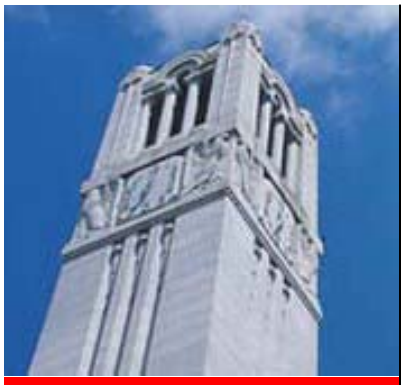

NC STATE UNIVERSITY

Constructed Facilities Laboratory Department of Civil, Construction, and Environmental Engineering

Test Report
IS-04-11

TENSILE TESTING OF HARDWIRE BAR.

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TEST REPORT

ASTM D 3039
STANDARD TEST FOR TENSILE PROPERTIES OF POLYMER MATRIX COMPOSITE MATERIALS

Description of Material

ASTM D 3039 tensile tests were performed on four Hardwire™ composite bars provided by Structural Preservation Systems, Inc. The cross-section dimensions of these bars varied due to the thickness and shape of the outer matrix material. Because the outer layer of the matrix material provides little contribution to the strength and behavior of the bars, the dimensions of the bar cross sections were assumed to be the same as in a previous report (IS-04-09). These dimensions are shown in Figure 1. Using these dimensions the area of the bar was calculated to be 0.236 in^2. The bars provided were approximately 35" long.

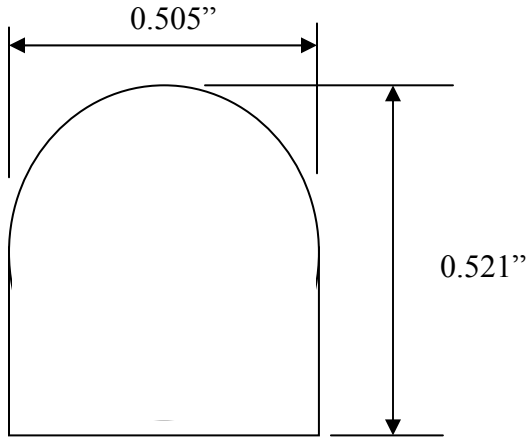

Figure 1 – Specimen Dimensions

Test Specimens

Test specimen was prepared by placing each end of the bar in a 10 in. piece of steel tubing. The tubing was then filled with an expansive grout to provide a suitable mechanism for gripping as well as transferring load into the bars. A longitudinal strain gage was placed on each bar to measure the strain under load.

Test Setup

The specimens were gripped in a 220 kip MTS hydraulic wedge-grip machine. Load and stroke from the machine as well as the strain in the bar were recorded using an electronic data acquisition system at a rate of 1 point per second. Specimens were loaded using displacement control at a rate of 0.05 in/min. An extensometer was used in addition to the strain gage to measure strains up to failure. Figure 1 shows the test setup.

Figure 1 – Test Setup

Results

The load strain diagram for the specimens is shown in Figure 2. Figure 3 shows the failed specimens. For specimen 1 the failure was due to fracture of most of the Hardwire™ material at a single location. Approximately 25 wires in the center of the cross section did not fracture at the same location as the rest of the wires but did fracture elsewhere in the bar. For specimens 2, 3, and 4 the failure was due to a complete fracture of all Hardwire™ material at a single location. The failure for specimen 3 occurred approximately 1 inch into the lower grip. Non-linear behavior was observed in all specimens at high load levels. Table 1 summarizes the results for all specimens.

