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STRESS AND FAILURE ANALYSIS OF COMPOSITE MATERIALS USING FINITE ELEMENT METHOD

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To my family who gave me great
support and assistant during preparation of this dissertation.

In the Name of Allah (God),
the most Merciful, the most Compassionate

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Abe

CONTENTS

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SUMMARY

STRESS AND FAILURE ANALYSIS OF GLASS/POLYESTER WOVEN ROVINGS COMPOSITE MATERIALS

A micro-mechanistic approach was performed with three-dimensional finite element analysis of stress and failure of glass/polyester woven roving mat composites. In this study the pre- and post-processor software MYSTRO and the finite element analysis software LUSAS were utilised.

The effects of a crimp (curvature), weft fibre, and the matrix volume fraction on the stress distribution and failure of a single short fibre, with 10 μm diameter and 50 mm length, subject to a tensile load, were studied. With the assumption of a perfect fibre-matrix interface the following were concluded:

A) Any curvature along the length of the fibre causes a big internal stress concentration which depends on the radius of the curvature.

B) With an increase of the matrix volume fraction, the stress concentration factor (S.C.F.) decreases.

C) Any direct contact between the interlaced fibres in the cross cover region can cause the fibre failure mode to occur before the other failure modes.

D) The composite failure initiates at the crimped area and propagates along the length of the fibre as a debonding phenomenon. This is followed by matrix failure mode and finally the composite will collapse by the fibre fracture mode.