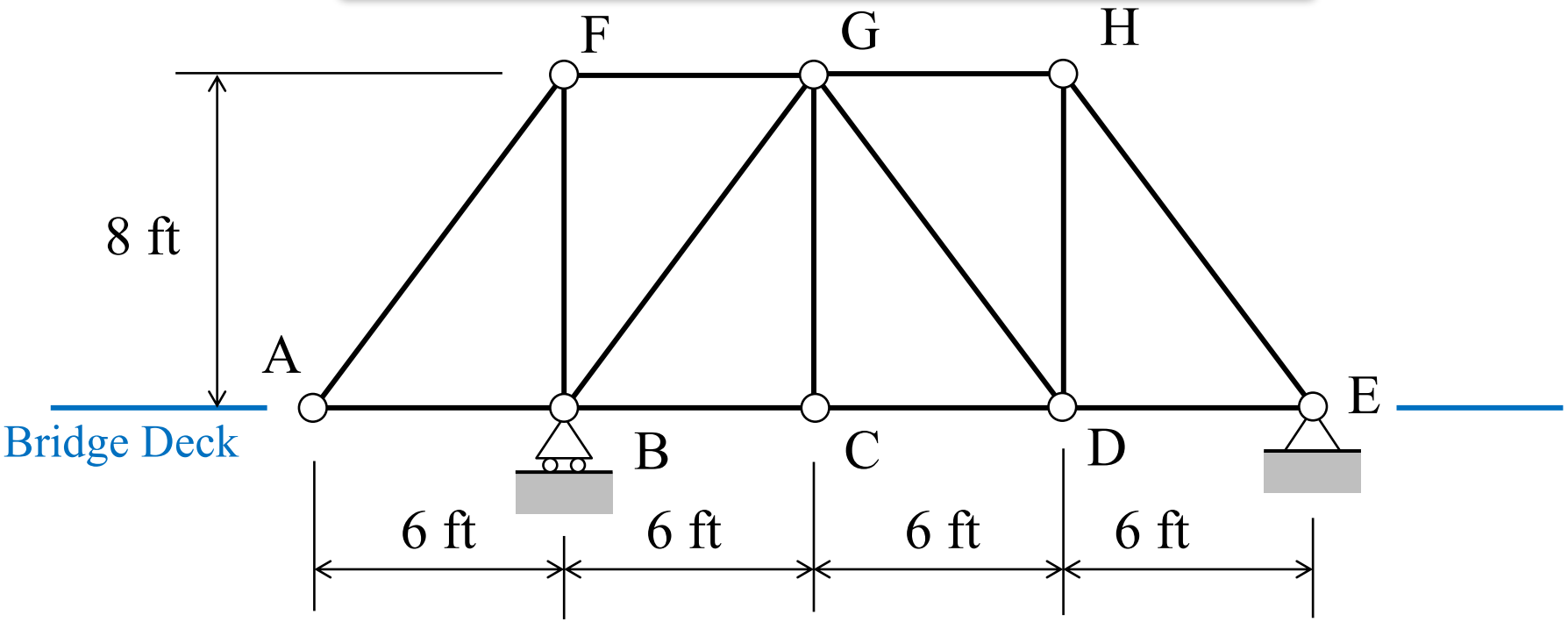
Constructing Influence Lines for Trusses

Steven Vukazich
San Jose State University

General procedure for the construction of influence lines

1. Choose a reference coordinate;
2. Choose a sign convention for each diagram;
3. Place a unit, dimensionless load on the structure;
4. Use equilibrium analysis to find the response quantity (e.g. support reaction, internal force) at the position of the unit, dimensionless, load;
5. Move unit load to another position and repeat Step 4;
6. Plot the value of the response quantity versus the position of the unit, dimensionless, load.

