

GMA '08

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SIZE EFFECT IN FRP-SUBSTRATE MATERIAL BONDED JOINTS

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MOTIVATIONS

Difficulties in the definition of interface laws and related parameters
identification from laboratory test;

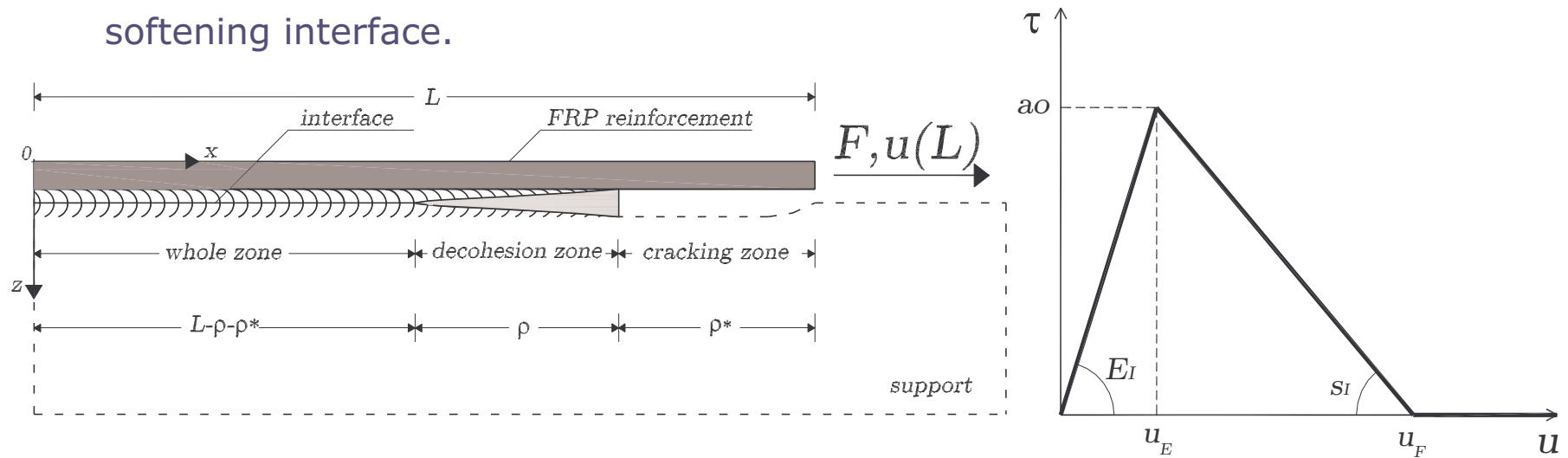
OBJECTIVES

Derive constitutive interface parameters and other engineering quantities
from simple single-shear pulling tests;

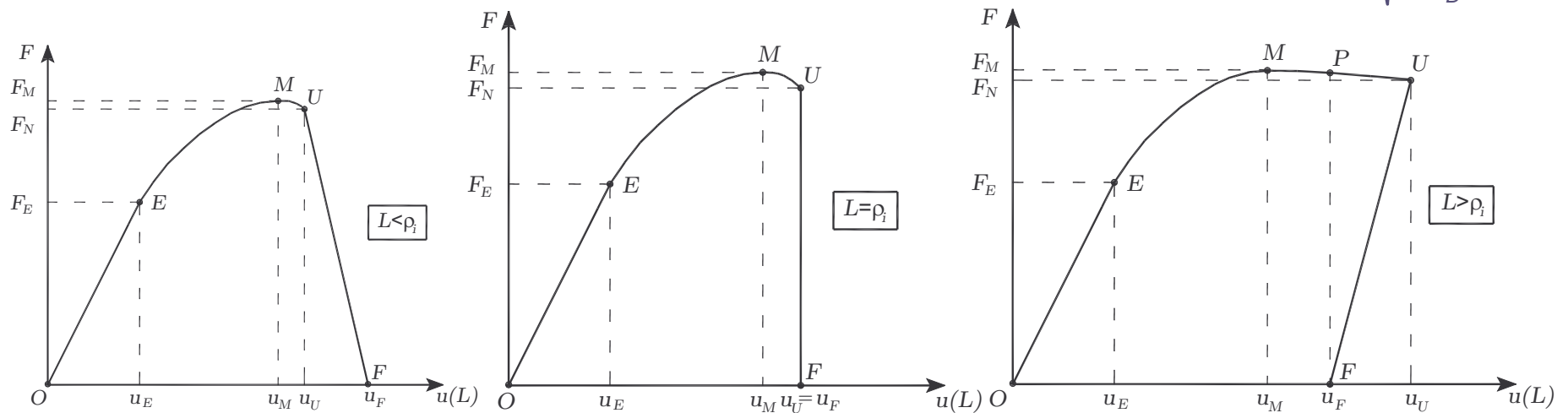
TOOLS

Simple bi-linear interface law, analytical treatment of the laboratory test,
single-shear pulling tests performed on specimens with different bond lengths;

Model: Elastic beam connected to a rigid substrate by elasto-plastic with softening interface.



