Solution

**Topic:** Moment Distribution – No-Sway Rigid-Jointed Frames

**Problem Number:** 5.6

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**Fixed-end Moments:**

![Fixed-end Moments Diagram]

Length of member AB = \( \sqrt{2.0^2 + 4.0^2} \) = 4.472 m

Member BC*

\[
M_{BC} = - \frac{PL}{8} - \frac{wL^2}{12} = - \frac{40.0 \times 5}{8} - \frac{8.0 \times 5^2}{12} = -41.67 \text{ kNm}
\]

\[
M_{CB} = + \frac{PL}{8} + \frac{wL^2}{12} = + \frac{40.0 \times 5}{8} + \frac{8.0 \times 5^2}{12} = +41.67 \text{ kNm}
\]

*Since support C is pinned, the fixed-end moments are \( M_{BC} - 0.5M_{CB} \) at B and zero at C.

\( M_{BC} - 0.5M_{CB} = [-41.67 - (0.5 \times 41.67)] = -62.51 \text{ kNm} \).
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Distribution Factors : Joint B

\[ k_{BA} = \left( \frac{I}{4.472} \right) = 0.22I \]

\[ k_{BC} = \frac{3}{4} \left( \frac{I}{5} \right) = 0.15I \]

\[ k_{\text{total}} = 0.37I \]

\[ DF_{BA} = \frac{k_{BA}}{k_{\text{Total}}} = \frac{0.22}{0.37} = 0.59 \]

\[ DF_{BC} = \frac{k_{BC}}{k_{\text{Total}}} = \frac{0.15}{0.37} = 0.41 \]

Moment Distribution Table:

<table>
<thead>
<tr>
<th>Joint</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AB</td>
<td>BA</td>
<td>BC</td>
</tr>
<tr>
<td>Distribution Factors</td>
<td>0</td>
<td>0.59</td>
<td>0.41</td>
</tr>
<tr>
<td>Fixed-end Moments</td>
<td>-62.51</td>
<td>+36.88</td>
<td>+25.63</td>
</tr>
<tr>
<td>Balance</td>
<td>+18.44</td>
<td>+36.88</td>
<td>+36.88</td>
</tr>
<tr>
<td>Carry-over</td>
<td>+18.44</td>
<td>+36.88</td>
<td>-36.88</td>
</tr>
<tr>
<td>Total</td>
<td>+18.44</td>
<td>+36.88</td>
<td>-36.88</td>
</tr>
</tbody>
</table>

Continuity Moments:

Free bending moment:

Member BC:

\[ M_{\text{free}} = \frac{PL}{4} + \frac{wL^2}{8} \]

\[ = \frac{40 \times 5}{4} + \frac{8.0 \times 5.0^2}{8} \]

\[ = 75.0 \text{ kNm} \]
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Consider Member BC:

\[ +ve \sum M_B = 0 \]
\[ -36.88 + (40.0 \times 2.5) + (8.0 \times 5.0 \times 2.5) - (V_C \times 5.0) = 0 \]
\[ \therefore V_C = +32.62 \text{ kN} \]

For the complete frame:

\[ +ve \sum M_A = 0 \]
\[ +18.44 + (40.0 \times 4.5) + (8.0 \times 5.0 \times 4.5) - (32.62 \times 7.0) + (H_C \times 4.0) = 0 \]
\[ \therefore H_C = -37.53 \text{ kN} \]

\[ +ve \sum F_y = 0 \]
\[ V_A - 40.0 - (8.0 \times 5.0) + 32.62 = 0 \]
\[ \therefore V_A = +47.38 \text{ kN} \]

\[ +ve \sum F_x = 0 \]
\[ H_A - 37.53 = 0 \]
\[ \therefore H_A = +37.53 \text{ kN} \]

Deflected Shape