

FE Study of FRP Strains in Split-Disk Test

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Introduction

Eventual failure of FRP-confined concrete is usually governed by the rupture of the FRP jacket. The ultimate tensile strength of FRP is usually tested using one of the following two tensile methods:

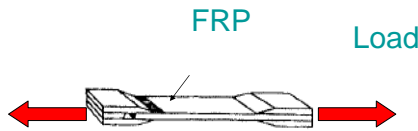


Fig.1 Flat coupon test (ASTM 1995)

Numerous experiments have shown that the rupture strain determined from the split-disk test is significantly lower than that from flat coupon test.

In this study, FE analysis of FRP split-disk test is performed to investigate the reason of the reduction of tensile strength of split-disk test.

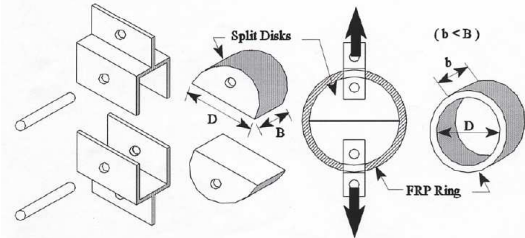


Fig.2 Split-disk test (ASTM 1992)

Finite element model

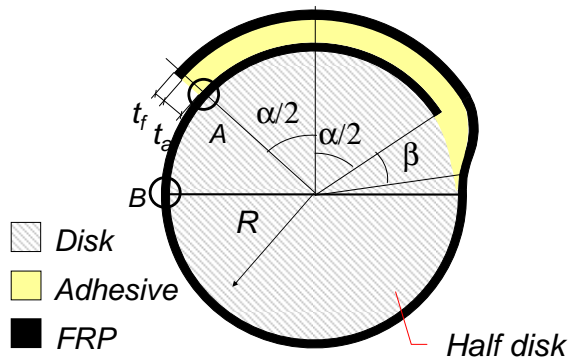


Fig. 3 Two half disks with test FRP ring

- General:** The FE analysis package ANSYS version 11.0 was used. The test is modelled as a plane stress problem using eight-node plane stress elements.
- Geometry:** Two assembled half disks with one layers of FRP ring are considered. As shown in the left. The shape of the transition is assumed to be sinusoidal with an angle of β .
- Material properties:** FRP composites are considered as orthotropic materials; the adhesive was treated as an isotropic material and perfectly elastic-plastic; The actual thickness of the FRP composite was used.

FEA results

Lam and Teng's (2003) tests were modelled. Their flat coupon tests results were used as input material properties.

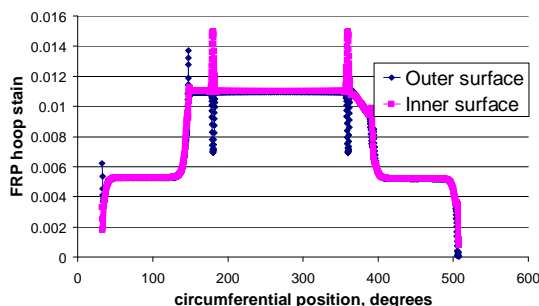


Fig. 4 FRP strain distribution

Type of FRP	Experimental result		FE result		
	Ultimate Strain of Coupon Exp. (%)	Ultimate Strain of Ring Exp. (%)	Maximum Strain in location A (%)	Maximum strain in location B (%)	FRP strain outside overlap zone (%)
CFRP	1.511	1.030	1.371	1.497	1.101
GFRP	2.325	1.987	2.367	2.327	1.794

Tab.1 Comparison of test and FE results

Conclusions

- The geometric discontinuities at the ends of the FRP increase the local strains in the FRP ring;
- Circumferential bending of the FRP ring at the gap is arisen from the relative moment of the two half disks leading to higher strains in the inner surface of the FRP ring.
- FRP ruptures once on of the peak strains at the above location reaches the rupture strain, leading to lower tensile strength than that from flat coupon tests.