THE UNIVERSITY of ADELAIDE

FRP-CONCRETE-STEEL COMPOSITE STRUCTURAL MEMBERS

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CONTENTS

ABSTRACT

The use of fibre reinforced polymer (FRP) composites as a confinement material for concrete has received a great deal of attention over the past two decades. Together with the retrofitting applications, the use of FRP as confinement material in the construction of new high-performance composite members in the form of concrete-filled FRP tubes has become increasingly popular. Following from the research on CFFTs, a new type of composite system, which consists of a steel tube inside, an FRP tube outside and a concrete sleeve sandwiched in between, has received significant recent research attention. These double-skin tubular (DST) beams and columns (referred to as DSTBs and DSTCs) rely on the same FRP tube confinement mechanism that is present in CFFTs, and through the combination of the advantages of the three constituent materials they can be designed to exhibit extremely high structural performance levels. The research reported in this thesis was aimed at investigating the behaviour of CFFT and DST structural members under various loading conditions. To this end, five experimental studies were designed and undertaken at the University of Adelaide.

First, an experimental study was conducted to investigate the seismic performance of high-strength concrete (HSC) CFFT columns, in which the column specimens were tested under combined axial compression and reversed-cyclic lateral loading. The seismic behaviour of the columns was evaluated on the basis of their experimentally recorded moment-lateral drift hysteretic relationships. Following this, four series of experimental studies were conducted on DSTCs and DSTBs, which consisted of tests on: i) circular and square DSTCs under combined axial compression and reversed-cyclic lateral loading, ii) circular and square cantilever DSTBs under reserved-cyclic loading, and iii) circular simply supported DSTBs under monotonically increasing four-point loading. The results of these

studies clearly indicate that DSTCs and DSTBs may provide an attractive alternative to CFFTs for the construction of new high-performance composite structural members. The results also show that the provision of a concrete-filling inside the inner steel tube of DSTCs significantly improves the overall behaviour of these columns.

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