room full.								

I	L	2	Will waterproof trays be located under all plants to prevent irrigation water and dampness on adjacent surfaces?		yes	Dampness and overflowed water are significant causes of microbiological contamination.	Waterproof overflow trays are recommended under all plants.		No detriment to the IAQ.	0	0	0	0	0
					no	Dampness and overflowed water are significant causes of microbiological contamination.	Waterproof overflow trays are recommended under all plants.H239		Potential source of microbiological contamination.	0	0	-2	0	0
I	L	3	Are the plants on a plumbed irrigation system which runs through office accommodation areas?		no	Dampness and overflowed water are significant causes of microbiological contamination.	Plumbed irrigation systems runnign through office accommodation area are not recommended.		No detriment to the IAQ.	0	0	0	0	0
					yes	Plumbed irrigation systems are prone to leaking at the joints. Water leaking from the system can provide sufficien moisture for microbiological contamination of wetted materials. Care needs to be taken in the installation of an irrigation system so that joints are properly installed and tested. Access for regularly inspection will help to detect leaks throughout the life of the system.	Plumbed irrigation systems should be carefully installed to prevent leakage. Access points for regular inspections should be provided.		Potential source of microbiological contamination.	0	0	-2	0	0
I	L	4	Does the irrigation system have misting, sprinkling or spraying functions?		yes	Misting and spraying water can cause wetting of surrounding surfaces. Water droplets from the irrigation system can provide sufficient moisture for microbiological contamination of wetted materials. Misting or spraying functions should not be used where there is the potential for moisture to over spray onto porous materials.	Misting, sprinkling and spraying of water is not recommended where materials other than the plants and soils could become wet.		No detriment to the IAQ.	0	0	0	0	0

					no	Containing water to the defined garden area and avoid aerosolisation of water is important to limit the water availability on surrounding materials for microbial contamination.	Drippers and sub soil irrigation methods are recommended.		Potential source of microbiological contamination.	0	0	-2	0	0

			Questions		Options	Justification	Recommendations	Linkages	Conclusion	VOCs	Particulates	Microbials	Gaseous	Thermal	
Ventilation (V)															
System Type (S)															
V	S	1	The mechanical ventilation system used in the building is:	a	centralised HVAC system	Centrally located plant is often easier to maintain throughout the life of the building compared to decentralised plant.	Well design, installed, commissioned and maintained central plant has been shown to be capable of delivery good quality air.	Air pressure relationships, access for maintenance.	No detriment to the indoor air quality.	0	0	0	0	0	
				b	decentralised HVAC system	Decentralised plant represents a large maintenance commitment, and can cause problems with access to all the equipment.	Decentralised plant can deliver good quality air providing provisions for access are well catered and the plant is well designed, installed, commissioned and maintained. However there are higher risks that maintenance will be neglected through out the life of the building, which leads to deteriorated IAQ.	Terminal equipment, air pressure relationships, access for maintenance.	Potential source of microbial contamination and reduction in effectiveness of removal of particulate matter in the long term.	0	-3	-3	0	0	
				c	combination of centralised and decentralised	Well design, installed, commissioned and maintained central/decentralised plant has been shown to be capable of delivering good quality air.		Terminal equipment, air pressure relationships, access for maintenance.	Potential source of microbial contamination and reduction in effectiveness of removal of particulate matter in the long term.	0	-2	-2	0	0	
V	S	2	Is the HVAC plant:	a	constant air volume (CAV)	Well design, installed, commissioned and maintained CAV systems can deliver good quality air.	CAV system as recommended.		No detriment to the indoor air quality.	0	0	0	0	0	

				b	variable air volume (VAV)	There is a tendency for VAV systems to deliver insufficient outdoor air to dilute bioeffluents and other internally generated contaminants under low thermal load conditions. Changes in the velocity and throw of air as it exits the supply diffusers can lead to poor room air mixing under certain conditions. This can reduce the effectiveness of the air exchange.	Well design, installed, commissioned and maintained VAV systems can deliver good quality air, however care needs to be taken to maintain adequat air exchange at all times.	Terminal equipment, air exchange	Potential reduction in ventilation and dilution of indoor pollutants.	-2	-2	0	-2	0	
				c	fan coil	Distributed systems increase the difficulties of maintenance and cleaning of the HVAC system. Experience shows they are prone to more problems with microbiological contaminants anc poor filtration. Care needs to be taken in the location of these units to insure they are drawing air from the cleanest possible source. Drawing the air supply from the ceiling plenum or carpeted floor area is not recommended.	Provisions for access and great care in the design, installation, commissioning and maintenanc are recommended.	provision for maintenance, air intakes	Potential source of microbial contamination.	0	-2	-3	0	0	

				d	heat pump	Distributed systems increase the difficulties of maintenance and cleaning of the HVAC system. Experience shows they are prone to more problems with microbiological contaminants anc poor filtration. Care needs to be taken in the location of these units to insure they are drawing air from the cleanest possible source.	Provisions for access and great care in the design, installation, commissioning and maintenance are recommended.	provision for maintenance, air intakes	Potential source of microbial contamination.	0	-2	-3	0	0	
				e	rooftop unit ventilator	Roof top unit ventilators can deliver good quality air. Care needs to be taken in the design and location of the air intakes to prevent the ingress of pollutants. Protection from rain water ingress and avoidance of standing water is important. Maintaining containment of internally generated contaminant can be very difficult to achieve due to lack of control over air pressure relationships and greater care needs to be taken tc remove contaminants at source. Care needs to be taken to separate the air intake airstream and the exhaust air stream. Roof top units are typically supplied with a low efficiency filter.	Provisions for access and great care in the design, installation, commissioning and maintenance are recommended. Upgrading of the filter is recommended.	air intakes	Potential source of microbial contamination, lack of containment of indoor pollutants and reduction in effectiveness of removal of particulate matter in the long term.	-2	-2	-3	-3	0	

				f	unit ventilator	Unit ventilators can deliver good quality air. Care needs to be taken in the design and location of the air intakes to prevent the ingress of pollutants, such as vehicle emissions or rain water. Maintaining containment of internally generated contaminant can be very difficult to achieve due to lack of control over air pressure relationships and greater care needs to be taken to remove contaminants at source. Care needs to be taken to separate the air intake airstream and the exhaust air stream. Unit ventilators are often difficult to maintain in a clean condition, and attention to the correct operation of the dampers is required.	Provisions for access and great care in the design, installation, commissioning and maintenance are recommended.	air intakes	Potential source of microbial contamination, lack of containment of indoor pollutants and reduction in effectiveness of removal of particulate matter in the long term.	-2	-2	-3	-3	0	

				g	hybrid natural and mechanical ventilation	Hybrid natural and mechanical ventilation can deliver good quality air. Care needs to be taken in the design of air intakes and their locations, including all windows and doors to prevent th ingress of outdoor pollutants, such as vehicle emissions. Maintaining containment of internally generated contaminant can be very difficult to achieve due to lack of control over air pressure relationships and greater care needs to be taken to remove contaminants at source. The ingress of un-tempered and un-filtered air can cause thermal discomfort and moisture problems.	Hybrid ventilation systems are recommended for buildings in locations with clean outdoor air. Natural ventilation systems can have uncontrollable air pressure relationships and other means o pollutant mitigation are required.	air intakes, building height outdoor pollutants	No detriment to the indoor air quality.	0	0	0	0	0	
V	S	3	Is the HVAC plant:	a	all - air	All air systems reduce the potential for leaks and condensation down stream of the plant room.	All-air systems are recommended.		No detriment to the indoor air quality.	0	0	0	0	0	
				b	air - and - water	Distribution of water systems throughout the building can risk water leaks and moisture problems from cooling coils, leaking valves and uninsulated pipes. Provision for the introduction and circulation of fresh clean air and removal of contaminants is also required. Great care needs to be taken wit distribution of water to avoid all potential leaks, overflows and condensation.		Terminal equipment	Potential source of microbial contamination.	0	0	-3	0	0	

				c	all - water	Distribution of water systems through out the building can risk water leaks and moisture problems from cooling coils. Provision for the introduction and circulation of fresh clean air and removal of contaminants is also required. In-room filtration should be considered.	Great care needs to be taken with distribution of water to avoid all potential leaks, overflows and condensation. Provision for the introduction of fresh clean air and removal of contaminants is also required.	Terminal equipment, natural ventilation	Potential source of microbial contamination.	-2	0	-2	-2	0	
V	S	4	Does the ventilation system have the capacity to supply clean air at a rate higher than designed operational load during and post periods of construction?	a	yes, isolation of zones of the building during construction	Construction work significantly increases the concentrations of both particulate matter, moisture and VOCs. Every effort should be made to isolate areas of the building which may under go renovations during the life of the building from other occupied areas. Maintaining the construction area under negative air pressure, and shutting of the returns air ducts to the rest of the building is important.	Provision for construction and post construction ventilation is recommended to reduce indoor concentrations of VOCs, particulate matter and construction moisture.	Building uses, occupant loads.	Opportunity to contain indoor concentrations of VOCs, particulate matter and moisture.	3	2	2	0	0	

				b	yes, nil recirculation of air from zones affected by construction activities during and after construction	Construction work significantly increases the concentrations of both particulate matter and VOCs. It is prudent to supply maximum ventilation with outdoor air during and after until concentrations of contaminants have decayed to below the level of concern following all new construction works. Care needs to be taken to maintain correct air pressure relationships to avoid cross contaminating other areas of the building. Continuous operation of the ventilation system following new construction will assist the removal of VOCs, construction moisture and particulate matter.	Provision for construction and post construction ventilation is recommended to reduce indoor concentrations of VOCs, particulate matter and construction moisture.	Building uses, occupant loads.	Opportunity to contain indoor concentrations of VOCs, particulate matter and moisture.	2	2	2	0	1	

				c	continuos operation of the ventilation system for the first 3-6 months following construction	Construction work significantly increases the concentrations of both particulate matter and VOCs. It is prudent to supply maximum ventilation with outdoo air during and after until concentrations of contaminants have decayed to below the level of concern following all new construction works. Care needs to be taken to maintain correct al pressure relationships to avoid cross contaminating other areas of the building. Continuous operation of the ventilation system following new construction will assist the removal of VOCs, construction moisture and particulate matter.	Provision for construction and post construction ventilation is recommended to reduce indoor concentrations of VOCs, particulate matter and construction moisture.	Building uses, occupant loads.	Opportunity to reduce indoor concentrations of VOCs, particulate matter and moisture.	3	2	2	0	0	
				d	no	Construction work significantly increases the concentrations of both particulate matter and VOCs. It is prudent to supply maximum ventilation with outdoo air during and after until concentrations of contaminants have decayed to below the level of concern following all new construction works. Care needs to be taken to maintain correct al pressure relationships to avoid cross contaminating other areas of the building. Continuous operation of the ventilation system following new construction will assist the removal of VOCs, construction moisture and particulate matter.	Provision for construction and post construction ventilation is recommended to reduce indoor concentrations of VOCs, particulate matter and construction moisture.	Building uses, occupant loads.	Potential source of microbial contamination, particulate matter and VOCs.	-3	-2	-2	0	0	

V	S	5	Is the air supply strategy:	a	displacement	Displacement ventilation can be the most efficient means of achieving good air exchange, i.e. dilution of indoor pollutants.	Locating air supply grills and return air extracts in different planes is recommended.	air supply diffusers	No detriment to the indoor air quality.	2	2	2	2	2	
				b	room mixing	Air supply strategies relying on room mixing are prone to short circuiting of the air supply if they are not properly designed. This can lead to ineffective air exchange and the accumulation of room or occupant generated contaminants. It can also lead to thermal discomfort.	Locating the air supply grills and return air extracts in the same plane is not recommended.	air supply diffusers, ceiling height	Potential reduction in ventilation and dilution of indoor pollutants.	-1	-1	0	-1	-1	
V	S	6	Will the proposed building be installed with a continuous trickle ventilation system?	a	yes	Continuous trickle ventilation is useful for providing low levels of background ventilation. It can assist in the removal of moisture and pollutants from continuous sources such as VOCs emitted from construction materials. Trickle ventilation can also help to prevent excessive indoor temperatures during warm weather. This will help to reduce the emission rate of VOCs from construction and furnishing materials and finishes, especially during warm weather when emissions will increase.	Trickle ventilation is recommended.	material selection, outdoor pollutants	Potential for continuous dilution and removal of indoor generated pollutants.	2	2	2	2	2	

				b	no	Trickle ventilation is useful for providing low levels of background ventilation. It can assist in the removal of moisture and pollutants from continuous sources such as VOCs emitted from construction materials, during unoccupied periods.	Trickle ventilation is recommended.		Potential for lack of removal of indoor generated pollutants.	-2	-2	-2	-2	-2	
			System Control (C)												
V	C	1	Is the system installed with an economiser cycle?	a	yes	Economiser cycles can increase the rate of ventilation to make us of free cooling. During periods o low thermal demands they can sometimes decrease the introduction of outside air below the level required to dilute internally generated contaminates.	Economiser cycles are recommended. However the minimum outdoor rate should be set high enough to dilute internally generated contaminates and maintain acceptable IAQ at all times, as a separate criteria to thermal loads or odour control.	materials selection, occupancy loads	Potential dilution of VOCs, particulates, and gaseous pollutants.	2	1	0	1	0	
				b	no	Economiser cycles can increase the rate of ventilation to make us of free cooling. Sometimes during periods of low thermal demands they can decrease the introduction of outside air below the level required to dilute internally generated contaminates.	Economiser cycles are recommended. However the minimum outdoor rate should be set high enough to dilute internally generated contaminates and maintain acceptable IAQ at all times, as a separate criteria to thermal loads or odour control.	materials selection, occupancy loads	No detriment to the IAQ.	0	0	0	0	0	

V	C	2	Will contaminants that are generated in the building be dissipated during periods when the building is not occupied, so as to provide acceptable air for the next occupation period?	a	yes	Ventilation at non peak periods is required to remove lingering concentrations of contaminants and break the sink effect.	Ventilation which lags and leads the occupancy period is recommended to dissipate residual contaminants.	materials selection, occupancy loads	Potential dilution of VOCs, particulates, and gaseous pollutants.	2	2	2	2	0	
				b	no	Ventilation at non peak periods is required to remove lingering concentrations of contaminants and break the sink effect.	Ventilation which lags and leads the occupancy period is recommended to dissipate residual contaminants.	materials selection, occupancy loads	Potential for VOCs, particulates and moisture to be retained in the building.	-1	-1	-1	-1	0	
V	C	3	Are contaminants, such as emissions of VOCs from materials, generated within the space independent of the occupants and their activities?	a	no	The space should be flushed with outside air for a period prior to occupancy to remove the contaminants.	The ventilation system should be set to allow the ventilation to lea the occupancy.	materials selection, occupancy loads	No detriment to the IAQ.	0	0	0	0	0	
				b	yes	The space should be flushed with outside air for a period prior to occupancy to remove the contaminants.	The ventilation system should be set to allow the ventilation to lea the occupancy.	materials selection, occupancy loads	Potential source of VOCs.	-2	-1	0	0	0	

V	C	4	Is the minimum outdoor air flow rate controlled?	a	yes	Minimum outdoor air flow rates are required to dilute internally generated contaminants. Although a requirement within th Building Code, this does not always happen in practice.	The percentage of outdoor air introduced into the air stream needs to be increased when air volumes are decreased during low thermal demands.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Minimum outdoor air flow rates are required to dilute internally generated contaminants. Although a requirement within th Building Code, this does not always happen in practice.	The percentage of outdoor air introduced into the air stream needs to be increased when air volumes are decreased during low thermal demands.	air exchange rates	Potential lack of dilution of VOCs and particulate matter.	-3	-2	0	0	0	
V	C	5	Under part-load conditions during reduced thermal demands of the zone, does the VAV system adjust the percentage of outdoor in order to maintain minimum outdoor air levels?	a	yes	When the total quantity of air supply is reduced under part-loa conditions it is important that the proportion of outdoor air is increased to maintain a minimum quantity of outdoor air to dilute contaminants.	Controls of the system to increase the proportion of outdoor air under part-load conditions are recommended.	air exchange rates	No detriment to the IAQ.	0	0	0	0	0	
				b	no	When the total quantity of air supply is reduced under part-loa conditions it is important that the proportion of outdoor air is increased to maintain a minimum quantity of outdoor air to dilute contaminants.	Controls of the system to increase the proportion of outdoor air under part-load conditions are recommended.	air exchange rates, material selection	Potential lack of dilution of VOCs, moisture, microbial contaminants and particulate matter.	-3	-2	-2	-2	0	

V	C	6	Is the ventilation system operation based on:	a	demand control	Demand control systems are usually activated by CO_2 sensors to respond to the numbers of occupants within the space. CO_2 is indicative of bioeffluents in the space but is not representative of other contaminates within the space, such as VOCs from construction materials. This type of control system is recommended especially where the occupants and their activities dominate the pollutant load, such as in meeting rooms.	CO_2 sensors can help provide ventilation for good air quality where the occupants are the predominant source of contaminates.	material selection	Potential for dilution of occupant generated pollutants as they are generated.	2	2	2	2	2	
				b	thermal control	Thermal control system respond to the thermal load in the space including solar gain but excludes recognition of all airborne contaminates.	Thermal control only indirectly aids good IAQ. Demand ventilation is more responsive to internally generated contaminant loads.	air exchange rates	Potential lack of dilution of VOCs, moisture, microbial contaminants and particulate matter.	-2	-2	-2	-2	2	
V	C	7	Are the CO_2 sensors located:	a	within the work area	This is representative of the bioeffluents in the air that the occupants breathe.	CO_2 sensors should be located in areas representative of the conditions within the work area.		Potential for dilution of occupant generated pollutants as they are generated.	2	2	2	2	2	
				b	in the return air duct	This can under represent the concentration of bioeffluents within the breathing zone if the a supply duct is leaky or the air supply short circuits.	CO_2 sensors should be located in areas representative of the conditions within the work area.	air exchange rates	Potential lack of dilution of VOCs, moisture, microbial contaminants and particulate matter.	-2	-2	-2	-2	-2	
V	C	9	Can the operation of the HVAC system be adjusted to supply outdoor air outside of "normal" office hours?	a	yes	Ventilation should be provided at all times when the space is occupied to supply outdoor air and dilute occupant generated contaminants.	The occupational schedule for the HVAC system should correlate with the hours of occupancy.	air exchange rates, material selection	No detriment to the IAQ.	0	0	0	0	0	

				b	no	Ventilation should be provided at all times when the space is occupied to supply outdoor air and dilute occupant generated contaminants.	The occupational schedule for the HVAC system should correlate with the hours of occupancy.		Lack of dilution VOCs, particulates and occupant generated bioeffluents.	-2	-2	0	0	0	
V	C	10	Does the HVAC system have sensors to measure the quantity of outside air?	a	yes	The quantity of outside air entering the system will vary considerable over time, and will need frequent monitoring. Sensors are more accurate for determining the quantity of outdoor air than estimates or indirect assessments from temperature ratios, or fan speed and static pressure.	Sensors to measure outdoor air quantity are recommended.	air exchange rates, material selection	Potential for dilution of occupant generated pollutants as they are generated.	2	2	2	2	0	
				b	no	The quantity of outside air entering the system will vary considerable over time, and will need frequent monitoring. Sensors are more accurate for determining the quantity of outdoor air than estimates or indirect assessments from temperature ratios, or fan speed and static pressure.	Sensors to measure outdoor air quantity are recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	
V	C	11	Will the controls be calibrated and fully commissioned prior to occupancy?	a	yes	Identifying malfunction of the HVAC systems controllers can be elusive and subtle though can cause significant problems.	Thorough commissioning and calibration of all controllers is recommended.		Potential for effective air exchange controls.	2	2	2	2	0	
				b	no	Identifying malfunction of the HVAC systems controllers can be elusive and subtle though can cause significant problems.	Thorough commissioning and calibration of all controllers is recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	

V	C	12	Will thermostats be used to determine supply air requirements?	a	yes	Temperature is indicative of thermal load only and does not relate on the pollutant load within the space.	Thermostats are not recommended as the primary controller of ventilation rates where the ventilation is required to control indoor concentrations of contaminants.								
				b	no	Sensors which measure the typical contaminants generated from internal sources will provide a more realistic measure of indoor air quality. Unfortunately there are few direct read instruments which are currently economically feasible. Carbon dioxide sensors measure bioeffluents and can approximate the contaminant load generated from occupant activities. Carbon dioxide levels do not relate to the pollutant load generated from building materials, moisture sources, microbiological contamination or other internal sources.	Carbon dioxide sensors are recommended for measuring ventilation where occupant activities are the predominant source of contaminants.								
V	C	13	Will the sensors to determine the supply air requirements be located in:	a	the occupied area	Sensors located at ceiling height can over represent the volume of outdoor air being supplied to the occupants breathing zone if the supply air is being short circuited	Locating sensors within the occupants breathing zone is recommended. Removal of conditions which could contribute to the short circuiting of the air supply are also recommended.		Potential for effective air exchange controls.	2	2	2	2	0	

				b	the return air plenum	Supply air ducts within the return air plenum need to be airtight to prevent leaked biasing the senso readings. This can over represent the volume of outdoor air being supplied to the occupied area, and trick the controller to reduce the outdoor air flow.	Air tight supply air ducts are recommended if the sensors re located in the return air plenum.		Potential under estimation of pollutant loads.	-1	-1	-1	-1	0	
V	C	14	Are the building's controls driven by:	a	direct digital control	Provided adequate training of building management personal, and correct documentation and programming of the system are provided then DDC can provide appropriate control of the ventilation for good IAQ.	Direct digital controllers are recommended where correct training of the building management personal, documentation and programmin of the system are assured.		Potential for effective air exchange controls.	2	2	2	2	0	
				b	pneumatic	Pneumatic controllers are subjec to loss of accuracy and calibration as well as catastrophi failure.	Pneumatic controllers of the HVAC services are not recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	
			Unit Ventilators (U)												

V	U	1	Is sufficient air drawn from the outside to meet the fresh air requirements?	a	yes	Sufficient outside air to dilute all internally generated pollutants is required. Unit ventilators are frequently operated on low outdoor air rates and this can lead to the accumulation of contaminants generated indoors.	Sufficient supply of clean outdoor air to dilute the contaminates generated indoors is recommended.		Potential for dilution of occupant generated pollutants as they are generated.	2	2	2	2	0	
				b	no	Sufficient outside air to dilute all internally generated pollutants is required. Unit ventilators are frequently operated on low outdoor air rates and this can lead to the accumulation of contaminants generated indoors.	Sufficient supply of clean outdoor air to dilute the contaminates generated indoors is recommended.	air exchange rate, material selection	Potential accumulation of occupant generated pollutants.	-3	-3	-3	-3	0	
V	U	2	Is the outside air drawn from clean sources?	a	yes	Decentralised units can frequently draw air from the most convenient rather than the cleanest source of outdoor air. Care needs to be taken in the location of the air intakes to avoid externally generated contaminants being drawn into the building.	Outside air should be drawn from the cleanest possible sources to avoid introducing outdoor contaminants.	air intakes	No detriment to the IAQ.	0	0	0	0	0	
				b	no	Decentralised units can frequently draw air from the most convenient rather than the cleanest source of outdoor air. Care needs to be taken in the location of the air intakes to avoid externally generated contaminants being drawn into the building.	Outside air should be drawn from the cleanest possible sources to avoid introducing outdoor contaminants.	air intakes	Potential source of outdoor generated VOCs, microbial contaminants, particulate matter and gaseous pollutants.	-3	-3	-3	-3	0	

V	U	3	Are all parts of the units easily accessed for maintenance?	a	yes	Decentralised units represent a considerable maintenance load, especially the cooling coils, drain pans and filters. This can be assisted by providing easy access to all units.	Ready access to all units is recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Decentralised units represent a considerable maintenance load, especially the cooling coils, drain pans and filters. This can be assisted by providing easy access to all units.	Ready access to all units is recommended.		Potential source of microbial contaminants and particulate matter.	0	-3	-3	0	0	
V	U	4	Has the unit been modified to include filtration?	a	yes	Filtration of the air supply stream is important to remove respirable particulate matter and microbial spores.	Care needs to be taken to ensure that filter frames fit tightly allowing for no air by-pass.	filtration	No detriment to the IAQ.	0	0	0	0	0	
				b	no	Filtration of the air supply stream is important to remove respirable particulate matter and microbial spores.	Care needs to be taken to ensure that filter frames fit tightly allowing for no air by-pass.	filtration	Potential pathway for outdoor generated particles to enter the air supply.	0	-3	0	0	0	
V	U	5	At the end of a cooling cycle, can condensate from the cooling coils be carried or evaporated into the air supply stream?	a	no	Condensation will occur on the cooling coils during a cooling cycle. This moisture can be re-evaporated or carried into the air supply especially at the conclusion of the cooling cycle. Care needs to be taken to avoid porous surfaces downstream of the coils and provide suitable access for cleaning and maintenance.	Care to limit the condensation being drawn into the air supply is recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Condensation will occur on the cooling coils during a cooling cycle. This moisture can be re-evaporated or carried into the air supply especially at the conclusion of the cooling cycle. Care needs to be taken to limit porous surfaces downstream of the coils and provide suitable access for cleaning and maintenance.	Care to limit the condensation being drawn into the air supply is recommended.	cooling coils, access of maintenance	Potential source of microbial contaminants.	0	0	-3	0	0	
			Heat Pump (H)												
V	H	1	Is the heat pump located in the:	a	ceiling plenum	Overtime a large quantity of dust can settle in the ceiling plenum due to the low air velocities in this area. This dust can be drawn into the raised floor ventilator and be recirculated throughout the building.	Access to the heatpump and the areas surrounding the heat pump is recommended for cleaning.	air intakes, filtration	Potential source of particulate matter.	0	-3	0	0	0	
				b	raised floor	Overtime a large quantity of dust can settle with the aid of gravity in the raised floor space. This dust can be drawn into the raise floor ventilator and be recirculated throughout the building.	Access to the heatpump and the areas surrounding the heatpump is recommended for cleaning.	air intakes, filtration	Potential source of particulate matter.	0	-3	0	0	0	
				c	outside	Decentralised units can frequently draw air from the most convenient rather than the cleanest source of outdoor air. Care needs to be taken in the location of the air intakes to avoid externally generated contaminants being drawn into the building.	Outside air should be drawn from the cleanest possible sources to avoid introducing outdoor contaminants.	air intakes, filtration	Potential source of outdoor generated VOCs, microbial contaminants, particulate matter and gaseous pollutants.	-3	-3	-3	-3	0	

