ARCH 324 - Structures 2, Winter 2009

von Buelow, Peter

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GIVEN:

6.5' 6.5'

5' SLAB

BEAMS

13' 13'

FRAMING PLAN

D.L + L.L = 200 psf

EFFECTIVE WIDTH = 90''

W 36 x 135

SECTION

\[ n = \frac{1}{9} \left[ \frac{E_c}{E_s} \right] \]

\[ f_{	ext{steel}} = 24 \text{ ksi} \]

\[ f_{	ext{conc}} = 1.35 \text{ ksi} \]

LOADING DIAGRAM

\[ W = 156 \text{k} \]

\[ 2\omega = 200 \text{ psf} \times 13' = 2600 \text{ psf} \]

\[ l = 60' \]

\[ W = \omega l = 2600 \text{ psf} \times 60' \]

\[ W = 156 \text{k} \]
(2) DETERMINE MOST ECONOMICAL SECTION (W SHAPE) TO CARRY LOAD WITHOUT COMPOSITE ACTION

FOR A SIMPLY SUPPORTED UNIFORMLY LOADED BEAM,

MAX. BENDING MOMENT,

\[ M = \frac{Wl}{8} = 156 \times 60 \times \frac{k}{8} \]

\[ M = 1170k\text{in}^3 \]

Thus,

\[ S = \frac{M}{f} = \frac{1170}{24} \times \frac{12}{k\text{in}^3} \]

\[ S = 585 \text{in}^3 \]

FROM TABLE D-35, FOR \( S_x = 585 \text{in}^3 \), SECTIONS APPROPRIATE ARE,

- W 30 x 191 \( 598 \text{in}^3 \)
- W 33 x 201 \( 684 \text{in}^3 \)
- W 36 x 182 \( 623 \text{in}^3 \)

Thus 'W 36 x 182' IS USED.

(3) TRANSFORMED SECTION

\[ h = \frac{1}{q} = \frac{E_c}{E_s} \]

TRANSFORMING THE CONCRETE TO AN EQUIVALENT AREA OF STEEL BY REDUCING THE WIDTH WE GET,
4. LOCATION OF NEUTRAL AXIS
   (USING D-28)

\[ \bar{x} = \frac{2Ax}{2A} \]

<table>
<thead>
<tr>
<th>A</th>
<th>( \bar{x} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 in²</td>
<td>( 2.5'' = 12.5 \text{ in}^3 )</td>
</tr>
</tbody>
</table>

\[ I = 39.7 \text{ in}^2 \times 22.75'' = 904.175 \text{ in}^3 \]

\[ \bar{x} = \frac{2Ax}{A} = \frac{1029.175}{89.7} \]

\[ \bar{x} = 11.47'' \text{ (from top)} \]

5. TRANSFORMED MOMENT OF INERTIA
   (By Parallel Axis Theorem)

\[ I_{TR} \]

<table>
<thead>
<tr>
<th>10</th>
<th>( \frac{10}{12} )</th>
<th>( \frac{10(11.47-2.5)^2}{12} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>104.17</td>
<td>402.3</td>
</tr>
</tbody>
</table>

\[ I = 7800 \quad 39.7(11.3)^2 = 5073.78 \]

\[ I_{a} = I_{q} + Ad^2 \]

\[ I_{a} = 104.17 + 402.3 = 4127.17 \]

\[ + I = 7800 + 5073.78 = 12873.78 \]

\[ I_{TR} = 17000.99 \]

\[ I_{TR} = 10^4 \]
Stresses

Now,

\[ M_c = \frac{f_c \ I_{TR}}{Cn} \]

\[ M_c = \frac{1.35 \ (17001)}{11.47 \ (1/9)} = 1808.9 \text{ k}-\text{ft} \]

\[ M_s = \frac{f_s \ I_{TR}}{C} \]

\[ M_s = \frac{24 \ (17001)}{29.08} = 14031.08 \text{ k}-\text{ft} \]

\[ f_s = 24 \text{ ksi} \]

\[ f_c = \frac{M_c n}{I_{TR}} = \frac{14031.08 \ (11.47)/19}{17001} \]

\[ f_c = 1.052 \text{ ksi} \]