Developing a Standard Test for the Strength of Curved Composite Beams

TCNJ THE COLLEGE OF NEW JERSEY
CIVIL ENGINEERING

Sofia Zapata and Andrew Bechtel, Ph.D

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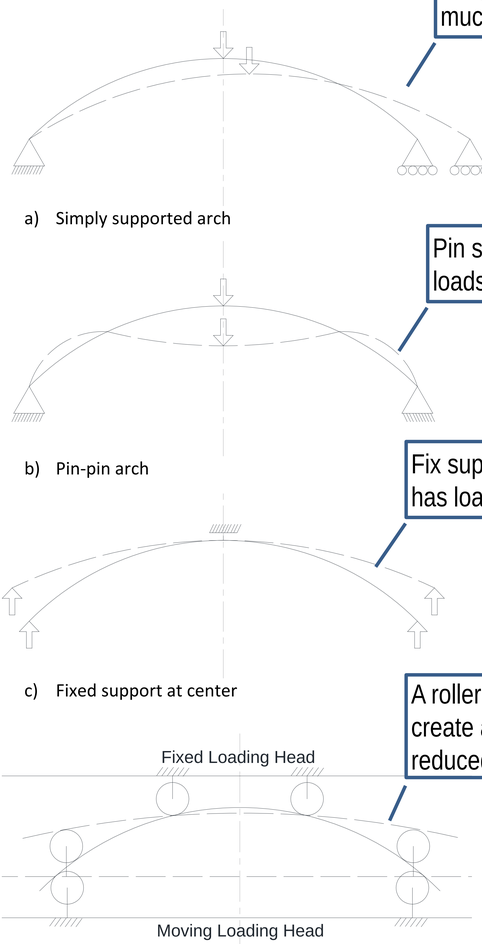
1. INTRODUCTION and BACKGROUND

Municipal Marina; Belmar NJ

Composite tubes provide a sustainable material for use in marine environments, but there are currently no tests which can be used to determine their design properties

2. TEST GEOMETRY

This test was focused on finding the transverse strength from a curved beam specimen cut from the circular cross-section



Simples supports would have to much lateral movement

Pin supports fix supports and loads but induce buckling

Fix support centers specimen, but has load movement at ends

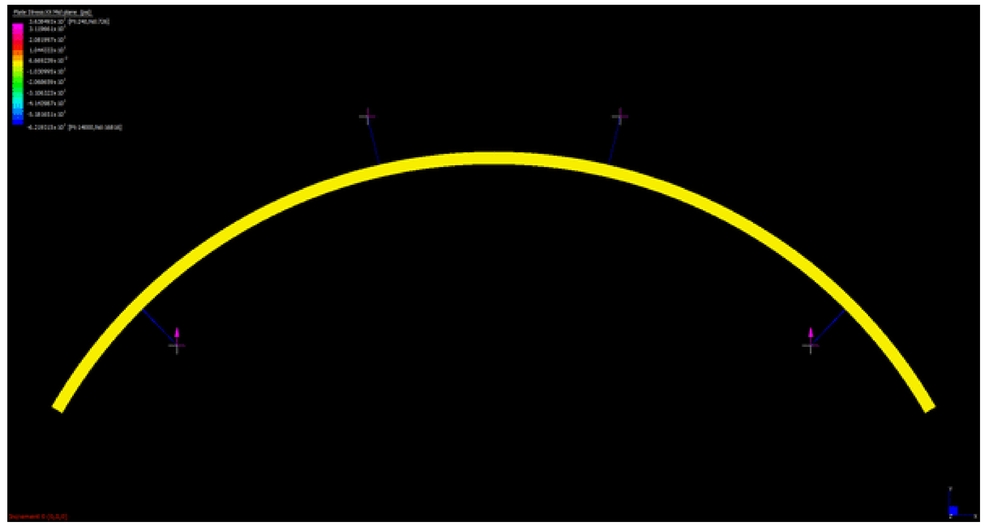
A roller system was developed to create a stable mechanism that reduced support movement

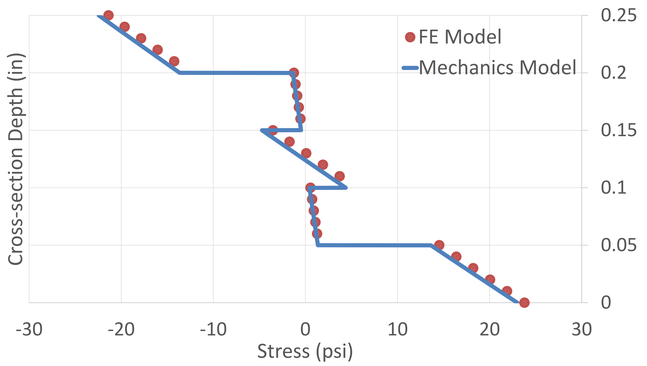
A standard test was conceived for the strength of curved composite beams. The mechanics of the Test were verified numerically using Finite Element (FE) Analysis. The properties found using the test were favorably compared to the results of an existing ASTM test.

3. MECHANICS and NUMERICAL MODELING

$$\epsilon = -\frac{y}{r_n - y}\left[\frac{r_n}{r} - 1\right]$$

ϵ=strain
y=distance from neutral axis
r_n=radius of curvature to neutral axis
r= deformed radius of to neutral axis

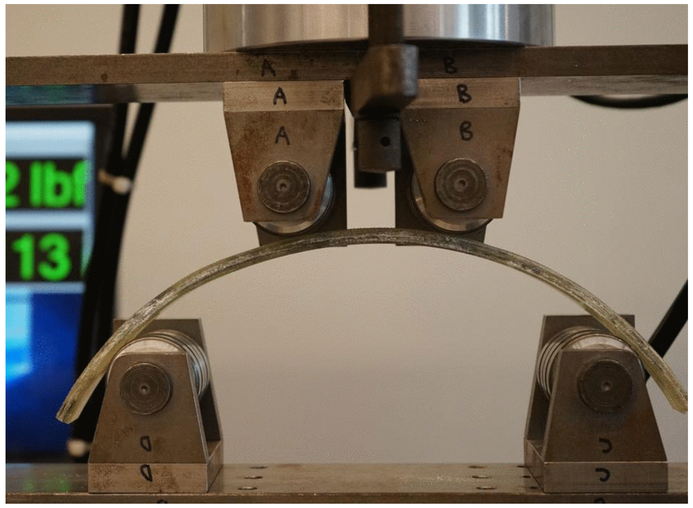




Good agreement was found between the Mechanics and FE models

4. PHYSICAL TESTING

Because the specimen geometry changed, images were used to track the geometry



	Samples	Avg. Max Stress (psi)	Standard Deviation (psi)	Coefficient of Variation
12 in. Curved Beam	9	26,451.89	1,114.32	2.15
10 in. Curved Beam	10	27,245.85	2,270.99	2.23
Rectangular (ASTM D7264)	10	28,983.64	1,764.75	2.37
12 in. vs. Rectangular		8.74%		
10 in. vs. Rectangular		6.00%		