V	H	2	Is this area fully accessible?	a	yes	Decentralised units represent a considerable maintenance load, especially the cooling coils, drain pans and filters. This can be assisted by providing easy access to all units.	Ready access to all units for maintenance and cleaning is recommended.								
				b	no	Decentralised units represent a considerable maintenance load, especially the cooling coils, drain pans and filters. This can be assisted by providing easy access to all units.	Ready access to all units for maintenance and cleaning is recommended.	access for maintenance	Potential source of microbial contaminants and particulate matter.	-3	-3	-3	-3	0	
V	H	3	Is the outdoor air:	a	ducted directly to the heat pump	Ducting air assists the correct volume of outdoor air reaching the heat pump.	Direct ducting of the outside air supply is recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	ducted to the vicinity of the heat pump	Only a percentage of fresh air that is ducted to the vicinity of the heat pump will find its way to the heat pump. This leads to the recirculation of thermally conditioned stale air and the accumulation of contaminants within the occupied space.	Direct ducting of the outside air supply is recommended.	air exchange	Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	
				c	dumped in the plenum	Fresh air that is dumped in the plenum often doesn't find its way to the heat pump. This leads to the mere recirculation of thermally conditioned stale air and the accumulation of contaminants within the occupied space.	Direct ducting of the outside air supply is recommended.	air exchange	Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-3	-3	-3	-3	0	

V	H	4	Is the condensate pan drained into the waste water plumbing?	a	yes	Moisture sitting in condensate pans is a frequent amplification site of fungi and bacteria. As the supply air blows over the condensate pan then microbiological contaminants can be readily communicated with the occupied areas.	Drained condensate trays are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Moisture sitting in condensate pans is a frequent amplification site of fungi and bacteria. As the supply air blows over the condensate pan then microbiological contaminants can be readily communicated with the occupied areas.	Drained condensate trays are recommended.	condensate drain pans.	Potential source of microbiological contaminants.	0	0	-3	0	0	
V	H	5	Is the condensate pan sloped in the direction of the drain?	a	>1:10	Moisture sitting in condensate pans is a frequent amplification site of fungi and bacteria. As the supply air blows over the condensate pan then microbiological contaminants can be readily communicated with the occupied areas.	Condensate drain pans should be sloped with a fall greater than 1:10 in the direction of the drain.	condensate drain pans.	No detriment to the IAQ.	0	0	0	0	0	
				b	<1:10	Moisture sitting in condensate pans is a frequent amplification site of fungi and bacteria. As the supply air blows over the condensate pan then microbiological contaminants can be readily communicated with the occupied areas.	Condensate drain pans should be sloped with a fall greater than 1:10 in the direction of the drain.	condensate drain pans.	Potential source of microbiological contaminants.	0	0	-3	0	0	

V	H	6	Are the condensate trays insulated?	a	no	Insulation should be avoided in a locations that have the potential to become damp. This is important to avoid a site for microbial contamination.	Condensate drain pans should not be insulated.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Insulation should be avoided in a locations that have the potential to become damp. This is important to avoid a site for microbial contamination.	Condensate drain pans should not be insulated.		Potential source of microbiological contaminants.	0	0	-3	0	0	
V	H	7	Is there easy access to the filters:	a	yes	Decentralised systems represent a higher maintenance burden than centralised plant. To facilitate the regular checking anc changing of filters it is important than access to the unit and the filters is as easy as possible.	Easy access to the unit and the filters is recommended.	filter access	No detriment to the IAQ.	0	0	0	0	0	
				b	no	Decentralised systems represent a higher maintenance burden than centralised plant. To facilitate the regular checking an changing of filters it is important than access to the unit and the filters is as easy as possible.	Easy access to the unit and the filters is recommended.	filter access	Potential source and lost opportunity for capture of particulate matter.	0	-3	0	0	0	

V	H	8	Is there easy access to the coils:	a	yes	Decentralised systems represent a higher maintenance burden than centralised plant. To facilitate the regular checking and changing of filters it is important than access to the unit and the filters is as easy as possible. As the coils are frequently wet, they represent a site for amplification of fungi and bacteria. As they coils are also in the air supply stream then these microbiological contaminants can be readily communicated with the occupied areas.	Easy access to the unit and the coils is recommended.	coil access	No detriment to the IAQ.	0	0	0	0	0	
				b	no	Decentralised systems represent a higher maintenance burden than centralised plant. To facilitate the regular checking and changing of filters it is important than access to the unit and the coils is as easy as possible. As the coils are frequently wet, they represent a site for amplification of fungi and bacteria. As they coils are also in the air supply stream then these microbiological contaminants can be readily communicated with the occupied areas.	Easy access to the unit and the coils is recommended.	coil access	Potential source of microbiological contaminants.	0	0	-3	0	0	

V	H	9	Is there easy access to the condensate pans:	a	yes	Decentralised systems represent a higher maintenance burden than centralised plant. As the condensate pans are frequently wet, they represent a site for amplification of fungi and bacteria. As the condensate pans are also in the air supply stream then these microbiologica contaminants can be readily communicated with the occupied areas.	Easy access to the unit and the condensate pans is recommended.	coil access	No detriment to the IAQ.	0	0	0	0	0	
				b	no	Decentralised systems represent a higher maintenance burden than centralised plant. As the condensate pans are frequently wet, they represent a site for amplification of fungi and bacteria. As the condensate pans are also in the air supply stream then these microbiologica contaminants can be readily communicated with the occupied areas.	Easy access to the unit and the condensate pans is recommended.	coil access	Potential source of microbiological contaminants.	0	0	-3	0	0	
			Air Intakes (A)												

V	A	1	Can water pond nea the air intakes?	a	no	Any regularly wetted outdoor surfaces will have a sufficient supply of nutrient matter and spores to readily become an amplification site for fungi and bacteria. As there is a direct airflow between the ponded wate and the air supply any microbial contamination will be drawn into the air supply. This can seed further microbial amplification sites with and beyond the HVAC plant.	Design of the air intakes to preclude all opportunities for nearby water ponding is recommended. Sufficient fall to all surfaces which could become wet near the air intakes is recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Any regularly wetted outdoor surfaces will have a sufficient supply of nutrient matter and spores to readily become an amplification site for fungi and bacteria. As there is a direct airflow between the ponded wate and the air supply any microbial contamination will be drawn into the air supply. This can seed further microbial amplification sites with and beyond the HVAC plant. All surfaces near the air intakes which could become wet from rain, washing etc., should be laid to a fall of greater than 1:20 away from the air intake.	It is very important to prevent air from being drawn from reservoirs contaminated with microbial colonies or biocides.		Potential source of microbiological contamination.	0	0	-3	0	0	

V	A	2	Can either the air intake or pollutant source be relocated?	a	yes	Where elimination of the moisture source is not practical, then consideration should be given to relocating the moisture source or the air intake. Physical separation is permanent and effective.	Physical separation is recommended wherever the moisture can not be eliminated.		No detriment to the IAQ.	0	0	3	0	0	
				b	no	Where elimination of the moisture source is not practical, then consideration should be given to relocating the moisture source or the air intake. Physical separation is permanent and effective.	Other means of isolation are recommended such as sealed doors and maintaining correct ai pressure relationships.		Potential source of microbiological contamination.	0	0	-2	0	0	
V	A	3	Are the air intakes located in a position where they could become blocked with debris?	a	no	Leaves, blown paper, plastic bags and other such debris can block the air intake opening. Access for regular cleaning is required.	Air intakes should be located above ground level to reduce the incidence of blown debris. Mesh bird screens with a minimum mesh size of 12mm are recommended to assist in the screen becoming blocked.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Leaves, blown paper, plastic bags and other such debris can block the air intake opening. Blocked air intakes will reduce the volume of outdoor drawn into the building and this will effect the dilution of internally generated pollutants such as bioeffluents and VOCs. Access for regular cleaning is required.	Air intakes should be located above ground level to reduce the incidence of blown debris. Mesh bird screens with a minimum mesh size of 12mm are recommended to assist in the screen becoming blocked.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-3	-3	-3	-3	0	

V	A	4	Are the air intakes sheltered from the ingress of rain and snow?	a	rainhood	Moisture can be driven into the air intakes which can increase the moisture load of the ventilation system and increase the risk of microbial contamination.	Rain hoods and /or louvers with low rain penetration characteristics are recommended to shelter the air intakes from the worst of the driving rain.		No detriment to the IAQ.	0	0	0	0	0	
				b	louvers	Moisture can be driven into the air intakes which can increase the moisture load of the ventilation system and increase the risk of microbial contamination.	Rain hoods and /or louvers with low rain penetration characteristics are recommended to shelter the air intakes from the worst of the driving rain.		No detriment to the IAQ.	0	0	0	0	0	
				c	overhang	Moisture can be driven into the air intakes which can increase the moisture load of the ventilation system and increase the risk of microbial contamination.	Overhangs unless very deep are seldom effective for sheltering the air intakes from driving rain.		Potential source of microbiological contamination.	0	0	-2	0	0	
				d	nothing	Moisture can be driven into the air intakes which can increase the moisture load of the ventilation system and increase the risk of microbial contamination.	Rain hoods and /or louvers with low rain penetration characteristics are recommended to shelter the air intakes from the worst of the driving rain.		Potential source of microbiological contamination.	0	0	-3	0	0	
V	A	5	Does the proposed building have any air intakes at roof level:	a	yes	This is usually the cleanest source of air. Care needs to be taken to avoid flues, fume hoods exhausts, stacks, droplets from cooling towers, evaporative condensers and standing water. The roof should be sloped at least 1:40 to prevent water ponding.	Air intakes at roof level are generally recommended.	envelope, outdoor pollutants sources	No detriment to the IAQ.	0	0	0	0	0	

				b	no	This is usually the cleanest source of air. Care needs to be taken to avoid flues, fume hoods, exhausts, stacks, droplets from cooling towers, evaporative condensers and standing water. The roof should be sloped at least 1:40 to prevent water ponding.	Air intakes at roof level are generally recommended.	envelope, outdoor pollutants sources	Potential pathway for outdoor pollutants to enter the building.	-1	-3	-1	-3	0	
V	A	6	Does the proposed building have any air intakes at street level:	a	no	Air intakes in the upper two thirds of the building tend to draw in the cleanest air.	Air intakes should be located in the upper two thirds of the building and away from other sources of contamination.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes, fire escape doors	Street level air is typically pollute with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, fire exit doors should be fitted with air seals to prevent infiltration of outdoor pollutants.		Potential pathway for outdoor pollutants to enter the building.	0	-1	0	-1	0	
				c	yes, openable windows	Street level air is typically pollute with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, unfiltered air intakes at street level are not recommended as these can admit particulate matter and gaseous pollutants into the building. An alternative means of ventilation with filtered air is recommended.		Potential pathway for outdoor pollutants to enter the building.	-1	-3	-1	-3	0	
				d	yes, entry doors	Street level air is typically pollute with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, vestibule arrangements on all entrance ways is highly recommended to limit particulate matter and gaseous pollutants from entering the building.		Potential pathway for outdoor pollutants to enter the building.	-1	-3	-1	-3	0	

				e	yes, air intakes	Street level air is typically pollute with gaseous pollutants and particulate matter, which can readily be entrained into the building through openings.	If the outside air quality is low, unfiltered air intakes at street level are not recommended as these can admit particulate matter and gaseous pollutants into the building. An alternative means of ventilation with filtered air is recommended.		Potential pathway for outdoor pollutants to enter the building.	-1	-3	-1	-3	0	
				f	yes, emergency generators	Emergency generators are required to be tested at regular intervals. Exhausted gases from the generator can entrained in th building if there are openings or air intakes near by.	Emergency generators should not be located near any air intakes or openings.		Potential pathway for gaseous pollutants, VOCs and particulate matter to enter the building.	-1	-2	0	-2	0	
V	A	7	Does the proposed building have any air intakes near or above a truck or loading dock:	a	no	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Air intakes and openings near loading docks are not recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Essential openings close to vehicle areas should be isolated from the interior space by an air lock. The interior should be maintained at positive air pressure relative to the truck dock area at all times.		Potential pathway for gaseous pollutants and particulate matter to enter the building.	0	-2	0	-3	0	
V	A	8	Does the proposed building have any air intakes near or above a carpark or carpark exhaust vent:	a	no	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Air intakes and openings near carparking areas are not recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Idling vehicles are a strong point source of VOC, gaseous pollutants and particulate matter, which can be readily entrained through any adjacent opening.	Essential openings close to vehicle areas should be isolated from the interior space by an air lock. The interior should be maintained at positive air pressure relative to the vehicle area at all times. Car parks should be ventilated separately from the remainder of the building.		Potential pathway for gaseous pollutants and particulate matter to enter the building.	0	-2	0	-3	0	
V	A	9	Does the proposed building have any air intakes within a climatic inversion strata?	a	no	Air intakes should be located above the inversion strata to draw air from a clean source. Air intakes within the inversion layer are not recommended. Exterior doors should be provided with air lobbies etc.	The building interior should be maintained at a higher air pressure relative to the outside air during periods of climatic inversions.	Infiltration, ventilation type, entrances, site factors	No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Contaminated air contained within the inversion layer can be drawn into the proposed building	Air intakes within the inversion strata are not recommended. A source of filtered air is recommended during periods when inversions are present. The building interior should be maintained at a higher air pressure relative to the outside air during periods of climatic inversions.	Infiltration, ventilation type, entrances, site factors	Potential pathway for gaseous pollutants, VOCs and particulate matter to enter the building.	-2	-3	0	-3	0	
V	A	10	Does the proposed building have any air intakes near or above a wet cooling tower:	a	no	Wet cooling towers are a strong point sources of bioaerosols and biocides. Neither of which should be allowed to enter the building.	Physical separation between all air intakes and wet cooling towers is recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Wet cooling towers are a strong point sources of bioaerosols and biocides. Neither of which should be allowed to enter the building. Biocides are toxic to human cells as well as microorganism and should therefore be prevented from entering the building. Wet cooling towers are a grave concern as droplets and aerosols from the sprayed water can travel beyond the immediate location o the cooling tower.	It is very important to prevent air from reservoirs contaminated with microbial colonies or biocides to enter the building.		Potential pathway for microbial contaminants to enter the building.	0	0	-3	0	0	
V	A	11	Does the proposed building have any air intakes near a water feature:	a	no	Water features can be a ripe site for fungi and bacteria to readily amplify. Water features are generally treated with biocides. Biocides are toxic to human cells as well as microorganism and should therefore be prevented from entering the building. Wate features are a concern especiall if the water is sprayed, splashed, agitated etc. as droplets and aerosols can travel beyond the immediate location of the water feature.	It is recommended that water features are located well away from all air intakes, including entrances without vestibules.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Water features can be a ripe site for fungi and bacteria to readily amplify. Water features are generally treated with biocides. Biocides are toxic to human cells as well as microorganism and should therefore be prevented from entering the building. Wate features are a concern especially if the water is sprayed, splashed, agitated etc. as droplets and aerosols can travel beyond the immediate location of the water feature.	Water features near air intakes, including entrances without vestibules are not recommended.		Potential source and pathway for microbial contaminants to enter the building.	0	0	-3	0	0	
V	A	12	Does the proposed building have any air intakes near a rubbish collection, compaction or disposal area:	a	no	Rubbish areas located near air intakes can lead to microbial contamination, particulate matter gaseous pollutants and/or VOCs being drawn into the air supply. They can be a source of rodents, flies, bugs and odours.	It is recommended that rubbish collection and compaction areas are located well away from all ai intakes, including entrances without vestibules.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Rubbish areas located near air intakes can lead to microbial contamination, particulate matter gaseous pollutants and/or VOCs being drawn into the air supply. They can be a source of rodents, flies, bugs and odours.	It is very important to prevent air from rubbish collection compaction, and disposal areas from being drawn into the air supply.		Potential source and pathway for microbial contaminants, particulate matter, gaseous pollutants and VOCs to enter the building.	-1	-3	-3	-2	0	

V	A	13	Does the proposed building have any air intakes near a chimney or exhaust vent:	a	no	Chimneys and exhaust vents located near air intakes can lead to particulate matter, gaseous pollutants and/or VOCs being drawn or re-entrained back into the air supply.	It is recommended that chimneys and exhausts are located well away from all air intakes and openings in the building envelope.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Chimneys and exhaust vents located near air intakes can lead to particulate matter, gaseous pollutants and/or VOCs being drawn or re-entrained back into the air supply.	It is very important to prevent air from combustion processes and exhausts from being drawn into the air supply.		Potential source and pathway for particulate matter, gaseous pollutants and VOCs to enter the building.	-2	-3	0	-3	0	
V	A	14	Does the proposed building have any air intakes near a kitchen exhaust:	a	no	Air intakes near kitchen exhausts can lead to moisture, microbial contamination, particulate matter and odours being drawn into the air supply.	It is important to prevent air from kitchen exhausts from being drawn into the air supply.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Air intakes near kitchen exhausts can lead to moisture, microbial contamination, particulate matter and odours being drawn into the air supply.	It is important to prevent air from kitchen exhausts from being drawn into the air supply.		Potential source and pathway for microbial contaminants, particulate matter and gaseous pollutants to enter the building.	0	-2	-3	-2	0	
V	A	15	Does the proposed building have any air intakes within 2m in any direction of a bathroom exhaust:	a	no	Air intakes near bathroom exhausts can lead to moisture, microbial contamination, gaseous pollutants and odours being drawn into the air supply.	It is very important to prevent air from bathroom exhausts from being drawn into the air supply.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Air intakes near bathroom exhausts can lead to moisture, microbial contamination, gaseou pollutants and odours being drawn into the air supply.	It is very important to prevent air from bathroom exhausts from being drawn into the air supply.		Potential pathway for gaseous pollutants and microbial contaminants.	0	0	-2	-3	0	
V	A	16	Does the proposed building have any air intakes 5m in any direction of a plumbing stack vent:	a	no	Air intakes, including windows located near the vents from wast water systems can lead to moisture, microbial contamination, gaseous pollutants and odours being drawn into the air supply.	It is very important to prevent air from plumbing stack vents from being drawn into the air supply.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Air intakes, including windows located near the vents from wast water systems can lead to moisture, microbial contamination, gaseous pollutants and odours being drawn into the air supply.	It is very important to prevent air from plumbing stack vents from being drawn into the air supply.		Potential pathway for gaseous pollutants and microbial contaminants.	0	0	-3	-3	0	
V	A	17	Does the proposed building have any air intakes near an outdoor smokers area:	a	no	Air intakes, including openable windows can lead to the entrainment of environmental tobacco smoke into the building. The stack effect will contribute to the drawing of outdoor air, which can include tobacco smoke, at ground level.	Location of outdoor smoking areas away from all openings in the building envelope is recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Air intakes, including openable windows can lead to the entrainment of environmental tobacco smoke into the building. The stack effect will contribute to the drawing of outdoor air, which can include tobacco smoke, at ground level.	Either the outdoor smoking area should be relocated or the opening in the building envelope relocated or sealed.		Potential pathway for respirable particulate matter, VOCs and gaseous pollutants.	-3	-3	0	-3	0	

V	A	18	Does the proposed building have any air intakes in sub-grade air wells?	a	no	Sub-grade air intake wells are prone to contamination with decaying plant material, moisture and bird droppings.	It is recommended that air is not drawn from sub-grade air-wells.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Sub-grade air intake wells are prone to contamination with decaying plant material, moisture and bird droppings.	Sub-grade air intake wells should be avoided. Ducting air from above grade is preferable.		Potential pathway for particulate matter and microbial contaminants.	0	-2	-2	0	0	
V	A	19	Are the air intakes at least 3m above the ground or a flat roof?	a	yes	Flat surfaces allow to water pond which can lead to microbial contamination within the HVAC systems.	A distance of 3m is recommended to provide separation from the ponded water to the air intakes.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Flat surfaces allow to water pond which can lead to microbial contamination within the HVAC systems.	A distance of at least 3m should be to provided separation from the ponded water to the air intakes.		Potential source of microbiological contaminants.	0	0	-3	0	0	
V	A	20	Are illuminated signage, exterior building lights or street lights installed near the air intakes?	a	no	Insects attracted by the exterior lighting and can be drawn into th air intakes. Dead insects can attract birds, whose faeces area strong source of contaminants. Decomposing insects are also an amplification site for microbiological contaminants. They can also be drawn throw th air intakes and block filters, dirty the mixing plenums and plug the coils.	It is recommended that lights should not be installed within 2m of air intakes.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Insects attracted by the exterior lighting and can be drawn into th air intakes. Dead insects can attract birds, whose faeces area strong source of contaminants. Decomposing insects are also an amplification site for microbiological contaminants. They can also be drawn throw th air intakes and block filters, dirty the mixing plenums and plug the coils.	Lights should not be installed within 2m of the air intake.		Potential source of microbiological contaminants.	0	0	-3	0	0	
V	A	21	Are all surfaces within the first 2m inside the air intakes waterproof?	a	yes	Wet surfaces can harbour microbial colonies. The components upstream of the filters typically become heavily contaminated with organic matte consequently elimination of all sources of moisture is necessary All surfaces within the air stream which have the potential to be wetted should be waterproof.	Non-porous surfaces which are also smooth and wipable are recommended within the first 2m of the air intake.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Wet surfaces can harbour microbial colonies. The components upstream of the filters typically become heavily contaminated with organic matter consequently elimination of all sources of moisture is necessary All surfaces within the air stream which have the potential to be wetted should be waterproof.	Non-porous surfaces which are also smooth and wipable are recommended within the first 2m of the air intake.		Potential source of microbiological contaminants.	0	0	-3	0	0	

V	A	22	Is it possible for birds to perch or nest near the outside air intakes?	a	no	Birds are a source of toxic and allergenic contaminates and should not be permitted to perch or nest anywhere in the airstream.	The outdoor air intakes and immediate vicinity should be screened off from birds with protective mesh not more than 12mm and not less than 6mm. Sites for birds to nest or perch should be eliminated.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Birds are a source of toxic and allergenic contaminates and should not be permitted to perch or nest anywhere in the airstream.	The outdoor air intakes and immediate vicinity should be screened off from birds and sites for birds to nest or perch should be eliminated.		Potential source of biological contaminants.	0	0	-3	0	0	
V	A	23	Is it possible for vermin to nest nearby or enter the outside air intakes?	a	no	Vermin are a source of toxic and allergenic contaminates and should not be permitted to nest or enter anywhere in the airstream.	The outdoor air intakes and immediate vicinity should be screened off from vermin.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Vermin are a source of toxic and allergenic contaminates and should not be permitted to nest or enter anywhere in the airstream.	The outdoor air intakes and immediate vicinity should be screened off from vermin.		Potential source of biological contaminants.	0	0	-3	0	0	
V	A	24	Is the floor of the area immediately inside the outside air intakes sloped to drain moisture that enters the building to discharged to the outside?	a	yes	Wet surfaces can harbour microbial colonies. The components upstream of the filters typically become heavily contaminated with organic matter consequently elimination of all sources of moisture is necessary.	All surfaces within the air stream which have the potential to be wetted should readily drain their water to a sanitary device or the outside.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Wet surfaces can harbour microbial colonies. The components upstream of the filters typically become heavily contaminated with organic matter consequently elimination of all sources of moisture is necessary.	All surfaces within the air stream which have the potential to be wetted should readily drain their water to a sanitary device or the outside.		Potential source of microbiological contaminants.	0	0	-3	0	0	

