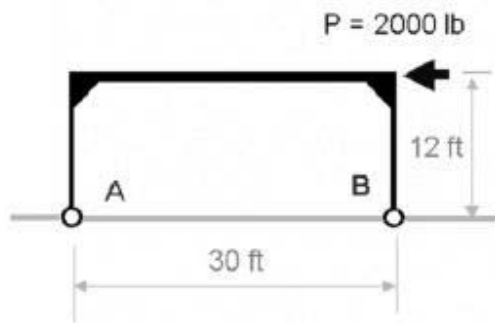


**Examples:  
Rigid Frames**

Example 1 From eStructures v1.1, Schodek and Pollalis, 2000 Harvard College

Lateral Loading STEP 1

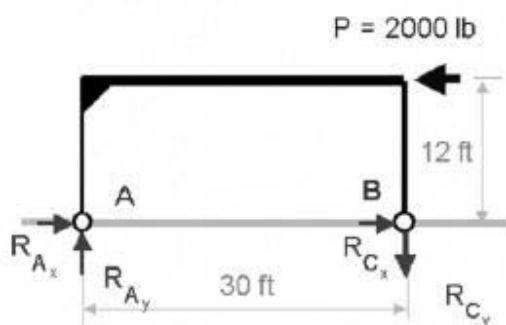
**RIGID FRAME STRUCTURES: LATERAL LOADING  
PINNED BASE CONNECTIONS**



Determine axial forces, shear forces, and bending moments in each member of the rigid frame shown.

Lateral Loading STEP 2

**RIGID FRAME STRUCTURES**



*Assumed directions of reactions:  
Horizontal components balance  
applied force  
Vertical components act as shown  
to prevent overturning*

**DETERMINE REACTIONS**

$$\Sigma M_A = 0$$

$$+ 2000(12) - R_{C_y}(30) = 0$$

$$R_{C_y} = 800 \downarrow$$

$$\Sigma F_y = 0$$

$$+ R_{A_y} - 800 = 0 \quad \text{or} \quad R_{A_y} = 800 \uparrow$$

$$\Sigma F_x = 0$$

$$R_{A_x} + R_{C_x} = 2000$$

*This last equation cannot be solved by statics alone. The structure is actually statically indeterminate. As shown on the following slides, an approximate method of analysis can be used to find the unknown reactions.*

Example 1 (continued)

**Lateral Loading** STEP 3

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**RIGID FRAME STRUCTURES**

**DRAW DEFLECTED SHAPE OF STRUCTURE**

Each of the top rigid joints translates and rotates as a unit.

A "point of inflection" naturally develops at the midspan of the horizontal member. This is a point of reverse curvature in the member, and hence is a point of zero moment.

If use is made of the point of inflection as a point of known zero moment, the structure is now statically determinate and can be analyzed much like a three-hinged arch.

**Lateral Loading** STEP 4

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**RIGID FRAME STRUCTURES**

**ANALYZE RIGHT PART**

*The forces shown at B are internal to the structure*

Example 1 (continued)

Lateral Loading
STEP 3

### RIGID FRAME STRUCTURES

### DRAW DEFLECTED SHAPE OF STRUCTURE

Each of the top rigid joints translates and rotates as a unit.

A "point of inflection" naturally develops at the midspan of the horizontal member. This is a point of reverse curvature in the member, and hence is a point of zero moment.

If use is made of the point of inflection as a point of known zero moment, the structure is now statically determinate and can analyzed much like a three-hinged arch.

Lateral Loading
STEP 4

### RIGID FRAME STRUCTURES

### ANALYZE RIGHT PART

The forces shown at B are internal to the structure

Example 1 (continued)

**Lateral Loading** STEP 5

---

**RIGID FRAME STRUCTURES**

**ANALYZE RIGHT PART**

**FOR RIGHT PART:**

$$\sum M_B = 0$$

$$-R_{C_y}(15) + R_{C_x}(12) = 0$$

or  $R_{C_x} = 1000 \rightarrow$

**Lateral Loading** STEP 5

---

**RIGID FRAME STRUCTURES**

**ANALYZE RIGHT PART**

**FOR RIGHT PART:**

$$\sum F_y = 0$$

$$R_{B_y} - R_{C_y} = 0 \text{ or } R_{B_y} = 800 \uparrow$$

$$\sum F_x = 0$$

$$R_{B_x} + R_{C_x} = 2000 \text{ or } R_{B_x} = 1000 \rightarrow$$















