#### Architecture 324 Structures II

# Structural Continuity



- Continuity in Beams
- Deflection Method
- Slope Method

Millennium Bridge, London Foster and Partners + Arup Photo by Ryan Donaghy

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#### Millennium Bridge, London Foster and Partners + Arup



#### **Continuous Beams**

- Continuous over one or more supports
  - Most common in monolithic concrete
  - Steel: continuous or with moment connections
  - Wood: as continuous beams, affected long Glulam spans
- Statically indeterminate
  - Cannot be solved by the three equations of statics alone
  - Internal forces (shear & moment) as well as reactions are affected by movement or settlement of the supports



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W = 2 k/ft

24 ft

1=0

#### **Deflection Method**

- Two continuous, symmetric spans
- Symmetric Load

Procedure:

- Remove the center support and calculate the center deflection for each load case as\_ a simple span.
- 2. Remove the applied loads and replace the center support. Set the deflection equation for this case (center point load) equal to the deflection from step 1.
- 3. Solve the resulting equation for the center reaction force. (upward point load)
- 4. Calculate the remaining two end reactions.
- 5. Draw shear and moment diagrams as usual.



24 ft



#### **Deflection Method**

1. Remove the center support and calculate the center deflection for each load case as a simple span.



EI



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## Deflection Method – Example

- 2. Remove the applied loads and replace the center support. Set the deflection equation for this case (center point load) equal to the deflection from step 1.
- 3. Solve the resulting equation for the center reaction force. (upward point load)





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## Deflection Method – Example

4. Calculate the remaining two end reactions.



#### Deflection Method - Example cont.:

5. Draw shear and moment diagrams as usual.



## Slope Method

- Two continuous spans
- Non-symmetric loads and spans

Procedure:

- 1. Break the beam into two halves at the interior support and calculate the interior slopes of the two simple spans.
- 2. Use the Slope Equation to solve for the negative interior moment.
- 3. Find the reactions of each of the simple spans plus the M/L reactions caused by the interior moment.
- 4. Add all the reactions by superposition.
- 5. Draw the shear and moment diagrams as usual.

$$M = \frac{3}{L_1 + L_2} \left[ EI\Theta_1 + EI\Theta_2 \right]$$





#### Slope Method - Example

- Given: Two non-symmetric spans with loading as shown.
- Find: All three reactions
- 1. Break the beam into two halves at the interior support and calculate the interior slopes of the two simple spans.
- 2. Use the Slope Equation to solve for the negative interior moment.

$$M = \frac{3}{L_1 + L_2} \left[ EI\Theta_1 + EI\Theta_2 \right]$$



Example of Slope Method cont.:

- 3. Find the reactions of each of the simple spans plus the M/L reactions caused by the interior moment.
- 4.Add all the reactions by superposition.



## Example of Slope Method cont.:

5. Draw the shear and moment diagrams as usual.



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