			Outside Air Dampers (OA)												
V	OA	1	Is the minimum closing point of the outside air dampers:	a	>15%	Outside air needs to be introduced into the building at all times to dilute internally generated contaminates.	15% opening of the outdoor air dampers will provide a slight trickle of outdoor air. Further opening of the outdoor air dampers is also required to dilute internally generated contaminates.		No detriment to the IAQ.	0	0	0	0	0	
				b	<10%	Outside air needs to be introduced into the building at all occupied times to dilute internally generated contaminates. It should not be assumed that closed dampers will leak sufficient air.	A higher minimum set point is recommended as well as further opening of the outdoor air dampers is also required to dilute internally generated contaminates.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-3	-3	-3	-3	0	
V	OA	2	Can the linkages which operate the outside air dampers be accidentally disconnected?	a	no	Incorrect operation of the outside air dampers can either reduce or shut-off the introduction of outside air if they fail shut, or waste energy if they fail open. Correct design and operation of the air intakes is an important aspect of ventilation for good IAQ.	Care in the design and fastening of the outside air damper linkages is recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	yes	Incorrect operation of the outside air dampers can either reduce or shut-off the introduction of outside air if they fail shut, or waste energy if they fail open. Correct design and operation of the air intakes is an important aspect of ventilation for good IAQ.	Care in the design and fastening of the outside air damper linkages is recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-3	-3	-3	-3	0	
V	OA	3	Are the outdoor air dampers modulating?	a	yes	It is easier for the dampers to find the appropriate opening rate for the conditions with dampers which can modulate through small increments. This results in less wear and tear on the dampers and reducing the likelihood of failure of the linkages.	Modulating dampers are recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	It is easier for the dampers to find the appropriate opening rate for the conditions with dampers which can modulate through small increments. This results in less wear and tear on the dampers and reducing the likelihood of failure of the linkages.	Modulating dampers are recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	
V	OA	4	Will the outside air dampers be closed when the system is shut off over night or during weekends?	a	yes	Outside air dampers can allow warm room air to flow backwards through the ductwork. This can contribute to condensation forming within the ducts and microbial contamination.	Outside air dampers should automatically close when the HVAC system is shut off.		No detriment to the IAQ.	0	0	0	0	0	

				b	no	Outside air dampers can allow warm room air to flow backwards through the ductwork. This can contribute to condensation forming within the ducts and microbial contamination.	Outside air dampers should automatically close when the HVAC system is shut off?		Potential source of microbiological contaminants.	0	0	-3	0	0	
			Mixing Plenums and Boxes (M)												
V	M	1	Is the air pressure inside the mixing boxes negative relative to the outdoor air pressure at all times?	a	yes	Pressure imbalances, mainly between the supply air and return air fans can cause the air intakes to function as air exhausts.	The air pressure in the mixing chambers should be maintained at a lower air pressure than outside the air intakes at all times.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Pressure imbalances, mainly between the supply air and return air fans can cause the air intakes to function as air exhausts.	The air pressure in the mixing chambers should be maintained at a lower air pressure than outside the air intakes at all times.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	0	
V	M	2	Is the mixing plenum accessible for inspection, cleaning and maintenance?	a	yes	Cleanliness of the mixing chamber is important to prevent contaminates from being introduced into he supply air stream.	Access for inspection, cleaning and maintenance is recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	no	Cleanliness of the mixing chamber is important to prevent contaminates from being introduced into he supply air stream.	Access for inspection, cleaning and maintenance is recommended.		Potential for source of particulates and microbial contaminants.	0	-2	-2	0	0	
V	M	3	Is there a floor or pan drain in the mixing plenum?	a	yes	Rain, mist and snow can often be drawn into the mixing chamber with the outdoor air. Moisture can increase the risk of microbial contamination of the HVAC components and direct dissemination into the air supply.	Drains are required to discharge and moisture.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Rain, mist and snow can often be drawn into the mixing chamber with the outdoor air. Moisture can increase the risk of microbial contamination of the HVAC components and direct dissemination into the air supply.	Drains are required to discharge and moisture.		Potential for source of microbial contaminants.	0	0	-3	0	0	
V	M	4	Is the drain trapped?	a	yes	Drains are required to be trapped to prevent foul air from the waste stack entering through the drain.	All condensate drains should be trapped to prevent foul air from the waste pipes entering the building.		No detriment to the IAQ	0	0	0	0	0	
				b	no	Drains are required to be trapped to prevent foul air from the waste stack entering through the drain.	All condensate drains should be trapped to prevent foul air from the waste pipes entering the building.		Potential source of gaseous pollutants.	0	0	0	-3	0	
V	M	5	Does the water seal in the trap have a trickle recharge of water?	a		Water sealed traps with low wate flow or dry periods can dry out and allow foul air from the waste stack to enter through the drain.	Trickle recharge of water seals are recommended to prevent traps drying out.		No detriment to the IAQ	0	0	0	0	0	

				b		Water sealed traps with low wate flow or dry periods can dry out and allow foul air from the waste stack to enter through the drain.	Trickle recharge of water seals are recommended to prevent traps drying out.		Potential source of gaseous pollutants.	0	0	0	-3	0	
V	M	6	Is the water seal in the trap of sufficient depth to prevent the water seal from oscillating and breaching under the high air pressure of the area above?	a	yes	Water sealed traps can lose their seal when high air pressure in th air handling unit or other such area force the water to oscillate over the head of the trap. This will permit foul air from the waste stack to enter the air conditioning system through the drain.	Deep water sealed traps or alternative air seals are recommended.		No detriment to the IAQ	0	0	0	0	0	
				b	no	Water sealed traps can lose their seal when high air pressure in th air handling unit or other such area force the water to oscillate over the head of the trap. This will permit foul air from the waste stack to enter the air conditioning system through the drain.	Deep water sealed traps or alternative air seals are recommended.		Potential source of gaseous pollutants.	0	0	0	-3	0	
V	M	7	Is the floor of the mixing box sloped to a drain?	a	yes	It is important to drain free water rather than allow it to evaporate back into the air stream.	The floor of all areas which could become wet should be sloped to a nearby drain.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	It is important to drain free water as likely as possible rather than allow it to evaporate back into th air stream.	The floor of all areas which could become wet should be sloped to a nearby drain.		Potential source of microbial contaminants.	0	0	-3	0	0	

V	M	8	Are the return air dampers air tight when closed?	a	yes	Leakiness of the return air dampers will preclude isolating the return airstream. This can allow pollutants from the return air stream to be re-entrained into the mixing chamber during periods when supply with 100% fresh air is required.	Air tight return air dampers are recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Leakiness of the return air dampers will preclude isolating the return airstream. This can allow pollutants from the return air stream to be re-entrained into the mixing chamber during periods when supply with 100% fresh air is required.	Air tight return air dampers are recommended.		Potential re-entrainment of indoor pollutants.	-3	-2	0	-3	0	
	M	9	Is the thermal/acoustic insulation protected from moisture, mechanical damage or erosion?	a	yes	Exposed insulation will release fibres into the air supply. It will also absorb moisture and provide a habitat for growth of microbials. Damp insulation will also have a substantially reduced performance.	All insulation should be protected from moisture, mechanical damage and erosion.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Exposed insulation will release fibres into the air supply. It will also absorb moisture and provide a habitat for growth of microbials. Damp insulation will also have a substantially reduced performance.	All insulation should be protected from moisture, mechanical damage and erosion.		Potential source of particulate matter and microbial contamination.	0	-2	-3	0	0	
			Filters (F)												

V	F	1	What type of filters are to be used?	a	mechanical	Mechanical filters with a moderate dust spot capacity (above 80% @ 0.3um) can remove most microbial agents and other particles of concern from the air stream. Good installation and maintenance are necessary components of the filter performance.	Mechanical filters with a dust spot capacity above 80% @ 0.3um is desirable.	outdoor sources of particulates, air exchange rate, access for maintenance	Opportunity to remove respirable particulate matter from the air supply.	0	3	0	0	0		
				b	electronic filters	Electronic filters can provide a high level of removal of particles at a low pressure drop. To perform to specification they need a very low air flow and regular cleaning of the collection plates.	Electronic filters are recommended in situations where a high level of maintenance and low air flows can be guaranteed.	outdoor sources of particulates, air exchange rate, access for maintenance	Opportunity to remove respirable particulate matter from the air supply.	0	3	0	0	0		
				c	charged media filters	Charged media filters are not ver effective at removing indoor air pollutants.	Charged media filters will not perform as effectively as mechanical filters with a moderate or better dust spot capacity.	outdoor sources of particulates, air exchange rate, access for maintenance	Opportunity to remove respirable particulate matter from the air supply.	0	2	0	0	0		
V	F	2	What is the arrestance capacity of the filters?	a	>95%	Arrestance is not as meaningful measure of the filters ability to remove the fine particles which are of concern for good indoor air quality compared to dust spot capacity.	Arrestance in excess of 95% is recommended.	outdoor sources of particulates, air exchange rate	Opportunity to remove respirable particulate matter from the air supply.	0	3	0	0	0		
				b	<95	Arrestance is not as meaningful measure of the filters ability to remove the fine particles which are of concern for good indoor ai quality compared to dust spot capacity.	Arrestance in excess of 95% is recommended.	outdoor sources of particulates, air exchange rate	Lost opportunity to remove respirable particulate matter from the air supply.	0	-2	-1	0	0		

V	F	3	What is the dust spot capacity of the filters?	a	>60%	Dust spot is the more meaningful measure of particle removal efficiency. A 60% @ 0.3um atmospheric dust spot efficiency filter will remove most microbial particles from the air stream.	60% or higher dust spot efficiency filters are recommended.	outdoor sources of particulates, air exchange rate	Opportunity to remove respirable particulate matter from the air supply.	0	3	0	0	0	
				b	30%-60%	Dust spot is the more meaningful measure of particle removal efficiency. A 30% - 60% atmospheric dust spot efficiency filter at least 5cm thick extended pleated surface is the minimum requirement for acceptable IAQ.	Filters with a dust spot arrestance greater than 60% are recommended.	outdoor sources of particulates, air exchange rate	Lost opportunity to remove respirable particulate matter from the air supply.	0	-2	-1	0	0	
				c	<30%	Dust spot is the more meaningful measure of particle removal efficiency. A filter rated at less than 30% atmospheric dust spot efficiency filter is unlikely to capture small respirable particles.	Filters below 30% dust spot arrestance are not recommended.	outdoor sources of particulates, air exchange rate	Lost opportunity to remove respirable particulate matter from the air supply.	0	-3	-2	0	0	
V	F	4	What is the extended surface of the filter?	a	<50mm	Increased filter surface area will increase filter performance by reducing pressure drop across filters and save on energy.	Filters with an extended surface in combination with high dust spot arrestance are recommended.	outdoor sources of particulates, air exchange rate	Opportunity to remove respirable particulate matter and nutrients from the air supply.	0	3	2	0	0	
				b	25 - 50 mm	Increased filter surface area will increase filter performance by reducing pressure drop across filters and save on energy.	Filters with a minimum extended surface of 25 - 50mm thick and rated at least 30-40% dust spot efficiency are the minimum acceptable recommended.	outdoor sources of particulates, air exchange rate	Opportunity to remove respirable particulate matter and nutrients from the air supply.	0	1	0	0	0	

				c	<25mm	Increased filter surface area will increase filter performance by reducing pressure drop across filters and save on energy.	Filters below 25mm extended surface are not recommended.	outdoor sources of particulates, air exchange rate	Lost opportunity to remove respirable particulate matter from the air supply.	0	-3	-2	0	0	
V	F	5	Are the filters tightly fitted into their frames?	a		The absence of gaps is critical to achieving the rated performance of the filter. Even a small gap around the filters will allow a larg volume of air to bypass the filter. This allows dirt and microbial spores to enter carry over to the cooling coils and distribution system.	Tight fitting, durable gasket sealed filter frames are recommended.		Opportunity to remove respirable particulate matter and nutrients from the air supply.	0	3	2	0	0	
				b		The absence of gaps is critical to achieving the rated performance of the filter. Even a small gap around the filters will allow a larg volume of air to bypass the filter. This allows dirt and microbial spores to enter carry over to the cooling coils and distribution system.	Tight fitting, durable gasket sealed filter frames are recommended.		Lost opportunity to remove respirable particulate matter and nutrients from the air supply.	0	-3	-2	0	0	
V	F	6	Are the filter frames tightly fitted into the air handling units?	a		The absence of gaps is critical to achieving the rated performance of the filter. Even a small gap around the filters will allow a larg volume of air to bypass the filter. This allows dirt and microbial spores to enter carry over to the cooling coils and distribution system.	A tight fit between the frames and AHU recommended.		Opportunity to remove respirable particulate matter and nutrients from the air supply.	0	3	2	0	0	

				b		The absence of gaps is critical to achieving the rated performance of the filter. Even a small gap around the filters will allow a larg volume of air to bypass the filter. This allows dirt and microbial spores to enter carry over to the cooling coils and distribution system.	A tight fit between the frames and AHU recommended.		Lost opportunity to remove respirable particulate matter from the air supply.	0	-3	-2	0	0	
V	F	7	Are the filter frames strong enough to resist the air resistance?	a		As the pressure drop increases, the force of the filter frames increase with a tendency to bow inwards. This opens up gaps around the filters and allows unfiltered air to enter the ventilation stream.	Tight seals between the filters and frames and AHU are recommended under all working conditions.		Opportunity to remove respirable particulate matter and nutrients from the air supply.	0	3	2	0	0	
				b		As the pressure drop increases, the force of the filter frames increase with a tendency to bow inwards. This opens up gaps around the filters and allows unfiltered air to enter the ventilation stream.	Tight seals between the filters and frames and AHU are recommended under all working conditions.		Lost opportunity to remove respirable particulate matter from the air supply.	0	-3	-2	0	0	
V	F	8	Are the filters easily accessed for inspection?	a	yes	Easy access will facilitate more inspections, which are very important for maintaining the hygiene of the system. Filters can become contaminated with fungi and bacteria and need regular hygiene checking.	Easy access for inspections are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Easy access will facilitate more inspections, which are very important for maintaining the hygiene of the system.	Easy access for inspections are recommended.		Potential source of particulates and microbial contamination.	0	-3	-3	0	0	

V	F	9	Are the filters easily accessed for replacement?	a	yes	Easy access with sufficient space surrounding the filter bank will facilitate replacement of the filters when required. This is very important for maintaining the hygiene of the system.	Easy access with sufficient room for replacing the filters is recommended.		Opportunity to remove particulate matter and nutrients from the air supply.	0	0	0	0	0	
				b	no	Easy access will facilitate more inspections, which are very important for maintaining the hygiene of the system.	Easy access for inspections are recommended.		Potential source of particulates and microbial contamination.	0	-3	-3	0	0	
V	F	10	Are prefilters installed?	a	yes	Prefilters capture a lot of particulate matter before it enters the system, and contribute to hygiene of the system. Prefilters are cheaper and extend the life o secondary filters.	Prefilters are recommended.		Opportunity to remove particulate matter from the air supply.	0	3	0	0	0	
				b	no	Prefilters capture a lot of particulate matter before it enters the system, and contribute to hygiene of the system. Prefilters are cheaper and extend the life o secondary filters.	Prefilters are recommended.		Potential source of particulates	0	-3	0	0	0	

V	F	11	How close are the prefilters and filters located to the air intakes:	a	>2m	Wind driven rain and rain droplets included in the air entering the air intakes can intrude into the plant room several meters. Organic nutrients and fungal spores will always be present on the filter media and can readily germinate with the addition of water. Microbial matter can then be directly included into the air stream and contaminate the ducting and other components. Moisture can also deteriorate the frames and allow air to bypass the filters.	Filters should recessing into the building at least 2m as a permanent and passive means of keeping them dry.		No detriment to IAQ.	0	0	0	0	0	
				b	<2m	Wind driven rain and rain droplets included in the air entering the air intakes can intrude into the plant room several meters. Organic nutrients and fungal spores will always be present on the filter media and can readily germinate with the addition of water. Microbial matter can then be directly included into the air stream and contaminate the ducting and other components. Moisture can also deteriorate the frames and allow air to bypass the filters.	Prefilters should be located close to the air intakes but protected from all moisture.		Potential source of microbiological contaminants.	0	0	-3	0	0	
V	F	12	How close are the pre-filters to the air intakes?	a	<5m	Prefilters should be located withi 2-5m of the air intakes to reduce the length of ducting exposed to unfiltered air.	Prefilters should be located close to the air intakes but protected from all moisture.		No detriment to IAQ.	0	0	0	0	0	

				b	>5m	Prefilters should be located within 2-5m of the air intakes to reduce the length of ducting exposed to unfiltered air.	Prefilters should be located close to the air intakes but protected from all moisture.		Potential source of particulates	0	-3	0	0	0	
V	F	13	Are pressure gauges installed to measure the pressure drop across filter banks?	a	yes	Accurate measurement of the pressure drop can provide reliable evidence of the filter performance and need to replace the filter media.	The installation of pressure gauges is recommended to assess the need for filter change. Magnehelic gauges are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Accurate measurement of the pressure drop can provide reliable evidence of the filter performance and need to replace the filter media.	The installation of pressure gauges is recommended to assess the need for filter change.		Potentially lose of efficiency of removal particulate matter and nutrients from the air supply.	0	-3	-2	0	0	
V	F	14	Are the filters installed up stream of the cooling coils and any humidification devices?	a		The air downstream of cooling coils and humidification devices has a relative humidity close to 100%. This is incompatible with preventing fungi and bacterial growth on filters, which should be kept below 60%RH at all times. Organic nutrients and fungal spores will always be present on the filter media and can readily germinate with the presence of moisture. Microbial matter can then be directly included into the air stream and contaminate the ducting and other components.	Filters should be located up stream of the cooling coils and humidifiers		No detriment to IAQ.	0	0	0	0	0	

				b		The air downstream of cooling coils and humidification devices has a relative humidity close to 100%. This is incompatible with preventing fungi and bacterial growth on filters, which should be kept below 60%RH at all times. Organic nutrients and fungal spores will always be present on the filter media and can readily germinate with the presence of moisture. Microbial matter can then be directly included into the air stream and contaminate the ducting and other components.	Filters should be located up stream of the cooling coils and humidifiers		Potential source of microbiological contaminants.	0	0	-3	0	0	
V	F	15	Are bag type filters supported from collapsing at low air velocity?	a		Arrested particles will be disturbed when the filters reinflate. Sudden movement of the filter bags can re-release arrested particles into the air stream.	Filter support frames are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b		Arrested particles will be disturbed when the filters reinflate. Sudden movement of the filter bags can re-release arrested particles into the air stream.	Filter support frames are recommended.		Potential source of particulate matter.	0	-3	0	0	0	

V	F	16	Are the filters impregnated with carbon?	a	yes	Carbon can remove odours and VOCs from the air stream. This maybe treating the symptom rather than the cause of the problem, such as the odour of vehicle exhaust if the air intake is incorrectly located. Difficulties arise from knowing when the carbon is saturated and requiring replacement. They are however useful during and after construction work.	It is advisable to remove the source of the odour or VOCs rather than the symptom.		Potential reduction in VOCs.	2	0	0	0	0	
				b	no	Carbon can remove odours and VOCs from the air stream. This maybe treating the symptom rather than the cause of the problem, such as the odour of vehicle exhaust if the air intake is incorrectly located.	It is advisable to remove the source of the odour or VOCs rather than the symptom.		No detriment to IAQ.	0	0	0	0	0	
			Cooling Systems (CS)												

V	CS	1	Is the building's ventilation system fitted with a cooling system?	a	night cooling of thermal mass, supplemented with mechanical cooling	Night cooling of the thermal mass, can increase the thermal comfort for the occupants and improve the quality of the indoor air. Outdoor concentrations of gaseous pollutants and particulate matter are generally lowest in the early hours of the morning. Consequently ventilating the building at night al will simultaneously flush the building of indoor contaminants and cool the structure. Night cooling in conjunction with mechanical cooling strategies can reduce the requirements of the cooing plant, and consequently reduce some of the risk of microbial contamination. Careful modelling of the design and thermal loads is required.	Natural cooling of building is recommended as it can reduce or eliminate the risks of microbia contamination associated with mechanical cooling systems.		Potential increase ir thermal comfort and reduction in microbial contamination, particulate matter and gases.	0	2	2	2	3	
				b	full mechanical system	Cooling the air supply will help to reduce the absolute humidity of the air, as well as aiding thermal comfort. Care needs to be taken with appropriate collection and drainage of the condensate.	Well designed and maintained cooling coils can improve the quality of the indoor air.		Potential increase ir thermal comfort, bu potential source of microbial contamination.	0	0	-2	0	3	

				c	natural	Natural cooling strategies, such as night cooling of the thermal mass, can increase the thermal comfort for the occupants, improve the quality of the indoor air by using free coolth from the outdoor air. Outdoor concentrations of gaseous pollutants and particulate matter are generally lowest in the early hours of the morning. Consequently ventilating the building at night air will simultaneously flush the building of indoor contaminants and cool the structure. Careful modelling of the design and thermal loads i required.	Natural cooling of building is recommended. Careful modelling of the thermal loads and whole building design is recommended.	outdoor air pollutants	Potential increase ir thermal comfort anc reduction in microbial contamination, particulate matter and gases.	0	2	2	2	3	
				d	no	Cooling the air supply will help to reduce the absolute humidity of the air, as well as aiding thermal comfort. Emissions of VOCs from building materials etc increase with air temperature anc relative humidity, therefore controlling the indoor temperatur can have flow benefits for the indoor air quality.	Maintaining the indoor temperature within the thermal standards is recommended.		Potential increase ir emissions of VOCs, as well as a decrease in thermal comfort.	-2	0	0	0	-3	Skip to next section
V	CS	2	Is the building fitted with a:	a	air cooled cooling tower	Air cooled systems are not a risk for microbiological contamination	Air cooling systems are recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	water cooled cooling tower	Water cooling systems provide ripe environments for the propagation of bacteria and fungi Wet cooling towers are a frequent sources of contamination and require carefu design, including provision for maintenance. The location of the cooling tower requires considerable attention and consideration needs to be given to the location of air intakes, window openings and other pathways which contaminants from the cooling tower could potentially enter the building.	Air cooling systems are recommended.	air intakes, window openings, entrances, wind modelling	Potential source of microbiological contaminants.	0	0	-3	0	0	
				c	neither				No detriment to the IAQ.	0	0	0	0	0	
V	CS	3	Is the temperature of the air leaving cooling deck above dew point?	a	yes	Some water droplets will form from the humidity present in the air if the air is cooled below the dew point. These will wet the surfaces of the ventilation system and growth and amplification of microbial organisms will result on the surfaces down stream of the cooling coils.	The cooling coils should not coo the air below the dew point.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Some water droplets will form from the humidity present in the air if the air is cooled below the dew point. These will wet the surfaces of the ventilation system and growth and amplification of microbial organisms will result on the surfaces down stream of the cooling coils.	The cooling coils should not coo the air below the dew point.		Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	4	Is the air temperature near the coils always above dew point when the cooling coils are off?	a	yes	Residual cooling capacity in the cooling coils at the time of shut off of the system can cool the air in the air handling box below the dew point. Condensation can then occur and wet the surfaces. This can provide sufficient moisture for the growth and amplification of microbial organisms.	It is recommended that the shut off of the air flow through the air handling boxes is delayed until the cooling coils have returned t ambient temperature.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Residual cooling capacity in the cooling coils at the time of shut off of the system can cool the air in the air handling box below the dew point. Condensation can then occur and wet the surfaces. This can provide sufficient moisture for the growth and amplification of microbial organisms.	It is recommended that the shut off of the air flow through the air handling boxes is delayed until the cooling coils have returned t ambient temperature.		Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	5	Is the air velocity within 8m of cooling deck always below 5m/s?	a	yes	High air velocities can carry wate droplets further into the ventilation system and spread the areas at risk of microbial contamination. This increases the areas requiring special inspection, cleaning and treatment.	Velocities below 5m's are recommended through the cooling coil.		No detriment to IAQ.	0	0	0	0	0	

				b	no	High air velocities can carry wate droplets further into the ventilation system and spread th areas at risk of microbial contamination. This increases the areas requiring special inspection, cleaning and treatment.	Velocities below 5m's are recommended through the cooling coil.		Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	6	Is the maximum permissible face velocity (volumetric air flow rate divided by the area of the face of the coils) able to be exceeded?	a	no	This will increase the potential fo condensation droplets to be carried over in the air stream.	The face velocity should not be able to be exceeded.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	This will increase the potential fo condensation droplets to be carried over in the air stream.	The face velocity should not be able to be exceeded.	Fan capacity	Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	7	Are the cooling coils designed for zero carry over of water droplets?	a	yes	Water droplets carried beyond the cooling coils can wet adjacen surfaces and establish sites for microbial amplification.	Cooling coils designed with zero water carry over are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Water droplets carried beyond the cooling coils can wet adjacen surfaces and establish sites for microbial amplification.	Cooling coils designed with zero water carry over are recommended.		Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	8	Is their potential for deposition of organic matter on the cooling coils:	a	low	Low deposition of organic material will result from high efficiency filtration and a clean ai supply. Organic material will provide nutrients for microbial growth and amplification as it is highly probable that moisture will be present.	Cleanliness of the cooling coils and the zone immediately down stream of the coils is very important Dust holds more moisture and provides a favourable host site for the growth and amplification of microbiological organisms.	filters, outdoor concentration of organic material	No detriment to IAQ.	0	0	0	0	0	

				b	medium	deposition of organic material wil provide nutrients for microbial contamination. As it is highly probable that moisture will be present, fungi and bacteria can proliferate and communicate viable spores and by-products directly into the air supply.	Cleanliness of the cooling coils and the zone immediately down stream of the coils is very important Dust holds more moisture and provides a favourable host site for the growth and amplification of microbiological organisms.	filters, outdoor concentration of organic material	Potential source of microbial contamination.	0	0	-2	0	0	
				c	high	deposition of organic material wil provide nutrients for microbial contamination. As it is highly probable that moisture will be present, fungi and bacteria can proliferate and communicate viable spores and by-products directly into the air supply.	Cleanliness of the cooling coils and the zone immediately down stream of the coils is very important Dust holds more moisture and provides a favourable host site for the growth and amplification of microbiological organisms.	filters, outdoor concentration of organic material	Potential source of microbial contamination.	0	0	-3	0	0	
V	CS	9	What is downstream of the cooling coils, within the first 3m?	a	Bend of 45 degrees or greater	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Bends should not be located within the first 8m of the cooling coils.		Potential source of microbial contamination.	0	0	-3	0	0	
				b	Constriction in duct	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Constrictions in the duct should not occur within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-3	0	0	

				c	Air filter bank	Air filters are loaded with organic nutrient matter and will readily amplify fungi and bacteria if moisture is present. Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Air filters should not be located downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-3	0	0	
				d	Acoustic baffle	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Acoustic baffles should not be located within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-3	0	0	
				e	Fire damper	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Fire dampers should not be located within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-3	0	0	