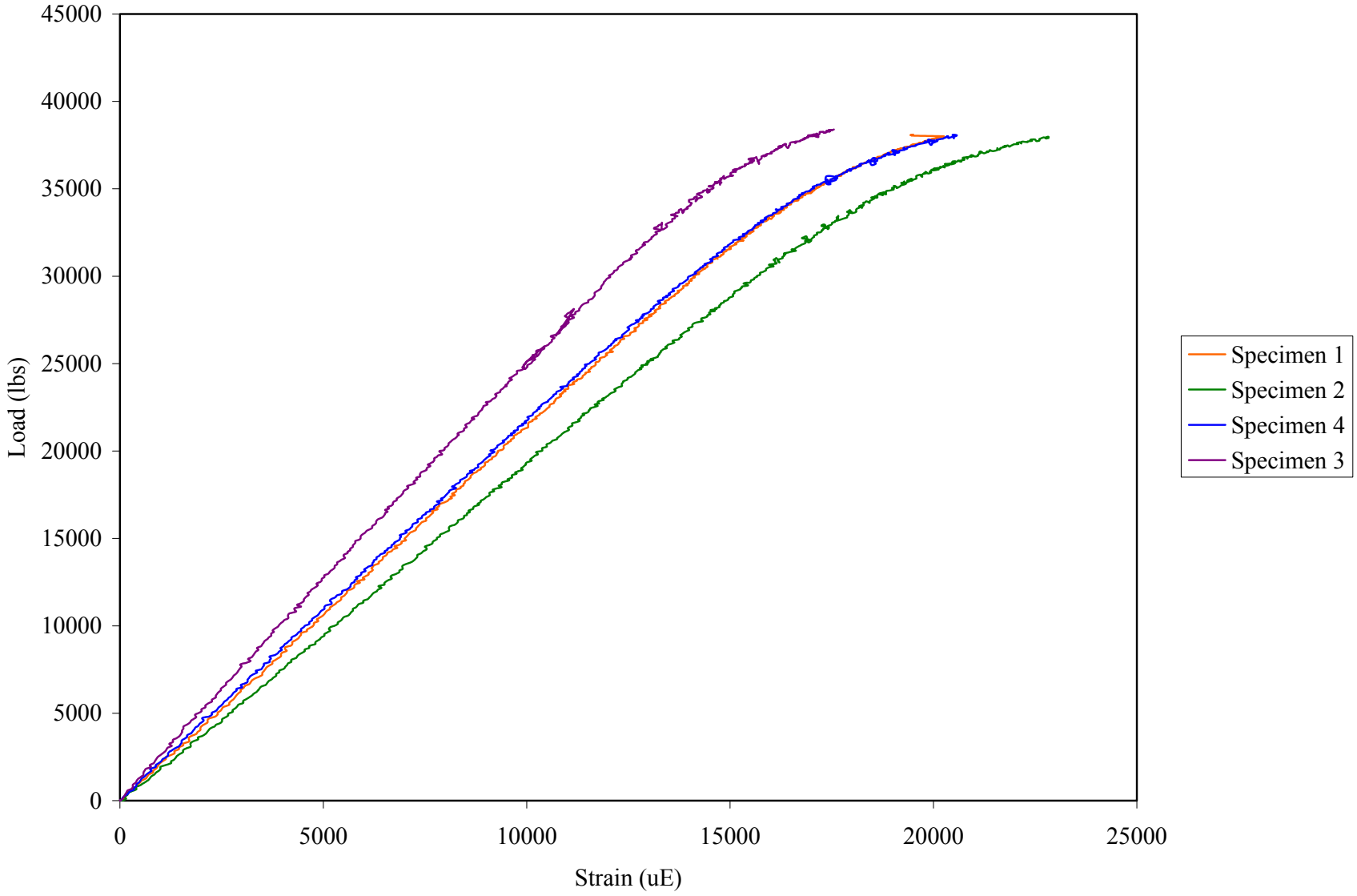

Figure 2 – Load-Strain Relationship

Figure 3 – Failed Specimens

Specimen	Modulus * msi	Max Load kips	Stress * ksi	Strain mE
1	9.16	38.2	161.9	20.2
2	8.14	38.0	161.0	22.8
3	10.72	38.5	163.1	17.6
4	9.04	38.1	161.4	20.6
average	9.27	38.2	161.9	20.3

* Using an area of 0.236 in^2

Table 1 – Results Summary