CE 142L

REINFORCED CONCRETE STRUCTURAL LABORATORY

BEAM EXPERIMENT

The beam experiment is designed to examine flexural and shear strength concepts, as well as deflection calculations. Based on the experimental results, your report should provide detailed information on the following items:

1. A plot of the experimentally obtained load-deflection and moment-curvature relations using the load cell, dial, and lvdt data recorded during the test.
2. Based on design material strengths (i.e., f_y = 40 ksi and f'_c = 4 ksi), compute the moment – curvature diagram for the given beam cross-section. Using the moment curvature relation, compute the deflections associated with: (a) just prior to cracking, (b) just after cracking, (c) yielding, (d) for an extreme fiber compression strain of 0.003, and (e) for an extreme fiber compression strains of 0.005 and 0.01. At each of these conditions, draw a figure with the beam cross-section and the associated strain diagram (with labels, e.g., ε_s = 0.01) and equilibrium diagram (with labels, e.g., $T_s = A_s f_s$ = 50 kips). At 0.003 and beyond, use the "plastic hinge" concept to model the inelastic zone at the center of the beam for three assumed plastic hinge lengths: 0.5h, 1.0h, and 1.5h (where h is the total depth of the beam). Plot the relations versus the measured load-displacement relation. Neglect the influence of reinforcement on the cracking moment; however, for other moment calculations, compute the moment capacity neglecting and including the "top or compression" steel. An iterative solution may be the easiest approach to computing the moment capacity for cases where the top steel is included, or where maximum strains exceed 0.003. For maximum compression strains exceeding 0.003, use material stress-strain relations, equilibrium, and plane sections assumption to obtain a solution. For concrete in compression, use the Hognestad equation to describe the stress – strain relation.
3. Based on actual material strengths (as tested), recalculate the values in item 2. Plot the moment curvature relations for items 2 and 3, and the experimentally obtained results, on a single plot and compare. Also plot the calculated load displacement relations in items 2 and 3, as well as the measured load-displacement relation, and compare.
4. Calculate the deflection at midspan using the effective inertia as defined in ACI 318-99 Section 9.5.2.3. Assess the reliability of the ACI expression by comparison with the computed and measured load-displacement relations.
5. Calculate the shear strength of the beam using ACI 318-02 equations (11-3) and (11-5) for the tested yield stress of the stirrups. On a single plot, compare the measured and computed (l_p = 1.0h) load-displacement relations and the calculated shear strength (plot as a horizontal line). Discuss how the shear strength influenced the behavior of the tested beam.
6. Draw figures that represent the cracking distribution and widths at cracking, yielding (if appropriate), and at failure (the displacement where the load starts to decrease).

Your report should contain all the information needed for someone to check all your work and calculations, including: detailed material information, detailed drawings of the specimens with an adequate description of the geometry and reinforcement, example calculations (in an appendix), sensor calibration curves, and recorded data. Your report will be checked carefully to ensure completeness!