V	CS	10	What is downstream of the cooling coils within the next 3-8m?	a	Bend of 45 degrees or greater	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Bends should not be located within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-2	0	0	
				b	Constriction in duct	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Constrictions in the duct should not occur within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-2	0	0	
				c	Air filter bank	Air filters are loaded with organic nutrient matter and will readily amplify fungi and bacteria if moisture is present. Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Air filters should not be located downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-2	0	0	

				d	Acoustic baffle	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Acoustic baffles should not be located within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-2	0	0	
				e	Fire damper	Obstructions are prone to collect water droplets and organic matter. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites.	Fire dampers should not be located within the first 8m downstream of the cooling coils.		Potential source of microbial contamination.	0	0	-2	0	0	

V	CS	11	Are there access points for cleaning and maintenance adjacent to the cooling coils?	a	yes	Access points for maintenance are vital to the hygienic operation of the cooling coils. As cooling coils are regularly wet with condensation, they require regular cleaning to remove microbiological contaminants. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites. Obstructions, such as the lips of access hatches are prone to collect water droplets and organic matter, therefore access hatches should be located upstream of the cooling coils where possible or alternatively they should be constructed as smoothly as possible. Dirt on the coils can reduce the cooling capacity. Heavily soiled coils can increase the pressure drop over the coils which further reduces the cooling capacity and volume of air able to be delivered.	Easy access to all parts of the cooling coils and surrounds is highly recommended.		No detriment to the IAQ.	0	0	0	0	0	

				b	no	Access points for maintenance are vital to the hygienic operation of the cooling coils. As cooling coils are regularly wet with condensation, they require regular cleaning to remove microbiological contaminants. As the cooling coils and the zone immediately down stream of the coils present a high risk for the growth and amplification of microbial organisms it is important to eliminate host sites. Obstructions, such as the lips of access hatches are prone to collect water droplets and organic matter, therefore access hatches should be located upstream of the cooling coils where possible or alternatively they should be constructed as smoothly as possible. Dirt on the coils can reduce the cooling capacity. Heavily soiled coils can increase the pressure drop over the coils which further reduces the cooling capacity and volume of air able to be delivered.	Easy access for cleaning of all surfaces of the cooling coils and surrounds should be provided.		Potential source of microbial contamination.	0	0	-3	0	0	

V	CS	12	Are cut off blades or drift eliminators installed up and down stream of the cooling coils?	a	yes	Strong cleaning solutions are frequently required to clean the cooling coils. To prevent the spread of these chemicals during the cleaning process, the installation of retractable chlorine resistant cut off blades should be installed to isolate the cooling coils from other parts of the HVAC system.	Blades or other devices which will contain cleaning chemicals to the area surrounding the cooling coils are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Strong cleaning solutions are frequently required to clean the cooling coils. To prevent the spread of these chemicals during the cleaning process, the installation of retractable chlorine resistant cut off blades should be installed to isolate the cooling coils from other parts of the HVAC system.	Blades or other devices which will contain cleaning chemicals to the area surrounding the cooling coils are recommended.		Potential source of gaseous pollutants and VOCs.	-2	0	0	-2	0	
V	CS	13	Is adequate low voltage waterproof lighting provided to illuminate all both the upstream and down stream sides of the coils?	a	yes	Lighting is important to facilitate thorough inspection and maintenance.	Waterproof low voltage lighting on both sides of the cooling coils is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Lighting is important to facilitate thorough inspection and maintenance.	Waterproof low voltage lighting should be provide on both sides of the cooling coils.		Potential hindrance to removal of microbial contamination.	0	0	-2	0	0	

V	CS	14	Can all surfaces adjacent to the cooling coils, including access hatch seals and lighting withstand cleaning with 5% chlorine?	a	yes	All components of the coiling coils will require thorough cleaning through out the life of the building.	Chlorine resilient materials are recommended to allow thorough cleaning of all components.		No detriment to IAQ.	0	0	0	0	0	
				b	no	All components of the coiling coils will require thorough cleaning through out the life of the building.	Chlorine resilient materials are recommended to allow thorough cleaning of all components.		Potential hindrance to removal of microbial contamination.	0	0	-2	0	0	
V	CS	15	Is UV light disinfection provided to the cooling coils?	a	yes	UV light will inhibit the growth of bacteria. Installation is recommended close to the coils and other potentially wet surfaces.	UV lights close to the coils are recommended.		Potential reduction in microbial contaminants.	0	0	2	0	0	
				b	no	UV light will inhibit the growth of bacteria. Installation is recommended close to the coils and other potentially wet surfaces.	UV lights close to the coils are recommended.		No improvement in IAQ	0	0	0	0	0	
V	CS	16	Does the cooling system have sufficient capacity to compensate for the internal (people plus equipment) and external (solar) loads?	a	yes	Excess heat can be considered a degradation of IAQ. Further if the demand for cooling exceeds the cooling capacity it is tempting to increase the fan speed to introduce more cool air. This can cause the carry over of water droplets onto other components of the air conditioning system, which can create other sites for microbial contamination.	Sufficient heat capacity is recommended.		No detriment to the IAQ.	0	0	0	0	3	

				b	no	Excess heat can be considered a degradation of IAQ. Further if the demand for cooling exceeds the cooling capacity it is tempting to increase the fan speed to introduce more cool air. This can cause the carry over of water droplets onto other components of the air conditioning system, which can create other sites for microbial contamination. Over heating in the building will increase the rate of emissions of VOCs.			Potential source of microbial contamination, VOC and thermal discomfort.	-2	0	-3	0	-3	
			Condensate Drain Pans (CD)												
V	CD	1	Is the tray of the condensate tray sloped by more than 1:12 towards the drain?	a	yes	To prevent microbial growths it is important that all moisture should drain completely and quickly.	Condensate trays should be sloped at a fall of more than 1:12 towards a drain.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	To prevent microbial growths it is important that all moisture should drain completely and quickly.	Condensate trays should be sloped at a fall of more than 1:12 towards a drain.		Potential source of microbial contamination.	0	0	-2	0	0	
V	CD	2	Does the drain connect to the lowest part of the tray without a lip or other obstruction?	a		To prevent microbial growths it is important that all moisture should drain completely and quickly.	Water should be able to enter the drain freely without a residue pool forming around the lip of the drain.		No detriment to the IAQ.	0	0	0	0	0	

				b		To prevent microbial growths it is important that all moisture should drain completely and quickly.	Water should be able to enter the drain freely without a residue pool forming around the lip of the drain.		Potential source of microbial contamination.	0	0	-1	0	0	
V	CD	3	Is the condensate tray deeper than the anticipated high water level?	a		Water overflowing condensate trays will wet surrounding materials and lead to propagation of fungi and bacteria.	The depth of the condensate tra should be generously proportioned.		No detriment to the IAQ.	0	0	0	0	0	
				b		Water overflowing condensate trays will wet surrounding materials and lead to propagation of fungi and bacteria.	The depth of the condensate tra should be generously proportioned.		Potential source of microbial contamination.	0	0	-2	0	0	
V	CD	4	Is it possible for debris to enter the condensate tray?	a	no	Debris will absorb and hold moisture and provide nutrients fo microbial growth or block off the drain pipe and lead to standing water.	Mesh screens to prevent debris entering the trap should be installed.		No detriment to the IAQ.	0	0	0	0	0	
				b	yes	Debris will absorb and hold moisture and provide nutrients fo microbial growth or block off the drain pipe and lead to standing water.	Mesh screens to prevent debris entering the trap should be installed.		Potential source of microbial contamination.	0	0	-2	0	0	
V	CD	5	Is the drain trapped?	a	yes	Drains are required to be trapped to prevent foul air from the waste stack entering through the drain. Foul air can consist of a mixture of gaseous pollutants and unpleasant odours. Foul air which finds it way into the air handling unit will be readily communicate with the remained of the building.	Drains from condensate trays should be trapped.		No detriment to the IAQ.	0	0	0	0	0	

				b	no	Drains are required to be trappec to prevent foul air from the waste stack entering through the drain. Foul air can consist of a mixture of gaseous pollutants and unpleasant odours. Foul air which finds it way into the air handling unit will be readily communicate with the remained of the building.	Drains from condensate trays should be trapped.		Potential pathway for gaseous pollutants and malodours to enter the building.	0	0	0	-3	0	
V	CD	6	Does the water seal in the trap have a trickle recharge of water?	a		Water sealed traps with low wate flow or dry periods can dry out and allow foul air from the waste stack to enter through the drain.	Trickle recharge of water seals are recommended to prevent traps drying out.		No detriment to the IAQ.	0	0	0	0	0	
				b		Water sealed traps with low wate flow or dry periods can dry out and allow foul air from the waste stack to enter through the drain.	Trickle recharge of water seals are recommended to prevent traps drying out.		Potential pathway for gaseous pollutants and malodours to enter the building.	0	0	0	-3	0	
V	CD	7	Is the water seal in the trap of sufficient depth to prevent the water seal from oscillating or siphoning under the high air pressure differentials on eithe side of the trap?	a		Loss of the water seal will allow foul air to enter the air supply.	The effective height of the water trap should be 40% greater than the expected peak static pressure of the supply air fan.		No detriment to the IAQ.	0	0	0	0	0	

				b		Loss of the water seal will allow foul air to enter the air supply.	The effective height of the water trap should be 40% greater than the expected peak static pressure of the supply air fan.		Potential pathway for gaseous pollutants and malodours to enter the building.	0	0	0	-3	0	
V	CD	8	Is there easy access to the condensate pan and trap for inspection and maintenance?	a	yes	Cleaning and maintenance can prevent the tray being blocked and overflowing and will allow an contamination to be removed.	Easy access to the drain pan and trap for maintenance and cleaning is recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Cleaning and maintenance can prevent the tray being blocked and overflowing and will allow an contamination to be removed.	Easy access to the drain pan and trap for maintenance and cleaning is recommended.		Potential source of microbial contamination.	0	0	-2	0	0	
	CD	9	Are the condensate trays constructed from:	a	stainless steel	Microbial colonies can grow on many substrates including some plastics and petrochemical products. Care needs to be taken in the selection so that viable spores are given as little opportunities to propagate as possible.	Stainless steel is the preferred material for the construction of condensate trays.		No detriment to the IAQ.	0	0	2	0	0	
				b	other smooth non-porous material with smooth non-porous joints	Microbial colonies can grow on many substrates including some plastics and petrochemical products. Care needs to be taken in the selection so that viable spores are given as little opportunities to propagate as possible.	Materials data sheets should be inspected prior to installation of all components including seals to verify that all materials do not support microbial growth.		Potential source of microbial contamination.	0	0	-1	0	0	

				c	porous or rough materials or materials with porous or rough joints	Microbial colonies can grow on many substrates including some plastics and petrochemical products. Care needs to be taken in the selection so that viable spores are given as little opportunities to propagate as possible.	Materials data sheets should be inspected prior to installation of all components including seals to verify that all materials do not support microbial growth.		Potential source of microbial contamination.	0	0	-3	0	0	
V	CD	10	Are all components, including seals, made from materials which do not support microbial growth and are seamless, with rounded corners and with no rough areas?	a	yes	Microbial colonies can grow on many substrates including some plastics and petrochemical products. Care needs to be taken in the selection so that viable spores are given as little opportunities to propagate as possible.	All parts of the condensate trays should be smooth, seamless free draining and easily cleaned		No detriment to the IAQ.	0	0	2	0	0	
				b	no	Microbial colonies can grow on many substrates including some plastics and petrochemical products. Care needs to be taken in the selection so that viable spores are given as little opportunities to propagate as possible.	All parts of the condensate trays should be smooth, seamless free draining and easily cleaned		Potential source of microbial contamination.	0	0	-2	0	0	
			Are the condensate trays insulated?	a	no	Insulation can readily absorb moisture and support microbial contaminants.	Insulation is not recommended in condensate trays.		No detriment to the IAQ.	0	0	2	0	0	
				b	yes	Insulation can readily absorb moisture and support microbial contaminants.	Insulation is not recommended in condensate trays.		Potential source of microbial contamination.	0	0	-2	0	0	
			Heating Coils (HC)												

V	HC	1	Do the heating coils have sufficient capacity to maintain a comfortable thermal environment and allow the tempering of cold outdoor air in winter?	a	yes	Lack of heat can be considered a degradation of IAQ. If the outside air temperature is below the thermal comfort range it is tempting to decrease the supply of outdoor air, which can lead to the accumulation of internally generated pollutants.	Correctly sized heating coils are recommended.		No detriment to the IAQ.	0	0	0	0	0	
				b	no	Lack of heat can be considered a degradation of IAQ. If the outside air temperature is below the thermal comfort range it is tempting to decrease the supply of outdoor air, which can lead to the accumulation of internally generated pollutants.	Correctly sized heating coils are recommended.		Potential source of thermal discomfort.	0	0	0	0	-3	
			Humidifiers (HM)												
	HM	1	Does the building have a humidifier?	a	no	Humidifiers are very frequent sources of microbiological contamination within the air stream.	Humidifiers are not recommended.		No detriment to IAQ.	0	0	0	0	0	
V				b	yes	Humidifiers are very frequent sources of microbiological contamination within the air stream.	Water spray or media humidifiers are not recommended.		Potential source of microbial contamination.	0	0	-3	0	0	
V	HM	2	Is the humidifier supplied with water from:	a	potable quality mains supply	Potable quality mains water has fewer problems with aerosolising bacteria spores into the air suppl than reservoirs.	Supplying humidifiers with water from the mains is preferable to a reservoir.		Reduction of microbial risk.	0	0	2	0	0	

				b	a reservoir	Reservoirs are very frequent sources of bacteria which are aerosolised into the air stream. Many chemicals used to preserve the quality of water are hazardous the health if aerosolised.	Supplying humidifiers with water from reservoirs should not be used.		Potential source of microbial contamination.	0	0	-3	0	0	
V	HM	3	Is the humidifier operated with:	a	steam	Steam humidifiers are less prone to the amplification of microorganisms than cold mist systems. Steam to steam converters are preferable other types of steam generation systems.	Steam to steam converters are preferable to other types of steam generation or cold mist systems.		Reduction of microbial risk.	0	0	2	0	0	
				b	cold mist vaporisers or media	Cold mist and media humidifiers are very prone to the amplification of microorganism.	Cold mist vaporisers and media humidifiers should not be used.		Potential source of microbial contamination.	0	0	-3	0	0	
V	HM	4	Are all surfaces within 3m downstream of the humidifiers?	a	non porous	non porous surfaces are less likely to hold moisture and have a lower risk of microbial contamination than porous surfaces.	All surfaces down stream of the humidifiers should be non porous.		Reduction of microbial risk.	0	0	2	0	0	
				b	porous	Porous surfaces will hold moisture and have a high risk of amplification of microorganisms.	Porous surfaces should not be used within 3m and preferable 10m of humidifiers.		Potential source of microbial contamination.	0	0	-3	0	0	
				c	warm	Warm surfaces are less like to form condensation and therefore have a lower risk of microbial contamination than cold surfaces.	All surfaces down stream of the humidifiers should be kept warm.		Reduction of microbial risk.	0	0	2	0	0	
				d	cold	Cold surfaces especially downstream of the humidifiers will readily form condensation and pose a high risk of microbial contamination.	Cold surfaces should not be allowed downstream of the humidifiers.		Potential source of microbial contamination.	0	0	-3	0	0	

			Access Hatches (AH)												
V	AH	1	Do all access hatches form an air tight seal when closed?	a	yes	Leakiness of the access hatches can allow contaminants to enter the supply airstream or supply ai to leak out of the ducts.	Access hatches should be designed to form air tight seals throughout the service life of the building.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Leakiness of the access hatches can allow contaminants to enter the supply airstream or supply ai to leak out. Access hatches should be rigid enough to provide a tight seal with minimal fixing devices and should be gasket sealed.	Access hatches should be designed to form air tight seals throughout the service life of the building.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generated bioeffluents.	-2	-2	-2	-2	-2	
V	AH	2	Are the access hatches secured with:	a	clamping type latches	To encourage inspections and maintenance of the building's services access hatches should be as easy to remove and replac as possible. There is a tendency for numerous fixings to not all be replaced when the access panel is closed, which can compromise the tightness of the seal.	Clamping type latches which are easy for maintenance personnel etc to remove and reinstall access hatches and provide air tight seals are recommended.		No detriment to IAQ.	0	0	0	0	0	

				b	numerous screws or nuts	To encourage inspections and maintenance of the building's services access hatches should be as easy to remove and replac as possible. There is a tendency for numerous fixings to not all be replaced when the access panel is closed, which can compromise the tightness of the seal in through out the life of the building. This can lead to excessive leakiness of the ducts, cross contamination of contaminants into the breathing air or the accumulation of dust in the ducting.	Numerous screw fixings are not recommended and self tapping screws are not acceptable.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generatec bioeffluents.	-1	-1	-1	-1	-1	
				c	devices requiring special tools	To encourage inspections and maintenance of the building's services access hatches should be as easy to remove and replac as possible. There is a tendency for numerous fixings to not all be replaced when the access panel is closed, which can compromise the tightness of the seal in through out the life of the building. This can lead to excessive leakiness of the ducts, cross contamination of contaminants into the breathing air or the accumulation of dust in the ducting.	Fixings which require special tools are not recommended.		Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generatec bioeffluents.	-2	-2	-2	-2	-2	

V	AH	3	Is there sufficient space adjacent to the access hatch both inside and outside of the equipment to allow inspections and maintenance to be undertaken?	a	yes	To encourage inspections and maintenance, adequate room for maintenance personnel and equipment should be provided to access all vulnerable areas of the HVAC system.	Provision of sufficient room for conducting necessary maintenance both inside and outside the components of the HVAC system is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	To encourage inspections and maintenance, adequate room for maintenance personnel and equipment should be provided to access all vulnerable areas of the HVAC system.	Provision of sufficient room for conducting necessary maintenance both inside and outside the components of the HVAC system is recommended.		Potential source of particulates, and microbial contaminants.	0	-2	-2	0	0	
V	AH	4	Are the openings rigidly framed to prevent distortion under operational and servicing conditions?	a	yes	Adequate reinforcing of the duct opening is necessary to prevent air leaking out of the supply side of the system which can compromise the quantity of supply air and entry of contaminates from outside the system which can compromise the air quality.	Rigid reinforcing of the access opening is recommended.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Adequate reinforcing of the duct opening is necessary to prevent air leaking out of the supply side of the system which can compromise the quantity of supply air and entry of contaminates from outside the system which can compromise the air quality. This can lead to excessive leakiness of the ducts, cross contamination of contaminants into the breathing air or the accumulation of dust in the ducting.	Access openings should be reinforced to prevent distortion under operational and servicing conditions.		Potential source of particulates, and microbial contaminants.	0	-2	-2	0	0	
V	AH	5	Is the floor of the AHU strong enough to support all maintenance loads without distortion?	a	yes	Adequate reinforcing of the floor of the duct or AHU is necessary to prevent distortion and degradation of the seal around the access door. This could allow air to leak out of the supply side of the system which can compromise the quantity of supply air and entry of contaminants from outside the system which can compromise the air quality. Bonded insulation material on the floor of the AHU should be protected with perforated metal plates or similar	The floor of the AHU and /or ducts should be adequately reinforced where personnel ente the system.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Adequate reinforcing of the floor of the duct or AHU is necessary to prevent distortion and degradation of the seal around the access door. This could allow air to leak out of the supply side of the system which can compromise the quantity of supply air and entry of contaminants from outside the system which can compromise the air quality. This can lead to excessive leakiness of the ducts, cross contamination of contaminants into the breathing air or the accumulation of dust in the ducting.			Potential for under estimation of the dilution VOCs, particulates, moisture, microbial contaminants and occupant generatec bioeffluents.	-1	-1	-1	-1	-1	
			Ducting (DT)												
V	DT	1	Will the ducting be cleaned of lubricant oil emulsions prior to installation?	a	yes	Residues of lubricant oils promote the accumulation of dus and provide nutrients for fungi if sufficient moisture is present.	Removal of all oil residue from ductwork is recommended before installation.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Residues of lubricant oils promote the accumulation of dus and provide nutrients for fungi if sufficient moisture is present.	All oil residues should be removed before installation.		Potential source of VOCs and microbia contamination.	-2	0	-2	0	0	
V	DT	2	Will all duct work be located in warm spaces?	a	yes	Water vapour inside ducting can condense if the ducting passes through cold zones and especially when the system is turned off overnight and weekends.	Ductwork should be located in continuously warm areas or the system should be run continuously to prevent warm moist air flowing back into the ducts.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Water vapour inside ducting can condense if the ducting passes through cold zones and especially when the system is turned off overnight and weekends.	Ductwork should be located in continuously warm areas or the system should be run continuously to prevent warm moist air flowing back into the ducts.		Potential source of microbial contamination.	0	0	-2	0	0	
V	DT	3	Will the ducts be insulated?	a	Double skin mild steel sandwich insulated	Double skin insulated ducting protects the insulation against moisture and organic matter, and therefore microbial contamination both sides of the duct skin. It is also cleanable. Attenuators to reduce the transmission of fan noise through the duct are recommended.	Double skin insulation is a recommended material for good IAQ wherever there is the potential for moisture or low temperatures on either side of the duct.		Reduction of the risk of microbial contamination within ducting.	0	3	3	0	3	
				b	Single skin mild steel, externally insulated	Water vapour inside ducting can condense if the ducting passes through cold zones. External insulation helps prevent the formation of condensation and also allows the internal surfaces to be cleaned. However external insulation can become damaged, which would lead to thermal bridges and localised sites of condensation. Insulation will help to prevent condensation occurring within the duct and help reduce the transmission of fan noise.	Externally insulated ducts are recommended where the risk of moisture on the outside of the ducts is very low.		Reduction of the risk of microbial contamination within ducting.	0	2	2	0	2	

				c	Single skin mild steel, internally insulated	The rough surface of internally insulated ducting will collect dust which bypasses the filtration system. Internally insulated ducts provide ripe host environments for microbial contamination, if moisture is not completely excluded from the air distribution system. Internal insulation is impossible to be cleaned effectively, which will cause problems during the life of the building. There is also some evidence to suggest that the insulation maybe eroded due to the constant movement of air over the surface, and liberated particles will be released into the supply air stream. Many insulation products are also treated with phenols, which can be released directly into the air stream.	Internally insulated ducts are no recommended.		Potential source of particulate matter, VOCs and microbia contamination.	-1	-3	-3	0	3	

				d	Fibreglass duct board	Fibreglass duct board can release phenols and other VOCs into the airstream. The foil coating can perforate during installation or duct cleaning which will expose the insulation to the air stream. This can lead to the accumulation of dirt and moisture on the insulation and microbial contamination or liberation of insulation particles. Duct board also does not fare well under high pressure or air velocity.	Duct board is not a recommended material for good IAQ.		Potential source of microbial contaminants and VOCs.	-2	-2	-2	0	3	
				e	Uninsulated mild steel	Condensation can form on the inside the ducting when the air supply stream is cooler than the air outside the duct, or on the outside of the duct when the air supply is warmer. The condensation will support for the growth of fungi and bacteria. Microbials grown on the inside of the ducts will be directly communicated with the occupied areas. Spores outside of the ducts can find their way into the indoor air via plenums and other indirect routes. Heat will readily transfer through the duct wall and the benefits of tempering the air will be lost. Bare metal ducts are able to be cleaned.	Uninsulated ducting is not recommended.		Potential source of microbial contaminants and thermal discomfort.	0	0	-3	0	-2	

V	DT	4	What ducting type is installed within the first 8m downstream of the cooling coils?	a	Double skin mild steel internally with rigid outer skin, sandwich insulated	Double skin insulated ducting protects the insulation against moisture and organic matter, anc consequently microbial contamination, and is cleanable. Alternative means of reducing th transmission of fan noise throug the duct, such as acoustic dampers will be required.	Double skin insulation is a recommended material whereve there is the potential for moistur or low temperatures on either side of the duct.		No detriment to IAQ.	0	0	0	0	0	
				b	Single skin mild steel externally insulated	External insulation helps prevent the formation of condensation and also allows the internal surfaces to be cleaned. Howeve external insulation can become damaged, which would lead to thermal bridges and localised sites of condensation. The condensation will provide moisture for the growth and amplification of microbiological organism.	External insulation of surfaces will help control condensation and growth of microbial organism. Protection from mechanical damage is required.		No detriment to IAQ.	0	0	0	0	0	

				c	Uninsulated mild steel	Warmer air outside the AHU/ducting and a lack of insulation can cause condensation to form on the outside and inside surfaces downstream and near the coils. The condensation will provide moisture for the growth and amplification of microbiological organism. Any particulate matter and water droplets carried over from the filters or coils will aid the host conditions. Bare metal ducts are able to be cleaned if access is provided.	Surfaces near and downstream from the coils should be insulated and scrubable, but should not harbour sites for microbial organisms to grow.		Potential source of microbial contaminants and thermal discomfort.	0	0	-2	0	-2	
				d	Single skin mild steel internally insulated	Internally insulated ducting can collect particulate matter and this can absorb moisture making a ripe environment for growth and amplification of microbiological organism. It is also not able to be cleaned.	Internally lined ducts should not be used downstream of the cooling coils.		Potential source of microbial contaminants.	0	0	-3	0	0	

				e	Fibreglass duct board	Fibreglass duct board can release phenols and other VOCs into the airstream. The foil coating can perforate during installation or duct cleaning which will expose the insulation to the air stream. This can lead to the accumulation of dirt and moisture on the insulation and microbial contamination. Duct board is not suitable within 8m of the cooling coil where regular and vigorous cleaning will be required during the life of the building. Duct board also does not fare well under high pressure or air velocity.	Duct board is not a recommended material near the cooling coils.	Filter type	Potential source of microbial contaminants, VOCs and particulates.	-1	-2	-3	0	0	
V	DT	5	Will the ducting pass through humid areas?	a	yes	A high vapour pressure outside the duct can force moisture into the duct and cause condensation at the next cool spot.	Ductwork should be run through dry areas only. Ducts passing through humid areas should be well sealed.		No detriment to IAQ.	0	0	0	0	0	
				b	no	A high vapour pressure outside the duct can force moisture into the duct and cause condensation at the next cool spot. Externally insulated ducting should not be run through humid plenums or other such areas.	Ductwork should be run through dry areas only. Ducts passing through humid areas should be well sealed.		Potential source of microbial contamination.	0	0	-2	0	0	

