Table 2.11 Modulus of Rupture (psi)

Type III	Type IV
865	765

The ACI Code (1999) gives the following equation for calculating the modulus of rupture.

$$f_r = 7.5\sqrt{f'_c} \qquad \text{(Eq. 2.5)}$$

where f_r = the modulus of rupture
f'_c = compression strength of the concrete

Using an average value of 10,500 psi for f'_c, Equation 2.5 gives a value of 770 psi, which compares very well with the test results presented in Table 2.11. Modulus of rupture was not specified as a performance criterion.

2.6 Coefficient of Thermal Expansion

Volume changes result from not only creep and shrinkage, but also thermal effects. It is imperative to obtain knowledge of the coefficient of thermal expansion of concrete members that are placed in a structure to mitigate against problems that may result. As with the type VCE 4200 VWGs that were placed in cylinders for the Sunshine Skyway Bridge (see Section 1.5), VWGs (ROCTEST Type EM-5) were placed in the center of 6 x 12 in cylinders in the NCSU laboratory. The EM-5 gage was suspended in place in the center of the mold with six small rubber bands (three at the top and three at the bottom). The VWG lead wire exited the cylinder mold through a hole approximately two inches below the top of the mold. Figure 2.9 shows the gage with lead wire attached and Figure 2.10 shows a prepared mold prior to placing concrete. Embedment ERSGs of