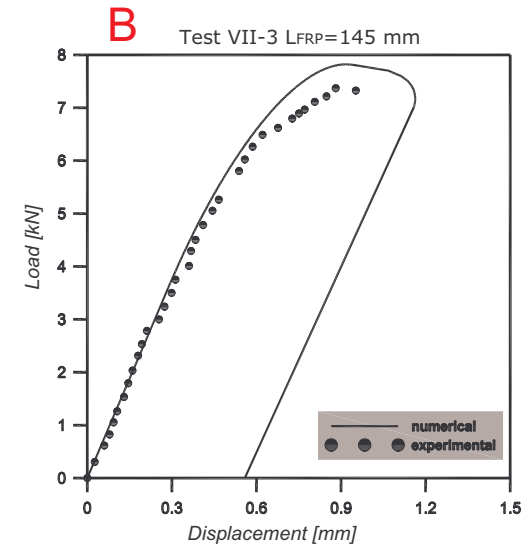
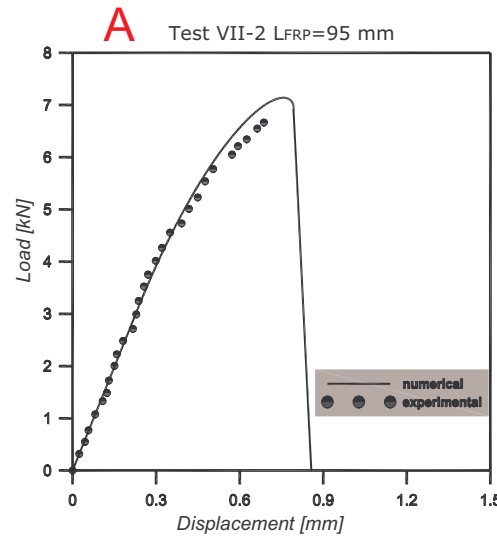
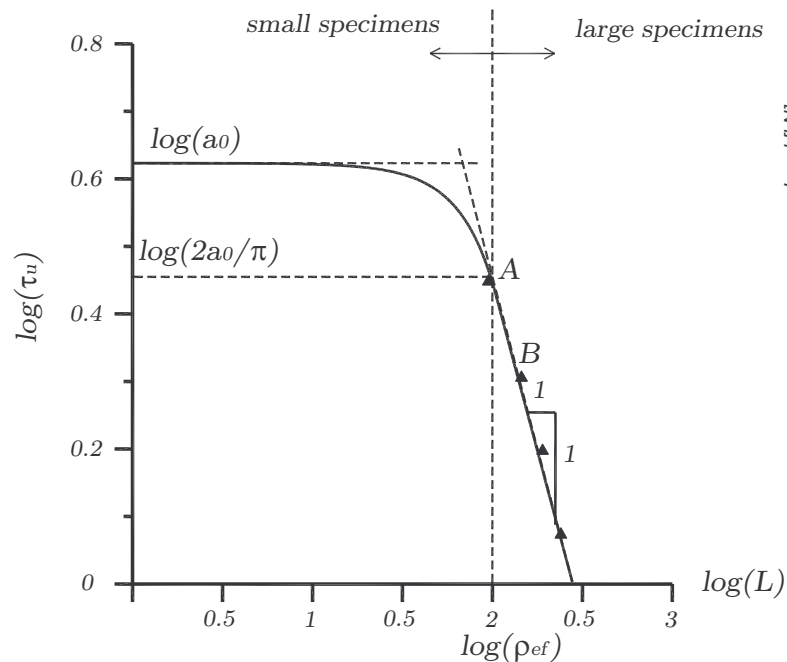
Results: The overall response depends on $\rho_i = \max \rho$ $\rho_i = \frac{\pi}{2\hat{\alpha}}$ $\hat{\alpha} = \sqrt{\frac{b \cdot s_i}{K_B}}$



Definition: Bond strength $\tau_u = F_u / b \cdot L$

Size Effect laws:

$$\left\{ \begin{array}{ll} \tau_u = \frac{F_u}{bL} = \frac{a_0}{\hat{\alpha} L} \sin(\hat{\alpha} L) & 0 \leq L \leq \rho_{ef} = \rho_i \\ \tau_u = \frac{F_u}{bL} = \frac{a_0}{\hat{\alpha} L} & L > \rho_{ef} \end{array} \right.$$



Assigned $K_B = 1056000 \text{ N}$

$\rho_{ef} = 104.7 \text{ mm}$; $a_0 = 4.2 \text{ N/mm}^2$; $s_i = 9.5 \text{ N/mm}^3$.

$K_I^A = 1200 \text{ N/mm}^2$; $G_f^A = 1.11 \text{ N/mm}$;

$K_I^B = 900 \text{ N/mm}^2$; $G_f^B = 1.17 \text{ N/mm}$.

Remarks:

- The effective bond length coincides with the internal length of the strip-interface assemblage;
- size effect laws are useful to identify the effective bond length and local constitutive parameters such as adhesion and fracture energy;
- bond length greater than the effective bond length improves ductility?
Or overall instabilities (snap-back) occur?

Developments:

- Study of the influence of peel stresses (mixed mode decohesion) on the effective bond length;
- study of the influence of friction at the interface;
- rate dependent phenomena.