V	DT	6	Are all air stream surfaces resistant to erosion?	a	yes	Erosion of the air stream surfaces will contribute to particulate concentration in the supply air stream. Rough eroded surfaces will collect dust and can provide ideal sites for microbial contamination if sufficient moisture is present.	Air stream surfaces which do not break away, crack, peel, flake or delaminate are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Erosion of the air stream surfaces will contribute to particulate concentration in the supply air stream. Rough eroded surfaces will collect dust and can provide ideal sites for microbial contamination if sufficient moisture is present.	Air stream surfaces which could either break away, crack, peel, flake or delaminate are not acceptable.		Potential source of particulate matter.	0	-3	0	0	0	
V	DT	7	Will rapid changes in direction of the air flow occur?	a	no	Rapid changes in direction of the airflow causes turbulence, which increases the noise, erodes internal insulation and disturbs settle particulate matter back into the air stream.	Sharp changes in direction should be avoided.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Rapid changes in direction of the airflow causes turbulence, which increases the noise, erodes internal insulation and disturbs settle particulate matter back into the air stream.	Sharp changes in direction should be avoided.		Potential source of particulate matter.	0	-3	0	0	0	
V	DT	8	Will turning vanes be installed in duct elbows with rapid changes in direction?	a	yes	Turning vanes can help reduce turbulence if they are smooth double thickness and are used in such a manner that the cross sectional area of the elbow is the same as the duct.	Turning vanes are recommended where rapid changes of direction are unavoidable.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Turning vanes can help reduce turbulence if they are smooth double thickness and are used in such a manner that the cross sectional area of the elbow is the same as the duct.	Turning vanes are recommended where rapid changes of direction are unavoidable.		Potential source of particulate matter.	0	-3	0	0	0	
V	DT	9	Are access hatches provided through out the length of the supply ducting?	a	at least every 50m	Access hatches will facilitate cleaning of the ducts at intervals through out the life of the building without cutting of ducts and duct insulation, which can cause debris to enter the system and compromise the air tightness of the ducting.	Access hatches approximately every 50m are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	greater than 50m	Access hatches will facilitate cleaning of the ducts at intervals through out the life of the building without cutting of ducts and duct insulation, which can cause debris to enter the system and compromise the air tightness of the ducting.	Access hatches approximately every 50m are recommended.		Potential source of particulates, and microbial contaminants.	0	-2	-2	0	0	
V	DT	10	Are access hatches provided through out the length of the exhaust ducting?	a	at least every 50m	Ducts carrying dust laden air should have access hatches for cleaning provided at regular intervals.	Access hatches approximately every 50m are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	greater than 50m	Ducts carrying dust laden air should have access hatches for cleaning provided at regular intervals.	Access hatches approximately every 50m are recommended.		Potential source of particulates, and microbial contaminants.	0	-2	-2	0	0	
			Terminal Equipment (T)												

V	T	1	Are there many terminal units distributed throughout the building?	a	no	Experience shows distributed units are not inspected, cleaned and maintained as frequently as required. The resulting dirt can lead to contamination of the air stream. Systems to locate and schedule maintenance of termina units are required.	Systems to record the location and schedule maintenance of al terminal units are required.		No detriment to IAQ.	0	0	0	0	0	
				b	a few	Experience shows distributed units are not inspected, cleaned and maintained as frequently as required. The resulting dirt can lead to contamination of the air stream.	Systems to record the location and schedule maintenance of al terminal units are required.	access for maintenance	Potential source of particulate matter and microbial contaminants.	0	-1	-1	0	0	
				c	yes	Experience shows distributed units are not inspected, cleaned and maintained as frequently as required. The resulting dirt can lead to contamination of the air stream.	Systems to record the location and schedule maintenance of all terminal units are required.	access for maintenance	Potential source of particulate matter and microbial contaminants.	0	-3	-3	0	0	
V	T	2	Does the terminal unit draw secondary air from sources other than the suppl air duct?	a	no	Air drawn from the plenum, occupied areas or other sources can contain particulate matter, microbial spores, and moisture. This can accumulate within the terminal unit and contaminate the remixed air.	It is recommended that air only be drawn from reliable clean sources.		No detriment to IAQ.	0	0	0	0	0	

				b	yes, the occupied area	Air drawn from the occupied area can contain particulate matter, microbial spores, and moisture. This can accumulate within the terminal unit and contaminate the remixed air.	It is recommended that air only be drawn from reliable clean sources.	access for maintenance, material selection	Potential source of particulate matter and microbial contaminants. Under estimation of the dilution of VOCs, bioeffluents and microbial spores.	-1	-1	-1	0	0	
				c	yes, the return air plenum	Air drawn from the return air plenum can recirculate particulate matter, bioeffluents, VOCs, microbial spores and moisture. These will be drawn into the terminal unit and contaminate the remixed air. Return air plenums are rarely cleaned and also represent a considerable source of contaminants.	Drawing air from the return air plenum is not recommended as it can compromise the indoor air quality. Filtration with a 30% pleated filter and good maintenance systems are recommended.	access for maintenance, material selection	Potential source of particulate matter and microbial contaminants. Under estimation of the dilution of VOCs, bioeffluents and microbial spores.	-2	-3	-2	0	0	
V	T	3	Is the secondary air stream filtered?	a	yes	Filtration of the air will reduce the incidence of dirt etc on the terminal unit coils.	Filtration of all secondary air stream entering all terminal boxes is highly recommended.	filtration	Reduction in the recirculation of particulate matter.	0	2	0	0	0	
				b	no	Filtration of the air will reduce the incidence of dirt etc on the terminal unit coils.	Filtration of all secondary air stream entering all terminal boxes is required.		No improvement to the IAQ.	0	0	0	0	0	
V	T	4	Will the terminal boxes contain cooling coils?	a	no	Cooling coils are a source of moisture and also frequently a source of microbial contamination.	Containing the cooling systems in easily accessible areas of the building is highly recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Cooling coils are a source of moisture and also frequently a source of microbial contamination.	Distribution of cooling coils throughout the space should be avoided where possible. Access for maintenance is required.	cooling coils	Potential source of microbial contaminants.	0	0	-3	0	0	

V	T	5	Are the coils accessible for cleaning and maintenance?	a	yes	The coils in terminal reheat boxe can become clogged and can impede the delivery of the supply air unless regular maintenance is provided. The coils should be exposed to only filtered air to reduce the nutrients available for growth of microbial contaminants.	Access for maintenance is recommended.	access for maintenance, filtration	No detriment to IAQ.	0	0	0	0	0	
				b	no	The coils in terminal reheat boxe can become clogged and can impede the delivery of the supply air unless regular maintenance is provided. The coils should be exposed to only filtered air to reduce the nutrients available for growth of microbial contaminants.	Access for maintenance should be provided.		Potential source of microbial contaminants.	0	0	-3	0	0	
V	T	6	If the wet valves or connections leak will the moisture spill onto:	a	a drained and trapped tray	Wet valves should be located above the drain trays to prevent leaks from wetting surrounding materials.			No detriment to IAQ.	0	0	0	0	0	
				b	non-porous materials	Non-porous materials can support microbial colonies and should be kept dry at all times.	All possibilities of potentially wet non-porous materials should be rigorously avoided.		Potential source of microbial contaminants.	0	0	-2	0	0	
				c	porous materials, such as ceiling tiles wall linings or carpet?	Wet porous materials provide an environment ripe for microbial contamination and should be kep dry at all times.	All possibilities of potentially wet porous materials should be rigorously avoided.		Potential source of microbial contaminants.	0	0	-3	0	0	

V	T	7	Will sensors be used to monitor for leaking of wet valves?	a	yes	Sensor can provide early detection of water leaks and limit water damage and microbial contamination.	Sensor for the early detection of water leaks are advisable where there is a risk of microbial contamination following a water leak.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Sensor can provide early detection of water leaks and limit water damage and microbial contamination.	Alternative means of containing leaks will be required.		Potential source of microbial contaminants.	0	0	-3	0	0	
V	T	8	Can condensation form on the outside of the terminal boxes or adjacent surfaces?	a	no	This can wet other building materials and lead to microbial contamination.	It is highly recommended that condensation should be avoided on all building surfaces, unless they are drained and trapped and regularly inspected, cleaned and maintained.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	This can wet other building materials and lead to microbial contamination.	Condensation should not be allowed to form on the outside of the terminal boxes or adjacent surfaces.		Potential source of microbial contaminants.	0	0	-3	0	0	
	T	9	Is the terminal box a variable air volume box?	a	no	VAV boxes regulate the volume of air being supplied to a zone. If the temperature within the zone is close to the temperature set point, then the VAV box will restrict the quality of air being delivered. This can fail to deliver adequate quantities of outdoor air to that zone.	VAV systems need to designed with provision for maintaining the required outdoor air flows to all zones under part- load conditions.		No detriment to IAQ.	0	0	0	0	0	

				b	yes	VAV boxes regulate the volume of air being supplied to a zone. I the temperature within the zone i close to the temperature set point, then the VAV box will restrict the quality of air being delivered. This can fail to deliver adequate quantities of outdoor ai to that zone.	VAV systems need to designed with provision for maintaining the required outdoor air flows to all zones under part- load conditions.	VAV, ventilation controls	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-2	-2	0	
			Air Supply Grilles (AS)												
V	AS	1	Will the supply air be provided at:	a	desk level	If the supply air is of a high quality, the supply air at desk level can form a cloud of fresh, clean air within the occupants breathing zone. This can help push contaminants generated by occupant activities and other internal sources away from the occupants, whilst they are engaged at desk activities. They can however be a source of draughts if the air supply is too cold or velocity too high.	Air supply grilles at desk level are the recommended solution in workstation areas. Air supply will need to be installed either at either floor, wall or ceiling level in other areas.		No detriment to IAQ.	0	0	0	0	0	

				b	floor level	If the supply air is of a high quality, the supply air at floor leve can form a cloud of fresh, clean air which rises up past the occupants breathing zone. This can help push contaminants generated by occupant activities and other internal sources away from the occupants, whilst they are engaged at desk activities. Care needs to be taken with the design and placement of air outle to prevent dust and debris from entering the distribution system. Raised floor systems should be very rigid to prevent vibrations.	Air supply grilles at floor level ar an acceptable solution in most areas.		No detriment to IAQ.	0	0	0	0	0	

				c	ceiling level	If the supply air is of a high quality, the supply air at ceiling level can trickle fresh, clean air down onto the occupants. Problems can occur with short circulating of the air supply, imperfect mixing due to pressure imbalances, interruptions from tall furniture, temperature differentials, etc. This can make to more difficult to dilute and remove contaminants generated by occupant activities and other internal sources. getting the freshest air to the breathing zone of the occupants whilst they are engaged in desk based activities can be difficult to achieve.	Care needs to be taken with the placement of supply diffusers and extracts, and partitions and tall items of furniture to avoid short circulting the air supply.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-2	-2	0	
V	AS	2	Are the floor grilles designed so that dirt which drops through the grilles can not enter the supply air?	a	yes	Dust and dirt which enters the air supply side will be entrained in the supply air. It can also provide nutrients for propagation of microbial if sufficient moisture is present.	Floor grilles should be positioned and designed to prevent room dirt falling into the supply air side.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Dust and dirt which enters the air supply side will be entrained in the supply air. It can also provide nutrients for propagation of microbial if sufficient moisture is present.	Floor grilles should be positioned and designed to prevent room dirt falling into the supply air side.		Potential source of particulate matter.	0	-2	-1	0	0	

V	AS	3	Is the room air mixing characterisec as?	a	displacement	Displacement ventilation is characterised by locating the air supply grills and air extraction at different heights and positions within the space. Displacement ventilation achieves the highest rate of room air mixing. This reduces zones of staleness, and aids the efficiency of delivery of supply air to the breathing zone of the occupants and promotes the short circuiting, dilution and removal of contaminants.	Displacement ventilation is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	piston	Piston ventilation is characterise by locating the air supply grills and air extraction at different heights but above one another within the space. Piston ventilation can achieve a relative high rate of room air mixing. Thi reduces zones of staleness, and aids the efficiency of delivery of supply air to the breathing zone of the occupants and dilution anc removal of contaminants.	Piston in room air flow is an acceptable ventilation strategy.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-1	-1	-1	-1	0	

				c	mixing	Mixing air flows are characterised by locating the supply diffusers and extracts within the same ceiling or floor plane. This can lead to short circulting of the air supply if the air supply is too close to the extracts, if the throw of the air is incorrect of physical obstacles such as high modular screens are placed under the air supply outlet. efficient ventilation and removal of contaminants is much more difficult to achieve with reliance on room air mixing.	Care needs to be taken with the placement of supply diffusers and extracts and tall items of furniture to avoid short circulting the air supply.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-3	-3	-3	-3	0	
V	AS	4	Does the supply air at the ceiling grilles have a minimum dew point of 12-14 deg C?	a	yes	Air with a low dew point temperature is unstable and interstitial or surface condensation is very likely to occur if the air is subjected to any further cooling.	A minimum dew point temperature of 12 deg C is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Air with a low dew point temperature is unstable and interstitial or surface condensation is very likely to occur if the air is subjected to any further cooling.	A minimum dew point temperature of 12 deg C is recommended.		Potential source of microbial contaminants.	0	0	-3	0	0	
V	AS	5	Are the air supply grilles positioned & orientated to prevent cooled air blowing directly onto a surface, such as a wall?	a	yes	Cold air blowing onto the surfaces near the supply air diffuser can cause interstitial or surface condensation. This can also reduce the effectiveness of room air mixing.	Air supply grills should not be located too close to walls, windows, curtains or other surfaces.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Cold air blowing onto the surfaces near the supply air diffuser can cause interstitial or surface condensation. This can also reduce the effectiveness of room air mixing.	Air supply grills should not be located too close to walls, curtains or other surfaces.		Potential source of microbial contaminants.	0	0	-3	0	0	
			Return Air (R)												
V	R	1	Will the return air be removed via:	a	ceiling plenum	Over the life of a building, ceiling plenums accumulate dust and debris. This can become entrained into the return air supply, increasing the particle load within the air supply system where a portion of the air is recirculated. Dust accumulated within the ceiling plenum can infiltrate back into the room when there are sudden changes in the air pressure, such as at start up or during maintenance of other services located in the ceiling space.	Soft starting the air supply fans to reduce sudden air pressure changes is recommended.	In room filtration, access for cleaning, fan controls	Potential source of particulate matter.	0	-1	0	0	0	
				b	under floor plenum	Over the life of a building, under floor plenums accumulate dust and debris. This can become entrained into the return air supply, increasing the particle load within the air supply system where a portion of the air is recirculated.	Soft starting the air supply fans to reduce sudden air pressure changes is recommended.	air supply	Potential source of particulate matter.	0	-1	0	0	0	

V	R	2	Is the return air driven by:	a	positive pressure exerted by the supply air	The amount of outside air entering the building is a function of the damper opening and the ai pressure difference between the mixing chamber and the outdoors. Unless other means o exhaust are provided the quantity of outside air entering the building will only be equal to the quantity of air exhausted (through toilet exhausts etc) and exfiltration.	The outdoor air supply damper needs to be interlocked to open only when the supply air fan operates. Exhaust at the AHUs or other means of relief are required to increase the total amount of outside air entering the building.	outdoor air supply damper, localised extraction vents	Low risk of detriment to IAQ.	0	0	0	0	0	
				b	a return air fan	The relationship between the return air fan and supply air fan is critical to effective delivery of fresh air to all parts of the building.	The relationship between the return air and supply air fans requires specific design attention.	outdoor air supply damper, localised extraction vents	Low risk of detriment to IAQ.	0	0	0	0	0	
V	R	3	Is it potential for ceiling tiles to be left out of place or other openings to be formed between the plenum & occupied space?	a	low	Unplanned openings in the plenum can redirect the return airflow and deprive other parts of the building further from the core of supply air. Cabling supplied to desk top from jackpoints in a raised floor system will significantly reduce the number of penetrations made into ceiling tiles and the need to remove ceiling tiles throughout the life of the building. Short circuiting of supply air can also occur if penetrations are near a supply grill.	Management of integrity of the surfaces which bound the plenum will need to be implemented.	interiors, reticulation of desktop services	Low risk of detriment to IAQ.	0	0	0	0	0	

				b	high	Unplanned openings in the plenum can redirect the return airflow and deprive other parts of the building further from the core of supply air. Cabling supplied to desk top from jackpoints in a raised floor system will significantly reduce the number of penetrations made into ceiling tiles and the need to remove ceiling tiles throughout the life of the building. Short circuiting of supply air can also occur if penetrations are near a supply grill.	Management of integrity of the surfaces which bound the plenum will need to be implemented.	interiors, reticulation of desktop services	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-3	-3	-3	-3	0	
V	R	4	Will the plenum be inspected for cleanliness and removal of all debris?	a	at the completion of the construction phase	Return air plenums are frequently laden with construction dust, which can become entrained in the return airstream, terminal boxes and migrate directly into the occupied areas, unless removed prior to commissioning/occupancy.	Removal of all construction dust and debris prior to commissioning and occupancy is recommended.		Potential to reduce the source of particulate matter and microbial contamination.	0	3	2	0	0	
				b	at the completion of the all renovations	Return air plenums are frequently laden with construction dust, which can become entrained in the return airstream, terminal boxes and migrate directly into the occupied areas, unless removed prior to commissioning/occupancy?	Removal of all construction dust and debris prior to commissioning and occupancy is recommended.		Potential to reduce the source of particulate matter and microbial contamination.	0	3	2	0	0	

				c	at regular intervals	Return air plenums accumulate dust and particulate matter which has been extracted from the occupied area but has settled from the return airstream.	Provision for cleaning of the return air plenum at regular intervals is recommended.		Potential to reduce the source of particulate matter and microbial contamination.	0	3	2	0	0	
V	R	5	Is the return air plenum partitioned with fire break walls?	a	no	Fire walls can restrict the remova of return air and consequently limit the quantity of supply air tha can be delivered to the space?	Care needs to be taken to co-ordinate the provisions for the return air with the needs for fire protection.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Fire walls can restrict the remova of return air and consequently limit the quantity of supply air tha can be delivered to the space?	Care needs to be taken to co-ordinate the provisions for the return air with the needs for fire protection.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-2	-2	0	
V	R	6	Are the dampers in the fire walls:	a	readily checked for correct operation	Over the life of a building, dampers can tend to fail. If they fail shut this will restrict the removal of return air and consequently limit the quantity of supply air that can be delivered t the space?	Access for checking the operation of dampers is recommended.		No detriment to IAQ.	1	1	1	1	0	

				b	monitored for correct operation	Over the life of a building, dampers can tend to fail. If they fail shut this will restrict the removal of return air and consequently limit the quantity of supply air that can be delivered t the space. As they are usually out of sight & out of mind their failure can go undetected for considerable periods. Fire dampers monitored with a simple reed switch of similar will provide the building managers with rapid feedback if the dampers fail shut	Monitoring of fire dampers is recommended.		No detriment to IAQ.	2	2	2	2	0	
V	R	7	Will chilled water pipes running through the plenum be insulated?	a	yes	Condensation can form on the outside of chilled water pipes. This can allow the propagation and amplification of microbial contamination. This can contaminate both the adjacent occupied space and return air stream. Condensation and soiling can also occur on the ceiling tiles.	Avoidance of condensation is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Condensation can form on the outside of chilled water pipes. This can allow the propagation and amplification of microbial contamination. This can contaminate both the adjacent occupied space and return air stream.	Avoidance of condensation is recommended.		Potential source of microbial contamination.	0	0	-2	0	0	

V	R	8	Will chilled air ducts running through the plenum be insulated?	a	no	Condensation can form on the outside of chilled air ducts. This can allow the propagation and amplification of microbial contamination. This can contaminate both the adjacent occupied space and return air stream.	Avoidance of condensation is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Condensation can form on the outside of chilled air ducts. This can allow the propagation and amplification of microbial contamination. This can contaminate both the adjacent occupied space and return air stream.	Avoidance of condensation is recommended.		Potential source of microbial contamination.	0	0	-2	0	0	
V	R	9	Will the system readily accommodate air balance testing?	a	yes	Over the life of the building distribution systems can become out of balance.	Provision for testing of air balancing to check for correct performance of all ventilation units is recommended every 5 years.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Over the life of the building distribution systems can become out of balance.	Provision for testing of air balancing to check for correct performance of all ventilation units is recommended every 5 years.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-1	-2	-2	
V	R	10	Will the system have provision for adjusting the airflow's through the distribution system?	a	yes	Over the life of the building distribution systems can become out of balance and rebalancing will be required.	Provision for rebalancing of the airflow's is required every 5 years.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Over the life of the building distribution systems can become out of balance and rebalancing will be required.	Provision for rebalancing of the airflow's is required.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-1	-2	0	
V	R	11	Will potentially harmful contaminates be exhausted from the building through the:	a	dedicated exhaust ducting	Potentially harmful substances can leak out of the return air or exhaust system and contaminate surrounding areas, unless the exhaust system is maintained under negative air pressure with return air fans.	The ducting should be well sealed to contain the potentially harmful substances and the air pressure within the duct should be maintained at a lower air pressure than the surrounding areas.	return air fans	No detriment to IAQ.	0	0	0	0	0	
				b	return air ducting	Potentially harmful substances can leak out of the return air or exhaust system and contaminate surrounding areas.	Potentially harmful substances should be extracted via a ducted system, isolated from the return air stream.		Potential cross contamination and recirculation of exhausted contaminants.	-1	-1	0	-1	0	
				c	return air plenum	Potentially harmful substances can leak out of the return air or exhaust system and contaminate surrounding areas.	Return air plenums should not be used for the extraction of potentially harmful substances as they are very prone to leakage. Potentially harmful substances should be extracted via a dedicated ducted system, isolated from the return air stream.		Potential cross contamination and recirculation of exhausted contaminants.	-3	-3	0	-3	0	

V	R	12	Will the surrounding areas be maintained at a higher air pressure than the return air or exhaust air system at all times when potentially harmful substances could be present?	a	yes	Potentially harmful substances can leak out of the return air or exhaust system and contaminate surrounding areas.	Ducts which could contain potentially harmful substances should be kept at a lower air pressure than surrounding areas to help prevent leakage.	fan operation	No detriment to IAQ.	0	0	0	0	0	
				b	no	Potentially harmful substances can leak out of the return air or exhaust system and contaminate surrounding areas.	Ducts which could contain potentially harmful substances should be kept at a lower air pressure than surrounding areas to help prevent leakage.		Potential cross contamination and recirculation of exhausted contaminants.	-3	-3	0	-3	0	
V	R	13	If potentially harmful substances could be entrained in the return air stream, will any portion of the return air stream be recirculated?	a	no	Potentially harmful substances should be directly exhausted out of the building to avoid being re-entrainment.	Air containing potentially harmful substances should be extracted directly to the exterior and not recirculated.		No detriment to IAQ.	0	0	0	0	0	
				b	some	Potentially harmful substances should be directly exhausted out of the building to avoid being re-entrainment.	Air containing potentially harmful substances should be extracted directly to the exterior and not recirculated.	localised extraction	Potential cross contamination and recirculation of exhausted contaminants.	-1	-1	0	-1	0	
				c	yes	Potentially harmful substances should be directly exhausted out of the building to avoid being re-entrainment.	Air containing potentially harmful substances should be extracted directly to the exterior and not recirculated.	localised extraction	Potential cross contamination and recirculation of exhausted contaminants.	-3	-3	0	-3	0	

			Air Handling Plant Room (PR)												
V	PR	1	Is the plant room floor sloped to a floo drains?	a	yes	Condensation and spills should be drained as rapidly as possible to prevent microbial contamination of the plant room floor, which could be drawn into the air handling unit.	Sloping the floor of the plant room to a floor drain is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Condensation and spills should be drained as rapidly as possible to prevent microbial contamination of the plant room floor, which could be drawn into the air handling unit.	Sloping the floor of the plant room to a floor drain is recommended.		Potential source of microbial contamination.	0	0	-2	0	0	
V	PR	2	Is the floor of the plant room:	a	resilient flooring material or non porous paint finish	Sealed flooring is easy to clean, is self draining is sufficient fall is provide and will not shed dust particles.	Sealed floors is recommended for plant room floors.		No detriment to IAQ.	0	0	0	0	0	
				b	unpainted concrete	Unpainted concrete will hold spilled moisture and condensation and will shed dust particles.	Sealed floors is recommended for plant room floors.		Potential source of microbial contamination.	0	0	-2	0	0	
V	PR	3	Does the water sealed trap in plant room floor drain automatically primed?	a	yes	The water seal in intermittently used water sealed traps can dry out and allow foul air gases from the sewer pipes to enter the building via the traps.	Water seals which are intermittently used should be automatically primed to maintain the air seal.		No detriment to IAQ.	0	0	0	0	0	
				b	no	The water seal in intermittently used water sealed traps can dry out and allow foul air gases from the sewer pipes to enter the building via the traps.	Water seals which are intermittently used should be automatically primed to maintain the air seal.	drain traps	Potential source of gaseous pollutants.	0	0	0	-3	0	

V	PR	4	Are water treatment chemicals etc storec in the plant room?	a	no	Plant rooms are typically under negative pressure relative to the air handling units. Contaminates within the plant room can readily be drawn through unsealed meta to metal joins in the shell of air handling unit and infect the air supply.	Air tight vessels should be provided for the storage of chemicals which are required to be stored in the plant room.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Plant rooms are typically under negative pressure relative to the air handling units. Contaminates within the plant room can readily be drawn through unsealed meta to metal joins in the shell of air handling unit and infect the air supply.	Storage of water treatment and similar chemicals should be separated from the air handling units.		Potential source of VOCs and gaseous pollutants.	-3	0	0	-2	0	
V	PR	5	Is the plant room used for any other uses?	a	yes	Plant rooms are frequently used for other purposes such as the storage of surplus materials, furniture, paint, chemicals etc. This can introduce contaminates into the plant room.	It is recommended that the plant rooms is dedicated to the function of providing clean air to the building and other uses should be prohibited.		No detriment to IAQ.	0	0	0	2	0	
				b	no	Plant rooms are frequently used for other purposes such as the storage of surplus materials, furniture, paint, chemicals etc. This can introduce contaminates into the plant room.	It is recommended that the plant rooms is dedicated to the function of providing clean air to the building and other uses should be prohibited.		Potential source of VOCs and gaseous pollutants.	-3	0	0	-2	0	

V	PR	6	Is the plant room located above a contaminate source such as:	a	carparking	Vehicle emissions can rise from this source and become entrained in the air handling units. Physical separation is a passive and permanent means of providing separation between the plant room and sources of contaminants.	Physical separation between the plant rooms and sources of contaminants such as carparking is recommended.	envelope tightness	Potential source of VOCs, particulate matter and gaseous pollutants.	-2	-2	0	-2	0	
				b	loading dock	Vehicle emissions can rise from this source and become entrained in the air handling units.	Physical separation between the plant rooms and sources of contaminants such as loading docks is recommended.	envelope tightness	Potential source of VOCs, particulate matter and gaseous pollutants.	-2	-2	0	-2	0	
				c	print shop	VOC emissions can rise from this source and become entrained in the air handling units.	Physical separation between the plant rooms and sources of contaminants such as print shops is recommended.	envelope tightness	Potential source of VOCs and particulate matter.	-2	-2	0	0	0	
				d	wet area, such as shower areas, water feature or swimming pool,	Microbial contamination and moisture can rise and become entrained in the air handling units.	Physical separation between the plant rooms and all wet areas is recommended.	envelope tightness	Potential source of microbial contamination.	0	0	-2	0	0	
				e	smoking area	VOC emissions can rise from this source and become entrained in the air handling units.	Physical separation between the plant rooms and sources of contaminants such as smoking areas is recommended.	envelope tightness	Potential source of VOCs, particulate matter and gaseous pollutants.	-2	-2	0	-2	0	

V	PR	7	Does the plant room have adequate lighting to view into all components which require inspection, cleaning and maintenance?	a	yes	Adequate lighting will assist maintenance and air quality personal to conduct visual inspections and maintenance.	Adequate permanently installed lighting is recommended to assist inspections and maintenance.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Adequate lighting will assist maintenance and air quality personal to conduct visual inspections and maintenance.	Adequate permanently installed lighting is recommended to assist inspections and maintenance.		Potential for poor maintenance of HVAC components.	0	-2	-2	0	-2	
			HVAC Components and Air Pressure Relationships (AP)												
V	AP	1	Is the variability of the buoyancy of the return air stream be accommodated for in the selection of the return air fan speed?	a	yes	Increased buoyancy of the return air stream due to the stack effect can cause pressure imbalances in the AHU and limit the volume of outside air drawn into the system.	The mixing chamber should be negatively pressurised relative to the outside air pressure.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Increased buoyancy of the return air stream due to the stack effect can cause pressure imbalances in the AHU and limit the volume of outside air drawn into the system.	The mixing chamber should be negatively pressurised relative to the outside air pressure.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-1	-2	0	

	AP	2	Will the HVAC system be designed to maintain a positive air pressure despite the stack effect?	a	yes	Negative air pressure relative to the outdoors can allow unfiltered and thermally unconditioned air t enter through the building envelope. This is a particular problem close to ground level where vehicle particulates, street dirt, odours, draught etc can become a problem.	All occupied areas in mechanically ventilated buildings should be kept at positive pressure relative to the outdoors Specific design of the fan operation maybe required to balance the stack effect. Installation of revolving doors at ground level can avoid the ingress of street level pollutants.		No detriment to IAQ.	0	0	0	0	0	
V				b	at the lower levels of the building	Negative air pressure relative to the outdoors can allow unfiltered and thermally unconditioned air t enter through the building envelope. This is a particular problem close to ground level where vehicle particulates, street dirt, odours, draught etc can become a problem.	All occupied areas in mechanically ventilated buildings should be kept at positive pressure relative to the outdoors Specific design of the fan operation maybe required to balance the stack effect. Installation of revolving doors at ground level can avoid the ingress of street level pollutants.	entrances	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-1	-2	0	
				c	at the middle o the building	Negative air pressure relative to the outdoors can allow unfiltered and thermally unconditioned air t enter through the building envelope. This can permit the entry of particulates, odours and draughts.	All occupied areas in mechanically ventilated buildings should be kept at positive pressure relative to the outdoors Specific design of the fan operation maybe required to balance the stack effect.	entrances	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-2	-2	-1	-2	0	

				d	at the upper levels of the building	Negative air pressure relative to the outdoors can allow unfiltered and thermally unconditioned air t enter through the building envelope. This can permit the entry of particulates, odours and draughts. The stack effect can cause pollutants generated on the lower floors of the building to accumulate in the upper levels.	All occupied areas in mechanically ventilated buildings should be kept at positive pressure relative to the outdoors Specific design of the fan operation maybe required to balance the stack effect.	entrances	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-3	-3	-2	-3	0	
V	AP	3	Will the mixing box be negatively pressurised at all times	a	yes	The mixing box needs to be negatively pressurised in order to draw air past the outdoor air dampers and into the AHU. An incorrect air pressure balance can lead to the outdoor air dampers acting as an unintentional air exhaust, and limit the correct supply of air door air.	The fans need to be sized to offset the stack effect and maintain the correct pressure relationship within the mixing box.		No detriment to IAQ.	0	0	0	0	0	
				b	no	The mixing box needs to be negatively pressurised in order to draw air past the outdoor air dampers and into the AHU. An incorrect air pressure balance can lead to the outdoor air dampers acting as an unintentional air exhaust, and limit the correct supply of air door air.	The fans need to be sized to offset the stack effect and maintain the correct pressure relationship within the mixing box.		Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-3	-3	-2	-3	0	

V	AP	4	Will the lower levels of the building be maintained at a higher air pressure relative to outdoors?	a	yes	Maintaining the air pressure at a higher air pressure reduces the quantity of unconditioned air entering at street level.	Designing the building to maintain a positive air pressure relative to the outside will help reduce the amount of pollutants and moisture entering the building from traffic, sub-grade etc..	outdoor pollutant concentrations	No detriment to IAQ.	0	0	0	0	0	
				b	no	Maintaining the air pressure at a higher air pressure reduces the quantity of unconditioned air entering at street level.	Maintaining a positive air pressure relative to the outside will help reduce the amount of pollutants and moisture entering the building from traffic, sub-grade etc..	outdoor pollutant concentrations	Potential under estimation of the dilution of VOCs, particulate matter, bioeffluents and microbial contaminants generated in the occupied area.	-3	-3	-2	-3	0	
V	AP	5	Are the fans of sufficient capacity to deliver fresh air for the proposed people and pollutant load without having to increase the air speed?	a	yes	Speeding up the fans to deliver more fresh air into the buildings can exceed the maximum face velocity at the cooling coils and cause water droplets to be carried over into the airstream. Increased air speed also reduces the efficiency of arrestance of very fine particles by the filters and can allow carry over of particulate matter into the ducting and room air. High velocity air also can cause erosion of the ducting material which can liberate fractions of fibreglass and other particles. High air velocity reduces the efficiency of electrostatic air cleaners.	The fans should be design with sufficient capacity for the intended building loads at low speed.		No detriment to IAQ.	0	0	0	0	0	

				b	no	Speeding up the fans to deliver more fresh air into the buildings can exceed the maximum face velocity at the cooling coils and cause water droplets to be carried over into the airstream. Increased air speed also reduces the efficiency of arrestance of very fine particles by the filters and can allow carry over of particulate matter into the ducting and room air. High velocity air also can cause erosion of the ducting material which can liberate fractions of fibreglass and other particles. High air velocity reduces the efficiency of electrostatic air cleaners.	The fans should be design with sufficient capacity for the intended building loads at low speed.		Potential source of particulates and microbial contamination.	0	-2	-2	0	0	
V	AP	6	Will the cycling on and off of the fans create sudden air pressure changes or imbalances in the air streams, plant rooms or occupied areas?	a	no	Sudden changes or pressures imbalances can resuspend particulate matter and microbial spores from within ducts, return air plenums etc. Air pressure changes can cause the suspended ceiling to vibrate and dislodge matter from the return air plenum into the room below.	Fans should be soft started and gradually slowed to avoid sudde fluctuation in pressure and resuspending particulate matter.		No detriment to IAQ.	0	0	0	0	0	

				b	yes	Sudden changes or pressures imbalances can resuspend particulate matter and microbial spores from within ducts, return air plenums etc. Air pressure changes can cause the suspended ceiling to vibrate and dislodge matter from the return air plenum into the room below.	Fans should be soft started and gradually slowed to avoid sudde fluctuation in pressure and resuspending particulate matter.		Potential distributior force for particulate matter and microbial contaminants.	0	-3	-2	0	0	
			Exhausts (E)												
V	E	1	Will the 3-dimensional wind flow patterns and air pressure dynamics around the building been modelled?	a	yes	Complex building shapes or building with unfavourable aerodynamic conditions should be tested with either CFD or winc tunnel analysis to determine air flows and pressure dynamics so that the most favourable location for the buildings extracts to prevent re-entrainment of contaminants can be found.	3-dimension wind analysis is recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Complex building shapes or building with unfavourable aerodynamic conditions should be tested with either CFD or winc tunnel analysis to determine air flows and pressure dynamics so that the most favourable location for the buildings extracts to prevent re-entrainment of contaminants can be found.	3-dimension wind flow analysis is recommended.		Potential re-entrainment of exhausted contaminants.	-2	-2	-2	-2	0	

V	E	2	Are pollutants exhausted from the building or neighbouring facilities which could potentially become entrained in the building?	a	no	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided.	Modelling of exhausts discharges in relation to the proposed building and openings within the building are recommended.		No detriment to IAQ.	0	0	0	0	0	
				b	yes	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided.	Modelling of exhausts discharges in relation to the proposed building and openings within the building are recommended.		Potential re-entrainment of exhausted contaminants.	-2	-2	-2	-2	0	
V	E	3	Can the source of the potentially re-entrainable pollutant be reduced via:	a	reducing the source strength by process modification	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided. Modification of the process to reduce concentrations of contaminants at source is beneficial to both the building and the environment.	Reduction of the concentrations of contaminants at source is recommended.		Reduction in risk of re-entrainment of exhausted contaminants.	2	2	2	2	0	

				b	Increasing the stack height beyond the zone of recirculation	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided. Increasing the stack height beyond the zone of recirculation can reduce the entrainment of contaminants under most environmental conditions.	Reduction of the concentrations of contaminants by increasing the dispersion of contaminants i recommended.		Reduction in risk of re-entrainment of exhausted contaminants.	2	2	2	2	0	
				c	Increasing the chimney discharge velocity	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided. Increasing the chimney discharge velocity can reduce the entrainment of contaminants under most environmental conditions.	Reduction of the concentrations of contaminants by increasing the dispersion of contaminants i recommended.		Reduction in risk of re-entrainment of exhausted contaminants.	2	2	2	2	0	

				d	relocating the exhaust stack to a safer position	Entrainment of exhausted matter from the same or an adjacent facilities is a common source of indoor contamination. Contaminants can range from toxic combustion products to moisture and should be rigorously avoided. Relocating the chimney away from increasing the chimney height beyond the zone of recirculation can reduce the entrainment of contaminants under most environmental conditions.	Reducing the potential for re-entrainment by physical separation of the chimney and openings into the building is recommended.		Reduction in risk of re-entrainment of exhausted contaminants.	2	2	2	2	0	
V	E	4	Will the exhausts air dampers be closed when the HVAC system is shut off e.g. over night or during weekends?	a	yes	Exhaust air dampers can allow cold night air to enter the system and/or warm room air to flow through the exhaust ductwork. This can contribute to condensation forming within the ducts and microbial contamination.	Exhaust air dampers should automatically close when the HVAC system is shut off.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Exhaust air dampers can allow cold night air to enter the system and/or warm room air to flow through the exhaust ductwork. This can contribute to condensation forming within the ducts and microbial contamination.	Exhaust air dampers should automatically close when the HVAC system is shut off.		Potential source of microbial contamination.	0	0	-2	0	0	
V	E	5	Will the exhausts vents be sheltered form the driving rain?	a	yes	Wind pressure on the exhausts can prevent the stale air from exiting the exhaust.	Exhausts should be sheltered to allow for correct function.		No detriment to IAQ.	0	0	0	0	0	
				b	no	Wind pressure on the exhausts can prevent the stale air from exiting the exhaust.	Exhausts should be sheltered to allow for correct function.		Potential source of microbial contamination.	0	0	-2	0	0	

			Air Cleaners												
V	AC	1	Will air cleaners be installed to remove VOCs from the air?	a	yes, in the occupied areas	Air cleaners located in the occupied areas are better suited to removal of VOC which originate within the occupied area from construction materials and occupant activities, than cleaners located in the central HVAC plant. They can however create higher requirement for maintenance. Charcoal filters wi not remove all gases from the indoor air. They eventually become clogged and lose effectiveness. Source of control of gaseous pollutants and VOCs is preferable to reliance on air cleaners.	Air cleaners located in the occupied areas are recommended where sources of VOCs originate in the occupied area from construction materials and occupant activities. Source control of VOCs is preferable.	material selection, occupant activities	Potential reduction in VOCs which originate in the occupied areas.	3	0	0	0	0	

				b	yes, in the central plant	Air cleaners located in the centra plant can remove VOC from outdoor air sources and the recirculated air. They are not as effective as air cleaners which are located within the occupied area, for intercepting contaminants generated within the occupied area from reaching the occupants. However they can significantly reduce the accumulation of VOCs. Effective room area mixing is very important to capture VOCs from the occupied area for removal. Charcoal filters will not remove a gases from the indoor air. They eventually become clogged and lose effectiveness. Source of control of gaseous pollutants anc VOCs is preferable to reliance or air cleaners.	Air cleaners located in the central plant are recommended the HVAC system will be operated with air recirculation.	material selection, occupant activities	Potential reduction in VOCs which originate in the occupied areas.	2	0	0	0	0	
				c	no	Air cleaners can help to remove VOCs which originate within the occupied area from construction materials and occupant activities They can however create a higher requirement for maintenance.	Air cleaners are recommended to help reduce VOC concentrations in the indoor air. Source control of VOCs is preferable.	material selection, occupant activities	No improvement in IAQ.	0	0	0	0	0	

APPENDIX 6 - INSTRUCTIONS TO REVIEWERS OF HEAD-START AND SAMPLE REVIEWERS' REPORT FORM

Instructions to Reviewers of HEAD-Start

Dear *Reviewer*,

Thank you for kindly agreeing to review HEAD-Start, the Healthy Office Environment Design Support Tool. I would be very pleased if you are able to review the *x and y* section. I have enclosed a copy of the whole system, to give you an overview and in case you wish to refer to other sections. However the topic which has been assigned to you for review has been printed on cream paper, to make it easy for you to find. You are welcome to make comments on other sections if you feel inclined.

Also enclosed in the folder is the following:

- An assessment sheet to be completed for each section reviewed (printed on blue paper).

- A paper which outlines the background and philosophy of HEAD-Start. This is for your information only and you have not been requested to review this paper.

The review should focus on the correctness and completeness of the justifications, recommendations and conclusions. Any suggestions to improve the science, clarity, succinctness, and quality of presentation will be welcome if you have the time to offer them in your comments. Please also feel free to make comments directly onto the printed copy of HEAD -Start. Where warranted, I would welcome positive feedback as well as constructive criticism.

It is acknowledged that the scoring system stills requires further development, which due to the complexity of the linkages between factors is difficult to achieve on a hard copy. This will be addressed when the system is programmed into software program.

Do not be concerned with grammatical errors etc. as these will be checked in a separate editorial review.

Also please find enclosed a small gift, which is a token of my gratitude for your time and expertise. Your efforts will help me complete the last stage of my PhD thesis, and will hopefully verify and improve the quality of the science, before the HEAD-Start is programmed in to an expert shell language.

I would appreciate it if you could complete the review within six weeks of receipt, and would appreciate early notification if you will have difficulty meeting this timeframe.

Please return the completed questionnaires and the folder if you have made comments on it, in the return mailbag.

Kind regards,

Robyn Phipps,
Senior Lecturer in Building Technology

Reviewed by ***reviewer's name***

Review report on Building Infrastructure

Please circle the number on the scale which best describes your response to the following questions. (1 = highly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = highly agree). Additional comments may be marked directly onto the hard copy of HEAD-Start where appropriate.

	Highly disagree				Highly agree
1. The section on "Building Infrastructure" adequately identifies how the components of the building infrastructure could contribute to the generation of the following pollutants:					
1a. Microbiological contaminants	1	2	3	4	5
1b.Gaseous pollutants	1	2	3	4	5
1c. Respirable particulate matter	1	2	3	4	5
1d. Volatile Organic Compounds	1	2	3	4	5
2. The section on "Building Infrastructure" adequately identifies how the components of the building infrastructure could form a pathway for the movement around the building of the following pollutants:					
2a. Microbiological contaminants	1	2	3	4	5
2b.Gaseous pollutants	1	2	3	4	5

2c. Respirable particulate matter | 1 2 3 4 5

2d. Volatile Organic Compounds | 1 2 3 4 5

3. The section on "Building Infrastructure" draws correct conclusions on the affects which the following pollutants that originate within the infrastructure can have on the indoor environment:

3a. Microbiological contaminants | 1 2 3 4 5

3b.Gaseous pollutants | 1 2 3 4 5

3c. Respirable particulate matter | 1 2 3 4 5

3d. Volatile Organic Compounds | 1 2 3 4 5

4. This section draws correct inferences from the current body of knowledge on indoor air quality? | 1 2 3 4 5

5. The section on "Building Infrastructure" is consistent with the IAQ model as described in the attached paper? | 1 2 3 4 5

6. This section would assist a designer, who is not an expert in indoor air quality, make decisions which will lead to a healthy office building environment? | 1 2 3 4 5

7. This section would help educate a designer, who is not an expert in indoor air quality, in indoor air quality issues?

1 2 3 4 5

8. The information is presented in a logical sequence?

1 2 3 4 5

9. What is the weakest point of this section?

10. What is the strongest point of this section?

11. Does the section have any important omissions?

APPENDIX 7 - DETAILED COMMENTS FROM REVIEWER C ON INFRASTRUCTURE SECTION AND RESPONSES

Reviewer C made the following comments on the Infrastructure section. Responses to these comments are shown in italics. The number beside each comment refers to the HEAD-Start question number.

Question number / Comment

1. Stairwells appear to be regarded purely as a pathway for pollutants. Pollutant movement is only really an issue if one floor is more polluted than another. Stairwells can also be designed as a means of extracting polluted air from the occupied areas. There are even arguments for taking supply air from stairwells where this provides some tempering of the air without mechanical cooling/heating. This option depends on having good ventilation of the stairwell and low emissions within and into the stairwell.

The value of a vestibule/lobby depends on the ventilation of/sources in the lobby.

The stairwell is regarded as a pathway for pollutants when an area or activities that generate pollutants could be connected to the stairwell, such as vehicle parking area. If there are no pollutants pathways into the stairwell, and it fits with the ventilation/extraction design of the building then the stairwell can be used for either air supply or air extraction. If it were used for air extraction then the rules covering re-entrainment of pollutants would apply.

2. Options for barriers need to be considered in the context of fire protection and noise control. While a well-fitting door can provide good fire protection, a lobby

can hinder escape. Prevention of noise and pollutant transmission might be served by the same design but ventilation to the stairwell may increase noise transmission. A well-fitting door can be sufficient to prevent pollutant movement unless it is frequently opened (and then pressure differentials become important). Double doors need to be well separated if they are to be effective, and then there is a space penalty.

It is good practice for the direction of air flow to be from stairwell to bathroom/toilet rather than vice versa. This is best achieved by air extract from the bathroom/toilet, which creates a need for a pathway for make-up air. This can be provided by grilles in the door(s). If there is no extract ventilation, then the guidance can remain as given. Double doors will do more for acoustic and visual privacy than for IAQ, if the air flow paths are correct.

Any extract from the stairwell (other than through the bathroom) should not be sufficient to reverse the flow of air between stairwell and bathrooms.

Actual air pressure relationships have been frequently found in field studies to be in the reverse direction to the planned flow, due to overwhelming pressures from the stack effect, malfunction, idling or switching off of the fans, or other influences. Therefore, permanent passive solutions, which are fail-safe, are recommended ahead of solutions which depend on air pressure. Installation of extracts in the bathrooms has been recommended to remove pollutants and moisture generated in these areas at source.

3. Comments for kitchens as for bathrooms, but kitchens are likely to require higher extract rates when in use and door designs may be dictated by fire protection, not ventilation. While a bathroom/toilet may be required on every floor, a kitchen is not. Hence, it can be located on the top floor, thus reducing the impact of emissions to the stairwell or the outdoor air.

Kitchens, like bathrooms, need to be separated from the other areas of the building, for both fire protection and IAQ – these design criteria can be complimentary. Frequently, the top levels of a building command higher rental *rates than other areas of the building due to better views or perceived status. Therefore, locating a kitchen on the upper floors may have a negative impact on the financial viability of the building. Methods to contain the emissions of pollutants from the kitchen area, other than locating the kitchen at the top of the building, have been recommended in HEAD-Start.*

5. If the plant room is contaminated, the first concern should be transmission through the ventilation system, not the stairwells. Otherwise, similar comments to bathrooms/toilets. Provision of conveniently located storage areas can reduce the risk of (a) chemical contaminating the plant room or (b) stored HVAC components (e.g. filters) becoming contaminated. Such storage areas should be clean, dry and well ventilated, and should allow separation of chemicals from HVAC components.

Methods to prevent and mitigate contamination of the HVAC system are covered in the Ventilation section. Means to prevent and mitigate contamination of the plant room and adjacent spaces are covered in the Infrastructure section. These two sections were deliberately separated, as the HVAC design is undertaken by the Mechanical Engineers, and the plant room design is typically the responsibility of the architectural consultants. Automatic links will be made between the two sections in the software application.

6. Need to specify what kind of plenum is meant. If it is carrying extract air then a good seal is essential, and should be straightforward to achieve. Seal needs to be designed to last, with specified inspection/replacement procedure. Other plenums – see bathrooms/toilets.

Agree. Distinctions on the type and properties of the plenum and inspection facilities of all seals are important. The most common plenum is the return air plenum. Air is frequently extracted from occupied area via the ceiling cavity, the lower surface of which is formed by an accessible ceiling tile system, that is, it not a sealed system. Leakage from this plenum is not usually a problem during operation of the mechanical ventilation system as it is under negative air *pressure. However, pollutants can escape this space, when the ventilation system is idle.*

7. Separation of stairwells from car parks should be given greater weight if the car park itself is not well ventilated and/or is subject to a large number of vehicle movements or idling vehicles. Vestibules (lobby) should ideally have extract ventilation.

   Agree.

8. Importance of separation from loading docks (loading bays on my island?) depends on vehicle movements and what is being loaded or unloaded. If it is just a post van passing through twice a day, it is of less concern than a large loading dock with potential for several diesel trucks to be idling. It comes down to how specific the design brief is, but the priority should be a well-ventilated loading area and prohibition of idling vehicles (if the designer has any control over these matters).

   Agree. Operation of the loading dock will most probably be outside the control of the building designers, and it is therefore, important to design the loading dock to fail-safe, that is to install systems to prevent the migration of idling vehicle exhausts into other parts of the building and are effective under most operation conditions.

10. We speak of a 'secure waste stream' from the point at which waste is generated to the point at which it is removed from the building. This section deals with only one part of the process. Also consider:
    - recycling/re-use storage areas within the building but outside the occupied areas;
    - routes for waste to the storage area(s) – avoid need to use same lift/stairwell as occupants;
    - cleanability of storage area(s)/bin(s);
    - ventilation of storage area(s).

Agree. These comments will be addressed in subsequent versiosn of HEAD-Start.

11. Comments on stairwells apply to some extent to lifts too, except that there is no case for getting supply air from lift shafts.

First section on lifts confounds three issues: (a) the lift/lift shaft as a source of contaminants to the occupied zone, (b) contaminants from goods in transit affecting lift users and (c) transmission of pollutants via the lift shaft from one area of the building to another. Try to separate these points.

Separation of points (a) and (c) will be addressed by physical separation of the lift area from the occupied areas. Point (b) can be addressed by the specification of a designated goods lift for materials which could release contaminants.

13. If the lift opens directly into a kitchen, there will be the potential for contaminants to enter the lift shaft. Do NZ fire regulations allow this?

Need to consider potential for steam from kitchens to condense in lift shafts, creating the potential for secondary pollution, and the lift maintenance implications of this.

Fire regulations require, and HEAD-start recommends, physical separation of kitchens from all pathways, including lifts. This will prevent both primary and secondary contamination of the lift shaft.

22. Also consider design of lift/lift shaft to minimise collection of debris/oil in the lift shaft or on top of the lift?

Selection of lift materials to minimise pollutant emissions, especially to the interior of the lift? Cleanability/sink potential of lift interior?

Agree.

23. Cleanability of duct interiors is also important (e.g. no fibrous linings).

Humidity-controlled shut-off needs more thought. Should it be relative or absolute humidity? Arguably, AH for room sensor but RH for duct sensor. Under some conditions, duct sensor could maintain flow that is increasing the duct humidity if kitchen RH is high because temperature has dropped. Alternatively, duct sensor could shut the system off too soon if ducts have become warmer than kitchen, and/or there is condensate in the duct.

Agree. This point is covered in detail in the Ventilation section. Additional experimental work may be required to verify the optimum control technique for moisture in ducts.

25. Detriment due to lack of make-up air would depend on where the air would otherwise come from.

All cooking can cause generation of pollutants; use of gas fuel just increases the range and rate of pollutant generation. Hence there should always be extract ventilation, used whenever the cooking appliance is on. Benefit of extraction will depend on extraction rate and design of extract hood (e.g. height above the cooker, depth of hood). Hence, rate of pollutant generation and efficiency of extraction need to be quantified separately.

Agree.

26. Humidity and water spillage are separate issues (for walls). Is a tiled wall considered to have a vapour barrier?

The benefit of floor drains is highly variable. They can become very smelly.

The extent of a vapour barrier behind a tiled wall depends partially on the adhesive and grouting system used. Porosity of the tile and thickness of the glaze will also have an impact on resistance to vapour. This level of detail was not attempted within the system in order to prevent users getting overloaded with fine detail prior to the working drawing design stages.

Access points for cleaning of floor drains are recommended in HEAD-Start to facilitate cleaning.

27. Does guidance on waste storage apply only to waste within the kitchen, or waste generally? What is a sealed bin? How do you get waste into it? Bags within bins, which can be sealed when full, makes more sense. The bags should then be stored where pests cannot get access. Will the designer control what bins are used?

    Waste storage applies to waste generally, however operational details of waste collection will be probably be outside the bounds of responsibility of the design team. Bulk storage of waste, in particular re-entrainment of pollutants from waste compactors, is covered in the Site and Building Envelope section. A sealed bin is a rubbish container with a self-closing access flap or lid. Use of bags within the bins is outside the designer decision-making scope, but would be advisable.

28. People also produce moisture.

    General point on extract ventilation: is the location of extract points in the building envelope covered elsewhere (i.e. avoiding re-entry into the building, other buildings or nuisance outdoors)?

    Agree. The removal of bioeffluents and moisture generated by the building's occupants is considered to be within the capacity of a correctly designed general dilution ventilation system (Liddament 2000). Occupancy levels and *ventilation rates are covered in the Interiors and Ventilation sections, respectively.*

The location of ventilation extracts to prevent re-entry of pollutants is covered extensively in the Building Envelope and Ventilation sections.

29. No allowance for extract in the bathroom, but not above the shower?

See comments on humidistats in kitchens.

Extract should be switched on or boosted when shower is in use, automatically by humidistat or by link to shower or lighting controls.

Agree.

31. See comments on kitchens.

32. See comments on kitchens.

33. See comments on kitchens.

34. Prominence given to type of outdoor surface is probably excessive. If the doormats are effective and well cleaned, combined with regularly cleaned carpets, this will largely negate the impact of what is directly outside the building. Ungrassed soil could have a greater impact if very wet or very dry. Grass can remove soiling from footwear.

Hard surfaces close to the building are preferable to grass. Grass can be a source of tracked in soil when wet as well as and pesticide/herbicides following application of these products.

35. Rough surfaces may well clean shoes better but they also retain soiling and water more than smooth surfaces. Slip-resistance in wet conditions should also be considered. 3 strides = 4.5 m or 5 m?

If the outdoor paved area is sheltered from the rain, then drainage should be sufficient to cope with wash-down cleaning.

Rough surfaces also give good slip resistance during wt weather.

Agree. A comment on the need for drainage of wash-down water will be added in subsequent versions.

37. Revolving doors can also be used to limit ingress of air pollutants.

Agree.

38. Cleanability of doormats?

Changing mats in the course of the day is a little extreme, but maybe it rains more in NZ. Presumably the mats are re-used after cleaning and drying.

Not clear what is meant by "required to be vacuumed". All offices have surfaces that are best cleaned by vacuum cleaner, but there is always an alternative method. This guidance would affect mainly soft furnishings and areas where papers are stored. Paper storage should be addressed separately, since it is more to do with the type of storage (open vs closable) that the occupants use. Removing all carpets and fabric coverings will have implications for comfort and is, in any case, not entirely within the control of the designer. Carpets are not necessarily less polluting than smooth floors, once the waxes and loose dust on smooth floors are taken into account. The use of smooth, non-porous chair covers is likely to be very unpopular. Some soft surfaces need to be provided to avoid excessive reverberation. Hence, the issue is more the provision for cleaning (how and how often). This is not something that the designer determines, although s/he could stipulate how cleaning should be carried out. The exception to this would be if central vacuum cleaning were installed, which is not mentioned at all. Central vacuum cleaning will also deal with the issue of emptying bags.

Doors mats services are common in New Zealand, where mats are removed for cleaning on a frequent basis and returned.

Paper storage is addressed in the Interiors section. It is anticipated that many designers will not select the option of replacing carpeted floors and other textile surfaces with non-porous materials, hence emphasis is given to preconditioning of these materials prior to installation, as well as delaying installation until after the primary off-gassing of VOCs from other construction/furnishing materials. The pros and cons of carpeted floors vs. resilient flooring is addressed in the Interiors section.

40. Similarly, the times when ventilation/filtration systems are operated are not controlled by the designer, although provision can be made for systems to be engaged on a room-by-room basis outside of normal working hours. Larger particles generally settle quickly and would not be captured by the ventilation system.

Although it is likely that the designer will not have any control of the hours of operation of the ventilation system, the ventilation system should be designed so that selected parts of the building can be operated outside normal operation hours as required to extract cleaning products or pollutants from refurbishment etc..

41. More than one cupboard may be required. If cleaners have to walk too far to refill cleaning devices, they are more likely to carry materials with them to do the refilling wherever it is convenient.

Floors of cleaners' cupboards should be water-resistant and easily cleaned.

Agree. A comment to this effect will be added.

45. Also, 'cold' pipes that get warm are more likely to be colonised internally by bacteria, including Legionella, if there is not a regular flow of water.

Agree. A comment to this effect will be added.

Whole section on natural ventilation appears to relate only to atria. Natural ventilation does not require an atrium. Re-title and possible move to HVAC section so that natural and mechanical ventilation are placed in context.

More material on natural ventilation strategies is included in the Ventilation section. Atria were included in the Infrastructure section as it can be used for visual/planning reasons as well as ventilation.

48. Ventilation of underground car parks is more sophisticated than designing to optimise the impact of wind forces. Cross-reference to relevant HVAC sections.

The quality of the air inside the car park needs to be considered, not just the movement of air to the occupied areas of the building.

Locating the building conveniently for public transport, and providing bicycle storage, may mean fewer cars around the building!

Agree. A comment to this effect will be added.

51. Will the designer select the printing equipment?

The designers may not have any control over the selection of printing equipment. However as printing is a significant source of both VOCs and gaseous pollutants, it is worthy to raise the issues of equipment selection. If there is no input into equipment selection then additional emphasis is placed on containment of pollutants, dilution ventilation and extraction.

52. Will the designer control the operation of the ventilation system?

Although it is likely that the designer will not have any control of the hours of operation of the ventilation system, the ventilation system should be designed so that isolated parts of the building can be operated outside normal operation hours as required to extract cleaning products or pollutants from refurbishment etc..

55. The designer can put in appropriate store rooms but the occupants will decide how they are used.

While the occupants determine how storerooms are used, they can be encouraged to use the storerooms if there are adequate storage provisions. Conversely, if storerooms are not provided then the occupants will be forced to store materials in the occupied areas or where ever space is available. This can lead to off gassing of VOCs directly into the occupied areas.

Additional options to consider for print shops are (a) flexibly located extract points, so that extraction can always be provided directly above printing equipment, (b) carbon filters in the room or for the extracted air and (c) for large facilities, separate toilets and rest areas for printing staff, to avoid re-emission from their clothing into the rest of the building.

Agree. Comments to this effect will be added.

APPENDIX 8 - CONFERENCE PAPER 1

Phipps R.A. (1997) Decision Support System for the Design of Healthy Office Buildings. Healthy Buildings and Indoor Air Quality '97, the joint American Society of Heating Refrigeration and Air Conditioning Engineers and International Society of the Indoor Air Quality and Climate's fifth International Conference on Healthy Buildings. Washington DC 27th Sept. -2 Oct. 1997. Vol 2, pp 347-352.

DECISION SUPPORT SYSTEM FOR THE DESIGN OF HEALTHY OFFICE BUILDINGS

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Abstract

There are many common factors which cause unhealthy conditions within an office building. In some instances building designers can specify seemingly benign building elements and factors which can interact to create problematic conditions.

This is in part due to the gap between the findings generated in the Healthy Building research sector and the transfer of this knowledge to building design practitioners. To bridge this gap and assist building designers to create healthy buildings, there is a need for a Decision Support System (DSS) which integrates known research, represents related factors and creates a framework for the evaluation of decisions.

Research is in progress to develop a system to qualitatively model the consequences of decisions which affect the healthiness of office environments. This includes a structure to capture and integrate existing knowledge, narrow the range of possibilities which must be considered and creates a framework for the evaluation of alternative scenarios. This type of DSS supports simultaneously presents heuristic knowledge on multiple levels of detail and non-monotonic reasoning.

Introduction

This paper presents the development of a Decision Support System (DSS) for the Design of Healthy Office Buildings. A worked example of microbial contamination within ventilation ducting is used to illustrate the system logic and structure.

The objective of the DSS is to qualitatively model the consequences of decisions made during the design of an office building which affect the healthiness of the indoor environment. The system supports the building design process by:

- integrating existing research knowledge on healthy/unhealthy environmental conditions and structuring the knowledge to allow timely retrieval,
- leading the designer through structured questions to focus their attention on the creation of healthy environmental conditions
- identifying combinations of factors which directly or indirectly affect the healthiness of the indoor environment
- identifying gate way points where alternative decisions could create healthier outcomes and model other options,
- evaluating the decisions and suggesting alternative solutions or mitigation strategies.

There are many common factors which research has shown can cause unhealthy conditions within an office building. In some instances, building designers can specify seemingly benign building elements which can interact directly or indirectly via a cascade effect, to create problematic conditions.

For example, an unhealthy sequence could start with the energy saving measure of shutting off the ventilation system at night [Pasanen et al 1993]. If sufficient vapour is contained in the ventilation system at the time of shut off or re-enters the duct from the rooms, this vapour can condense and wet the internal surfaces [Morey, P., 1996]. If the duct is internally lined with porous acoustic duct liner then the rough surfaces can harbour matter which has not been arrested by the air filters, depending on the efficiency, installation and maintenance of the filters [Reinhardt, I.H., 1991] or has infiltrated from leaks downstream. If the internal surfaces of the ventilation systems are also loaded with macro-organic dust and microbial spores [Gyntelberg, F., Suadicani, P., Wohlfahrt, J., et al. 1994] then a ripe host environment for fungal colonies is created. Dust in the duct will increase the hygroscopicity of the duct liner while providing a nutrient source [West & Hansen 1989]. As fungal spore germination can occur within 5 hours, both the temperature and time will be sufficient for germination and production [Pasanen et al 1993].

The potential for condensation is greatest within the first 3m beyond the cooling deck where the air is close to saturation point and around obstructions in the ducting. However if the duct is uninsulated or passes through a cold area, then air within the duct can cool below dew point [Pasanen, 1996].

Dissemination of microbial material throughout the building is imminent following the establishment of a microbial source reservoir [Foarde 1996] particularly with a rush of air upon restarting the ventilation system. Air velocity of 5-6m/s in a duct has been found sufficient to liberate *Penicillium* and *Aspergillus* spores [Pasanen, in Pasanen, 1996]. Drying of the moistened duct appears to promote the release of spores into the airstream.

Mitigation approaches for controlling microbial contamination in ventilation ducts also include upgrading the filtration system and avoiding the application of insulation on the airstream side of ducts [Morey]. Infiltration of some dirt & moisture is inevitable therefore the presence and configuration of access points to permit inspection and cleaning of the duct interior is highly desirable [Foarde et al 1996] as a monitoring strategy.

The high prevalence of Sick Building Syndrome (SBS) type symptoms in buildings which have been designed and maintained in accordance with building standards suggest that there are interactions and mechanism which are outside the scope of the regulations. As SBS has multiple dynamic causes of which many require further research, regulations may have limited merit.

A void exists between indoor air quality research and practitioners in a variety of disciplines who could utilise the information [El Daisty, 1993]. Further with many other important design aspects, such as aesthetics and energy efficiency, competing for the attention of the design team few building design professional give due consideration to indoor air quality and healthy design [levin, 91]. A DSS for the design of healthy office buildings has been considered necessary to bridge the gap and facilitate information transfer between the research community and the designers. An approach which emphasises the inter-relationships of all components and factors of the building, including the larger environment and the occupants has been suggested as the strategy for healthier buildings [stockton 1991]. The DSS encompasses a holistic approach and is designed to systematically identify contributing factors and their effects. Healthier solutions are generated through modelling of alternative design options followed by suggestions for elimination or mitigation.

The design of healthy office environments requires the integration of most building disciplines including architecture, mechanical, acoustical and lighting engineering, interior design, cladding design and building physics, as well as many other related sciences such as microbiology, toxicology, epidemiology and materials science.

This system focuses primarily on the architectural domain but incorporates other disciplines where appropriate. A multidisciplinary approach is necessary as the boundaries between domains are conceptual and ill-defined and the interface frequently requires additional attention to co-ordinate decisions. The DSS is intended to support building designers who are not experts in healthy building science to create healthy environments.

It is not intended to replace specialist skills or the in-depth analysis of selected parameters. The system is not intended to replace the advanced modelling techniques, such as computational fluid dynamic analysis for modelling air flows. While these techniques are valuable for the examination specific problems they can't holistically address the interdependencies all components and factors within the building.

Discussion

The DSS consists of two parts; a knowledge base and a design interface. The knowledge base holds heuristic information on healthy building environments in an integrated and structured format. The consequences of decisions are inferred from the data supplied by the users in the design interface. In the design interface, users are lead through a structured set of questions on aspects of the design and are provided with feedback on the consequences of their decisions. Users can trial design options and receive an evaluation of the healthiness of their decisions. The level of design detail from conceptual to developed design can be selected and users can also request feedback on the direct and indirect consequences of their decisions with an explanation or advise on possible mitigation strategies. System users are largely separated from the workings within the knowledge base.

Knowledge Base

The data used to deduct this model of healthy office conditions has been gained through extensive review and integration of scientific literature available up to 1996. A network matrix is derived from the literature which illustrates the direct and indirect inter-relationships between building factors and components that have repercussions for the healthiness of the environment. The network matrix is three dimensional to illustrates the interdependencies at various levels of resolution.

For the main risk factors of volatile organic compounds, particulates, microbial contamination potential, bacteria contamination potential, air supply hygiene, moisture potential, the network matrix is linked to individual optimum condition diagrams which illustrate the factors which will improve or compound the risk. An example of this is shown in figure 1.

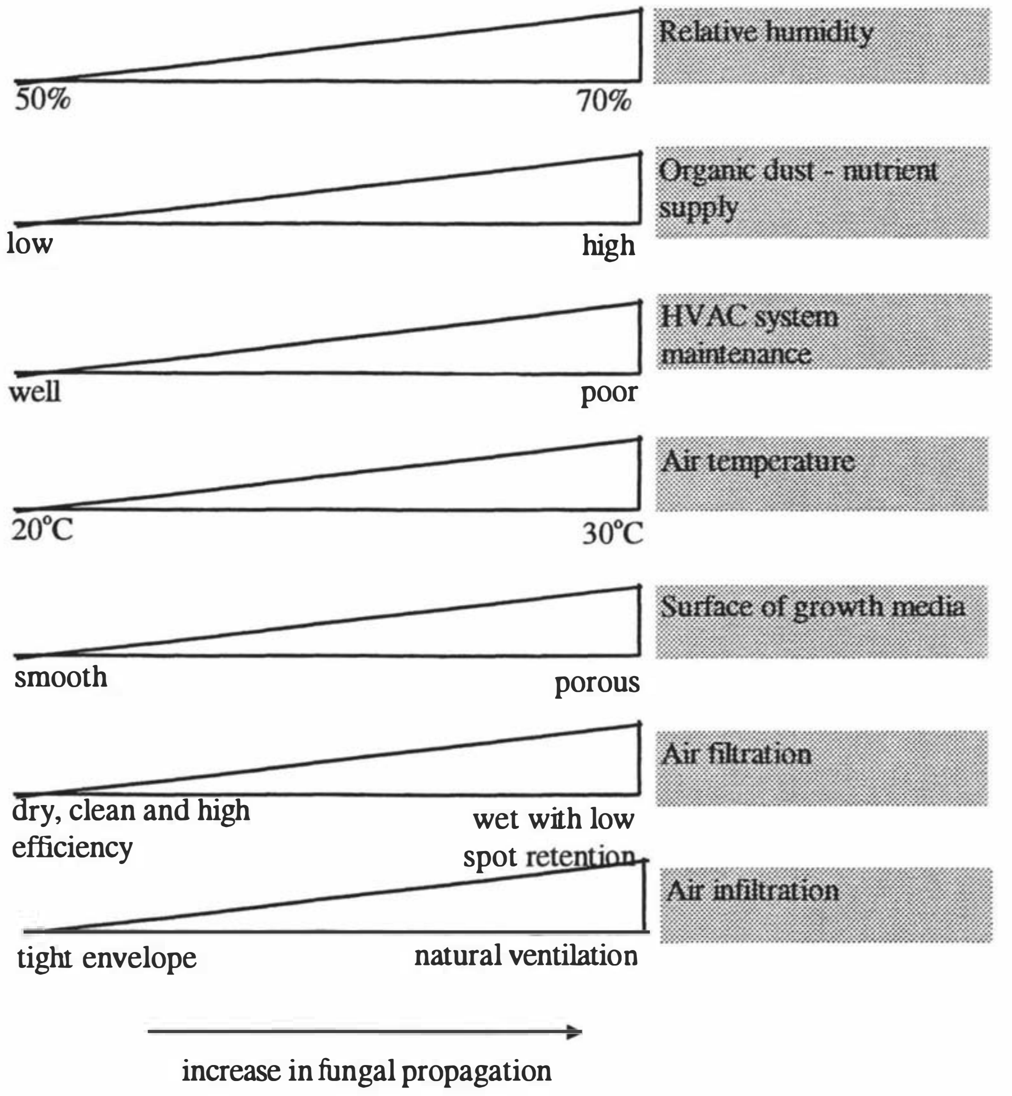

Figure 1 Optimum conditions for the alleviation or propagation of fungal matter

Although the scientific knowledge of healthy building environments is rapidly progressing, some of the research is incomplete, such as the combined health effects levels of total volatile organic compounds [Molhave, L., 1996] and there are other subjects where the results are contentious, such as the health effects of respired fibreglass insulation [*Indoor Air Quality Update* July 1994]. Where relevant, such information is coded and weighted to allow appropriate interpretation of the DSS by the users.

As the science is likely to continue to develop it is necessary to make provision for updating of the knowledge base of the DSS. To facilitate the inclusion of new knowledge, the design interface is separated from the knowledge base. This is aided by separating the design interface and inference engine from the knowledge base.

It is important that decisions which support a healthy environment are embedded in the building design from initial form and location concepts through to the developed design. Therefore the DSS has been developed to trial and model the consequences of decisions from the conceptual design stage through to more developed decisions.

To facilitate various levels of resolution without slowing the system, the network matrices are structured according to object-orientated principles that allow sharing and inheritance [Turban, E., 1992] of common data between different classes of building elements and levels of resolution within each element.

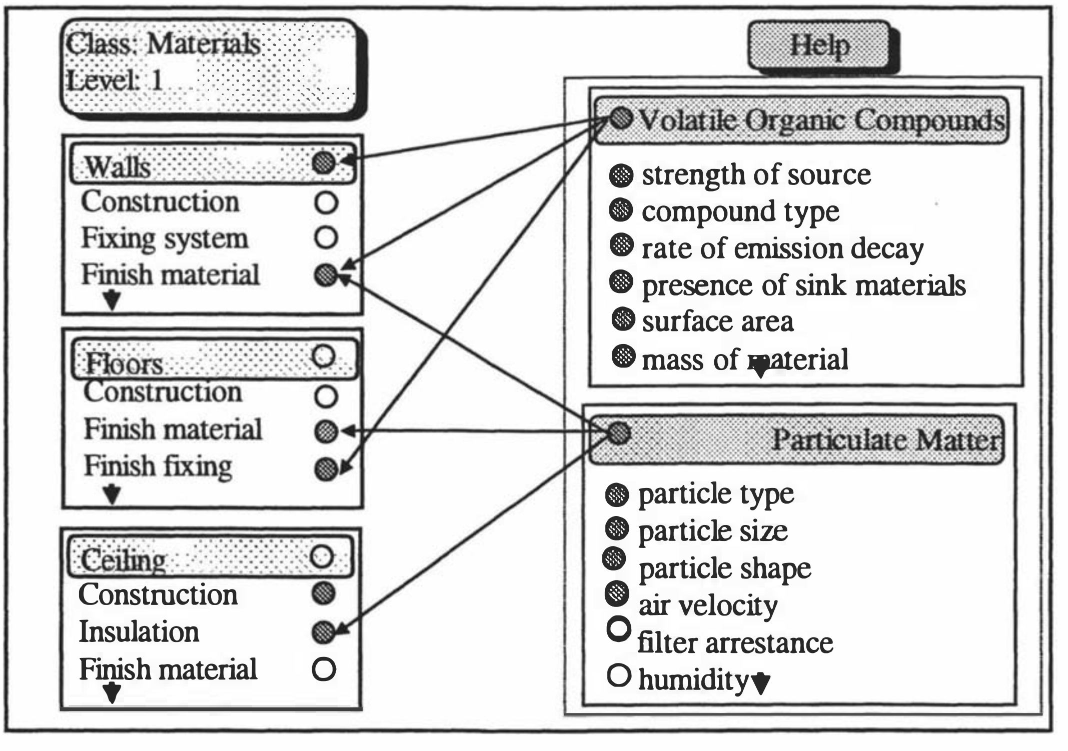

Figure 1 Inheritance of common data within a network matrix.

As new decisions on the subject building is added to the DSS, the dynamic structure of the knowledge base allows for non-monotonic reasoning, that is, dependent factors and their consequences are reassessed to consider the new decision inputs.

Design Interface

In the design interface the designer is presented with a structured set of questions on the proposed building. Gateway decisions are identified and the designer is prompted with alternative options. The designer can select a level of detail appropriate for the stage of the project being considered. The system can responds to inputted data with prompts for more information, evaluation on the affect of the decision, display of related factors, suggestions for improvements and/or a brief justification message.

Decisions are evaluated on a five point scale, ranging from "strongly not recommended" to "highly recommended" as the scientific literature is presently not empirically precise or sufficiently quantitatively complete to support a numeric ranking system for all facets of the whole indoor environment [Baglioni, A., 1992].

The operation of the design interface is best illustrated by example. From the outline on microbial contamination in ducting given in the introduction it can be seen there are a number of "gateway" points, where a good decision could alleviate the risk, or alternatively an inappropriate decision could exacerbate the problem. There are also sequences and conditions created by interdependent factors which evoke a chain reaction. A network diagram for these relationships is shown in figure 3 below.

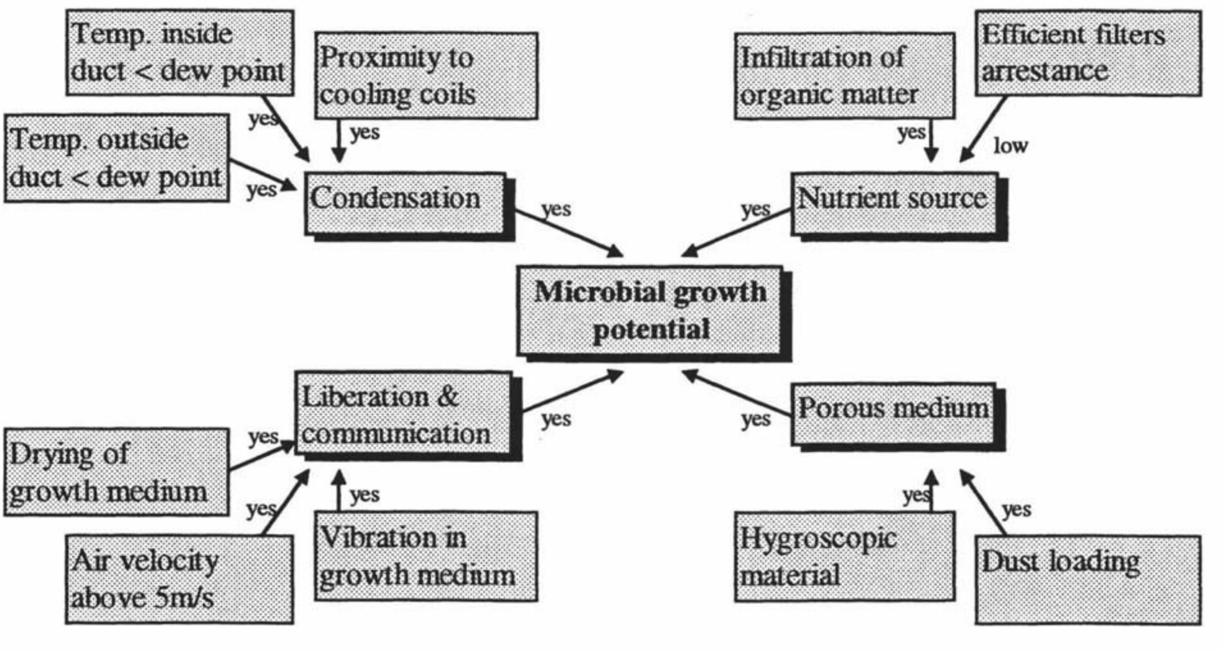

Figure 3 Network diagram showing relationships of factors contributing to microbial contamination within ducting.

The structured question set which is derived from this is shown in figure 4 below.

Conceptual Design	Preliminary Design	Developed Design	Show Explanation	Show Linkages	Show Evaluation	Show Mitigation

Is the HVAC system fitted with cooling coils?	Yes / No
Air temperature leaving cooling deck above dew point?	Yes / No
Air temperature always above dew point when cooling off?	Yes / No
Air velocity within 8m of cooling deck always below 5m/s?	Yes / No
Low potential for infiltration of organic matter?	Yes / No

What is downstream of the cooling coils?	**Within first 3m**	**Within 3-8m**
Ducting type:		
Uninsulated mild steel	Yes / No	Yes / No
Single skin mild steel internally insulated	Yes / No	Yes / No
Single skin mild steel externally insulated	Yes / No	Yes / No
Double skin mild steel sandwich insulated	Yes / No	Yes / No
Fibreglass duct board	Yes / No	Yes / No
Other factors:		
Inspection point for IAQ monitoring	Yes / No	Yes / No
Access point for cleaning	Yes / No	Yes / No
Bend of 45° or greater	Yes / No	Yes / No
Constriction in duct	Yes / No	Yes / No
Air filter bank	Yes / No	Yes / No
Acoustic baffle	Yes / No	Yes / No
Fire damper	Yes / No	Yes / No

Figure 4 Example of the decision enquiry database.

Explanation files are accessible from the design interface which give a brief overview of the topic and references for further reading.

Economic constraints and competing design criteria are often going to compromise the specification of the "perfect" building environment. Where non-optimum conditions are proposed, an appropriate mitigation strategy should be used. The preferred order of mitigation strategies of problematic conditions is ranked as follows:

1. elimination
2. reduction and control
3. isolation.

For example, ideally all sources of moisture such as leaks and cold spots where condensation could occur should be eliminated. However in reality, elimination is not always practical, so the system guides that these should be reduced. All moisture reservoirs in a building should be reduced to a minimum number of locations, with appropriate access, monitoring and second line of defence systems. There are also some situations, such as cooling towers, where isolation from all air intake streams is required in conjunction with other mitigation measures. The DSS suggests mitigating options and highlights any subsequent reactions, such as the application of biocide where this could potentially enter the airstream.

Conclusions

A DSS has been designed to transfer scientific information to building professionals and support non expert designers to specify healthy office building environments. This system which is continuing to evolve allows designers to model the built environment at various stages of the design process. It also supports the rapid trialling of alternative schemes and highlights the direct and indirect consequences of design decisions.

Three dimensional network diagrams illustrate the interdependencies between building elements at various levels of detail. The object orientated DSS supports non-monotonic logic and reprocessing of the repercussions and healthiness of the environmental conditions following the input of additional of design data. The DSS is structured to allow the updating of the scientific knowledge base.

Option prompts, help files and evaluations of proposed works guide the designer to specify an appropriate combination of factors. Where problematic conditions are identified, the system suggests appropriate mitigation strategies. The system has the potential to guide the non-specialist building designer to evaluate the impact of their design decisions on the healthiness of the office environment.

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APPENDIX 9 - CONFERENCE PAPER 2

Phipps R.A., Wall G.L., Laird I. (2001) Decision Support for Healthy Office Building Design: A Conceptual Framework. International Council for Research and Innovation in Building and Construction, International Congress. Wellington, New Zealand, 2nd – 6th April 2001

DECISION SUPPORT FOR HEALTHY OFFICE BUILDING DESIGN

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ABSTRACT

There are many common factors that cause unhealthy conditions within an office building. In some instances building designers can specify seemingly benign building elements and factors which can interact to create problematic conditions. Access by design practitioners to good quality research on criteria for the design of healthy office buildings, in a format appropriate for non-experts, has also been cited as a barrier to the adoption of research findings.

To assist building designers to create healthier buildings a Decision Support System (DSS), which presents research in lay terminology and identifies relationships between factors which have direct and indirect consequences for the healthiness of the built environment, is being developed. The system qualitatively models the alternative scenarios and evaluates the health implications of the various decisions. The DSS includes a structure to capture and integrate existing expert knowledge, a framework for the evaluation of alternative scenarios, and suggestions of parameters that need to be addressed.

KEYWORDS

Healthy office buildings, indoor air quality, design tool, microbial control, volatile organic compounds.

INTRODUCTION

Three International evaluations of the relative risks of environmental problems have identified poor indoor air quality (IAQ) within the top five greatest risks to human health. (United States Environmental Protection Agency, 1987; United States Environmental Protection Agency, 1990; Presidential and Congressional Commission, 1997). This is largely due to the duration of exposure to indoor air pollutants as citizens of developed counties spend on average 90% of their lives indoors. Also indoor environments have been frequently found to have levels of Volatile Organic Compounds (VOCs), gaseous pollutants, microbiological contamination and respirable particulates at levels detrimental to human health.

There is a vast body of literature that has identified that exposure to pollutants within a building can cause or aggravate ill health. However, several leading have identified that this knowledge is not being integrated into common practice (Bascom, 1997; Turner, et al., 1999). Odom (1995) observed that the key to IAQ problem avoidance in new buildings is making the right decisions at the right time.

There is a need for design tools to support building designers who are not IAQ experts to make the right decisions. Consequently, a decision support system (DSS) is being developed to qualitatively model the consequences of decisions, which affect the healthiness of the indoor environment, made during the design of a new mechanically ventilated, heated and cooled office building. This is being achieved through:

- A wide investigation of the literature on healthy and unhealthy office environmental conditions,
- Development of a conceptual model which integrates current knowledge in this field,
- Development of the logic for a DSS to quantitatively evaluate design options with emphasis on identifying interactions between factors which affect the healthiness of the indoor environment,
- Verification of the DSS with the assistance of experts in this domain.

Over 600 papers were reviewed. From the literature, the sources of contamination that need controlling are VOCs, gaseous pollutants, microbiological activity and respirable particulates. The contaminants need to be considered individually as they all have very different behaviors. The different origins, pathways into and throughout the building, driving forces and mitigation strategies need to be considered.

There is no simple formula for a "healthy office buildings". Indeed, there are numerous external, building and users factors which interact on various levels to either cause, communicate or mitigate problems. The DSS models the interactions of the buildings elements and environment via "trial and error" iterations to arrive at a best fit solution which maximises the site attributes, environmental conditions, etc. The DSS supports identification of gateway points where alternative decisions could create healthier outcomes. It also helps model the influences of alternative decisions, identification of potentially non-optimum conditions, with prompts for the designer to employ an alternative design solution, isolate the occupied areas from the pollutant or mitigate the problem.

The DSS is designed for New Zealand conditions. It is based on the prevailing conditions of a temperate, humid climate, with reasonably uncontaminated outdoor air and a geological structure without radon. Mechanical humidification is not included, as this is seldom employed in New Zealand office buildings.

The DSS considers the building as one component within the "building-environment-occupant" dynamics. Where the indoor environment building is the result of changing and complex interactions between the external conditions, the building entity and occupant activities.

This paper presents the conceptual model for the evaluation of decisions made for the design of healthy office buildings.

CONCEPTUAL MODEL

When decomposed to its philosophically simplest elements, IAQ problems occur when all four of the following major elements of the indoor air cycle are present:

- A primary outdoor, indoor or intermediate source of a contaminant,
- A pathway for the transportation of the contaminant to the occupied areas,
- A driving force for the transportation of the contaminant from the source to the occupied areas, intermediate factor or reservoir,
- Occupants or a reservoir within the space.

The indoor level of pollutants, to which the occupants are exposed, can be expressed as the sum of the contaminants generated and communicated to the occupied areas, less those removed via various mitigation techniques. This cycle is illustrated in Figure 1.

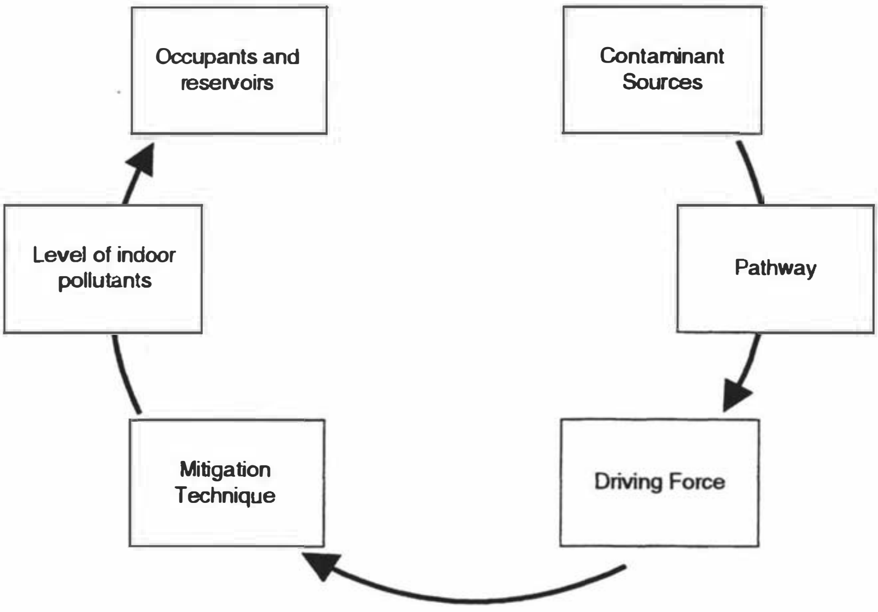

Figure 1: The Major Elements of the Indoor Air Quality Cycle

The DSS attempts to identify opportunities to minimise the first four elements of the indoor air quality cycle shown in Figure 1. If any of the above elements are removed then the magnitude of the IAQ problem is decreased. Conversely the magnitude of the problem will generally be exacerbated if the strength of the source, pathway or driving force are increased. Between the origin of the source and the occupant's exposure to the contaminants there are frequently opportunities to mitigate the problem.

A decision tree, which illustrates the hierarchy of the decision made in DSS, is illustrated in figure 2.

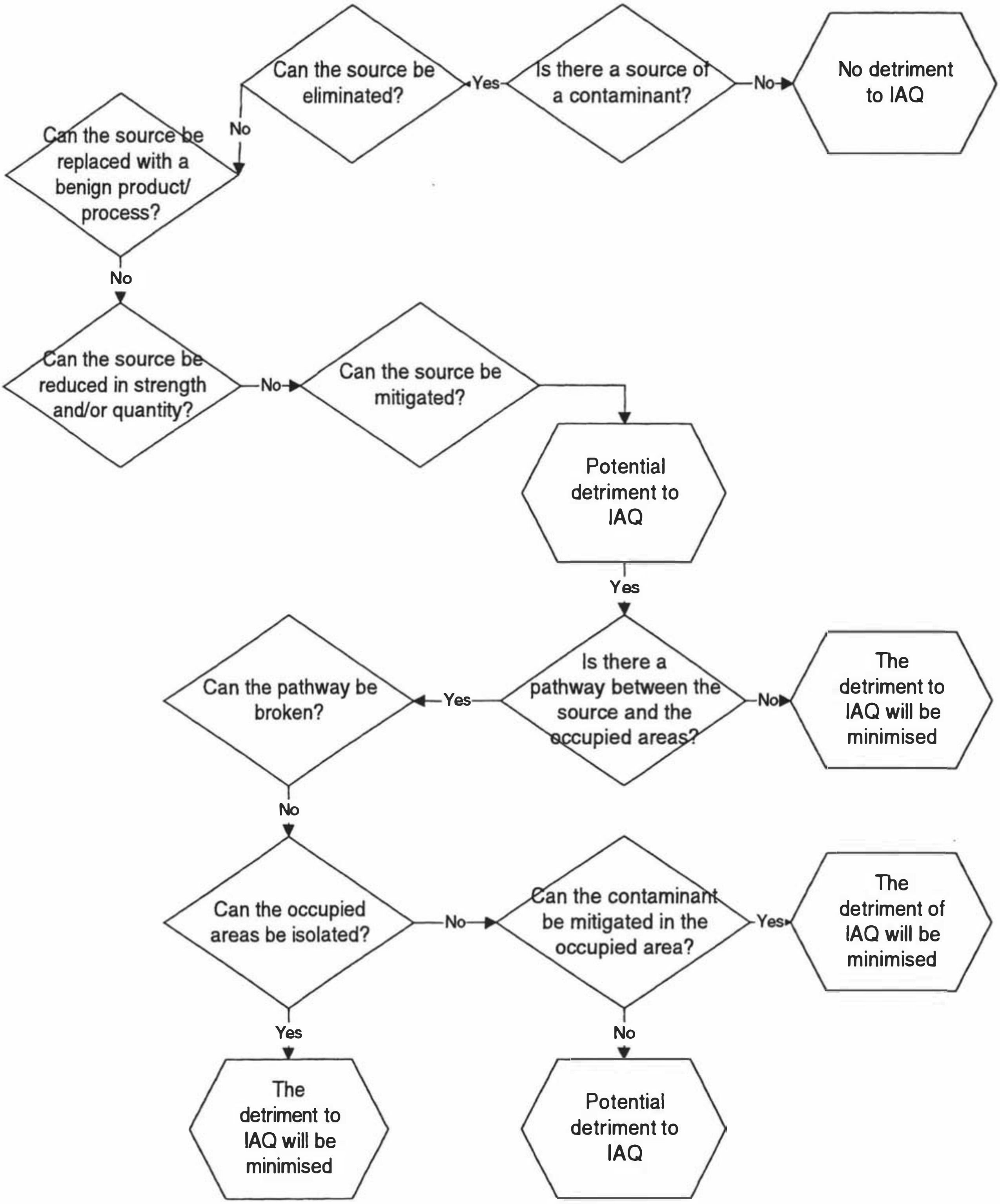

Figure 2 Hierarchy Structure of Decisions

CONTROL STRATEGY

Prevention of IAQ problems is better than a cure (Bower, 1997; Billings & Vanderslice, 1982). Source control comprises several principles depending on the nature of the polluting agent. A general occupational, safety and hygiene approach to dealing with pollutants employs the following hierarchy of control measures:

- Eliminating or minimise pollutants,
- Substitution with more benign products or systems,
- Enclosing or isolating the process, materials or system,
- Partial enclosure with local air extract,
- Dilution ventilation,
- Personal protection,

This hierarchy is applicable to office environments with the exception of personal protection, which is seldom feasibly or necessary.

Godish, (1989) agreed with the above principles and added that non-industrial indoor air source control strategies should also include the following specific objectives:

- Measures which prevent or exclude the various pollutant emitting materials (sources) in the building environment,
- Elements of the building design or maintenance that prevent or minimise air contamination,
- Treatment or modification of sources either directly or indirectly to reduce emissions
- Physical removal of the source or source materials and replacement with other materials with no or minimal effects,
- Measures that prevent the amplification and entrainment of biological contaminates in indoor air,
- Removal of particulate dust from surfaces by cleaning.

The above control strategies form the foundations of the DSS philosophy.

CONTAMINANT SOURCES

The DSS prompts building designers to identify materials with a low pollutant potential. Materials with low emissions of VOCs, and low adsorbance of VOCs, low water availability or porousity in areas prone to dampness, and low shedding of particles are recommended. Bacteria and fungi are frequently amplified in indoor environments wherever a warm moist site exists. Bacterial and fungi spores and byproducts are difficult to remove and the need for prevention of all stray moisture sources is paramount. Biocides by their very nature are toxic to living organisms, and the source control of microbiological activity via good engineering practices can reduce the reliance on their application (Burge, 1990).

Although elimination of pollutants is the preferred option, this is not always feasible. Therefore more needs to be known about the nature of the pollutants in order to determine the most appropriate method of control. Seifert & Ullrich, (1987) distinguished between continuos and discontinuous sources and whether these were regular (weeks to months) or irregular (minutes to days). Levin, (1992) gave spatially and temporal attributes to contaminant sources in a matrix. Spatial attributes include whether the source is distributed e.g. VOCs from carpet adhesive, or localised e.g. fungal activity on damp filters. Temporal patterns were classified as constant e.g. emissions of VOCs from construction materials for the first twelve months of the products life; periodic e.g. emissions of VOCs from the application of resilient flooring polish, and episodic e.g. entrainment of high concentrations of ambient pollutants during episodes of climate inversions. Etkin (1992) suggested that the proximity of the source to the occupants' breathing zone was a further spatial parameter to be considered. This is an important parameter where VOCs are released from office furnishings and partitions within fractions of meters from the occupants' breathing zone.

In addition, the contaminants interact differently with air movement, air temperature, temperature of surfaces, relative humidity, other contaminants and other building factors. The emission rate of most VOCs increase as the temperature of the material, relative humidity and air movement also increase (Wolkoff, 1995). The risk of propagation of many types of fungi increases when air close to its dew point comes into contact with cold surfaces.

Ventilation was frequently named in the literature as a source of contamination when the ventilation system failed to deliver sufficient air to dilute the level of indoor pollutants. However in the framework of the DSS, ventilation can be more correctly considered as either a:

- Pathway, for bringing contaminants from the outdoor air into the building if there is a source near the air intakes, or communicating contaminants generated within the mechanical ventilation plant to the occupied areas,
- A driving force by creating air pressure relationships which can move contaminants between areas, or
- A mitigation technique, by dilution and removal of bioeffluents, respirable particles or VOCs generated within the occupied area.

As the ventilation system has a direct pathway and a driving mechanism there is a need to evaluate what contaminants including moisture, which could be drawn into the building. The DSS prompts the designer to evaluate the temporal or spatial attributes of the site's outdoor air pollutants. A high outdoor pollutant level trapped in a climatic inversion is an example of a temporal factor when ventilation with outdoor air should be limited for certain periods. Localised points sources of pollutants such as exhausts, flues, outdoor smoking areas are examples of spatial factors from near where it would be undesirable draw outdoor air via intentional or unintentional air intakes.

This philosophical shift in the role of ventilation enables a clearer application of the control strategy presented above. Also shifting the reliance from the need to supply large quantities of ventilation for the dilution of the contaminants within the space to the control of the source, pathway or deployment of other mitigation techniques allows for more precise use of ventilation.

PATHWAYS

Little research has been specifically reported on the effectiveness of controlling pathways as means of changing the indoor air cycle. However, there are numerous field studies which have identified the detrimental effects of communication of pollutants via pathways (Melius et al., 1984; Kirkbridge et al., 1990; Namiesnik et al., 1992; Godish, 1995). Other authors have identified a positive outcome when a pathway has been interrupted (Hedge et al., 1993; Kemp et al., 1998; Kildeso et al., 1998).

Pathways include ventilation ducting, plenums, lift shafts and stairwells, penetrations in the building envelope. They also include the room air, openings between rooms. Pathways can be defined as either direct or indirect, and also have a distance factor.

Direct pathways are easier to identify and but not always easier to manage than indirect pathways. For example, a configuration of the HVAC system that allowed fungi to grow on the filters would have a direct communication route via the ducting, driven by the fans, to the occupied area. It would obviously be counter-productive to interrupt the pathway or remove the driving force, therefore control at source of all microbiological activity within the HVAC services is identified as a critical activity within the DSS. Similarly, diesel fumes from vehicles idling at a loading dock cannot feasibly be controlled at source by relocating the loading dock remotely from the building. However the indirect pathway from the loading dock, through the services bay, up the lift shaft to the occupied areas can be interrupted by the installation of a vestibule with self closing doors.

The distance of the pathway is an important factor. A short distance between the source of the contaminant and the occupied area, or more specifically the breathing zone of the occupants' limits the opportunities for mitigation of the pollutant. This is poignant where the mitigation device is dilution ventilation. Identification of a short pathway highlights the importance of control of contaminants at source. Consequently, the selection of materials with a low pollutant potential, where they are to be used in close proximity to the occupants', is emphasised in the DSS.

A principle adopted in the DSS is to break pathways as close to the source of contamination as possible if the pollutant originates from a point source, or close to the occupants if the source is distributed or there are multiple point sources.

Identification of all opportunities for contaminants to enter and exit the pathway will also suggest the most effective point to break the pathway. Logic suggests that attempting to mitigate contaminants generate within the occupied area with devices located in the central HVAC plant will be of limited effectiveness for the controlling the occupants' primary exposure. Centralised devices can however reduce the recirculation and accumulation of the same contaminants.

Devices for breaking pathways include:
- Reducing unintentional penetrations in the buildings' envelope and air circulation routes,
- Installation of vestibules,
- Localised air extracts,
- Buffer zones and physical separation
- Appropriate air pressure relationships to isolate the source or the occupants.

The four three devices are permanent and reliable systems and are recommended n the DSS.

DRIVING FORCES

Driving forces include air movement due to forced ventilation, the stack effect; wind pressure, temperature differentials, movement from people, lift cars etc. In reality, it is frequently difficult to control the driving forces, as they are often dynamic, unpredictable or not manageable. Maintaining the occupied area at a higher air pressure than a localised zone with a high concentration of contaminants, is a device used frequently in building designs to offset the pollutants' driving forces. Reliance on maintaining appropriate air pressure can be problematic under certain climatic and thermal conditions or when the mechanical ventilation system is shut off. This strategy is best suited for contaminants which have a short-term duration or the emissions coincide with the operation of the mechanical ventilation, unless there are other complimentary control strategies in place.

MITIGATION TECHIQUES

Mitigation techniques include;
- Ventilation with clean, fresh air,
- Air cleaners,
- Filters,
- Localised air extraction,
- Cleaning practices,
- Biocides.

The average office building relies on ventilation as the primary, if not only, strategy for achieving good air quality. While ventilation is an invaluable tool for improving indoor air quality, it should be used to supplement other good IAQ design strategies. An average ventilation system designed to provide thermal comfort for the occupants' would be operated around the hours of occupation of the building, with the outdoor air temperature relative to the indoor air temperature being a significant factor in the amount on outdoor air drawn into the building. An improvement in indoor air quality is frequently incidental.

However a ventilation system design for good IAQ would also be operated when the outdoor air has the lowest levels of pollutants as well as when there are airbourne pollutants within the building which can be removed by dilution. Typically, urban air during the early hours of the morning has the lowest concentrations of particles and gaseous contaminants, and this can be useful to flush the building of accumulated pollutants.

As discussed previously, all contaminant sources within the building have temporal and spatial attributes. Bioeffluents and many other occupant generated contaminants, are typically generated in certain periods of the day and are distributed through out the occupied area. Opportunities to interrupt the pathway or driving forces from one area to another are limited and consequently these sources are suited to removal by standard dilution ventilation. Other occupant activities, such as photocopying, are point sources and are most effectively removed close to the source with a localised extract.

VOCs are emitted continuously, but the emission rate can increase if the relative humidity or temperature increases. A continuous trickle of ventilation can remove free VOCs to prevent an increase in the indoor concentration, as well as controlling the environmental variables that influence the emissions rate.

The function of air cleaners and filters is self-explanatory, and systems specified to high performance criteria can greatly assist in the removal of airbourne particles and VOCs. Consideration should be given to installing filters and or air cleaners in the occupied areas where there are strong in-room sources, or sources down stream of the centralised filters/air cleaners and in buildings with unfiltered air pathways such as naturally ventilated buildings.

Thorough and regular cleaning of the interior of buildings and the ventilation system has been found to improve the air quality (Raw, et al., 1991; Schneider, et al., 1993; Franke, et al., 1997). Designing the building to facilitate cleaning and maintenance is a building design feature recommended in the DSS.

CONCLUSIONS

Most office buildings depend on ventilation as their primary or only means to improve the IAQ. Ventilation in the average building is generally operated for thermal comfort, and any improvement in the IAQ is largely incidental. Wholesale over ventilation can be energy inefficient, while under ventilation can deteriorate the quality of the air.

Designing a building to control sources of contaminants at the point of origin, and reduce the pathways and driving forces for the communication of contaminants between the source and the occupied areas can generate many opportunities to improve the indoor air quality. In addition, the installation and operation of mitigation techniques complimentary to the temporal and spatial properties of the contaminants can provide further tools in the quest for indoor environments which are healthy for the occupants. By evaluating the specific attributes of the types of contaminants precision and effective control techniques can be introduced.

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