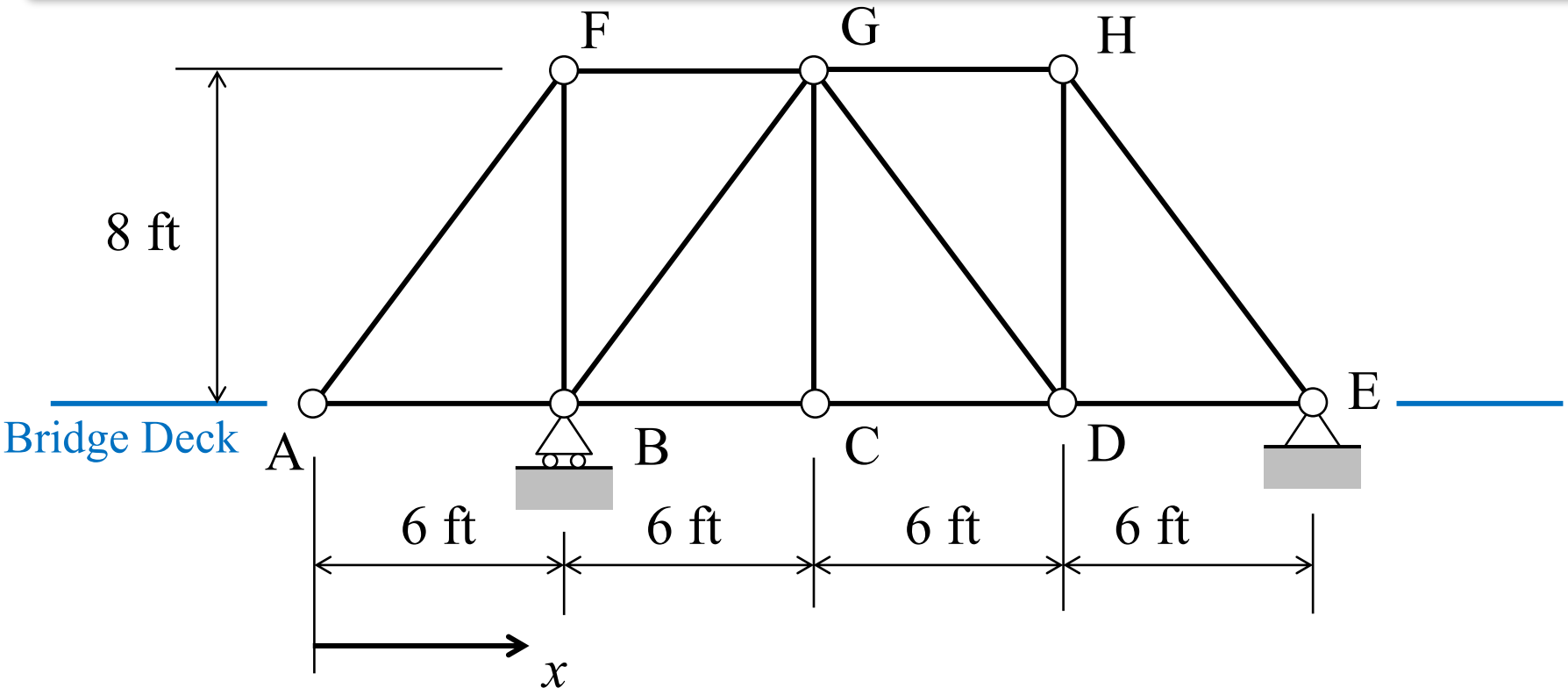
Truss Influence Line Example



The truss shown supports a bridge deck and has a pin support at E and a roller support at B. For a load moving across the bridge deck, construct influence lines for:

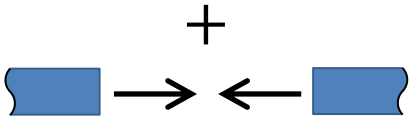
1. The axial force in member GH;
2. The axial force in member GD;
3. The axial force in member CD;
4. The axial force in member GC.

Choose Reference Coordinate and Sign Convention

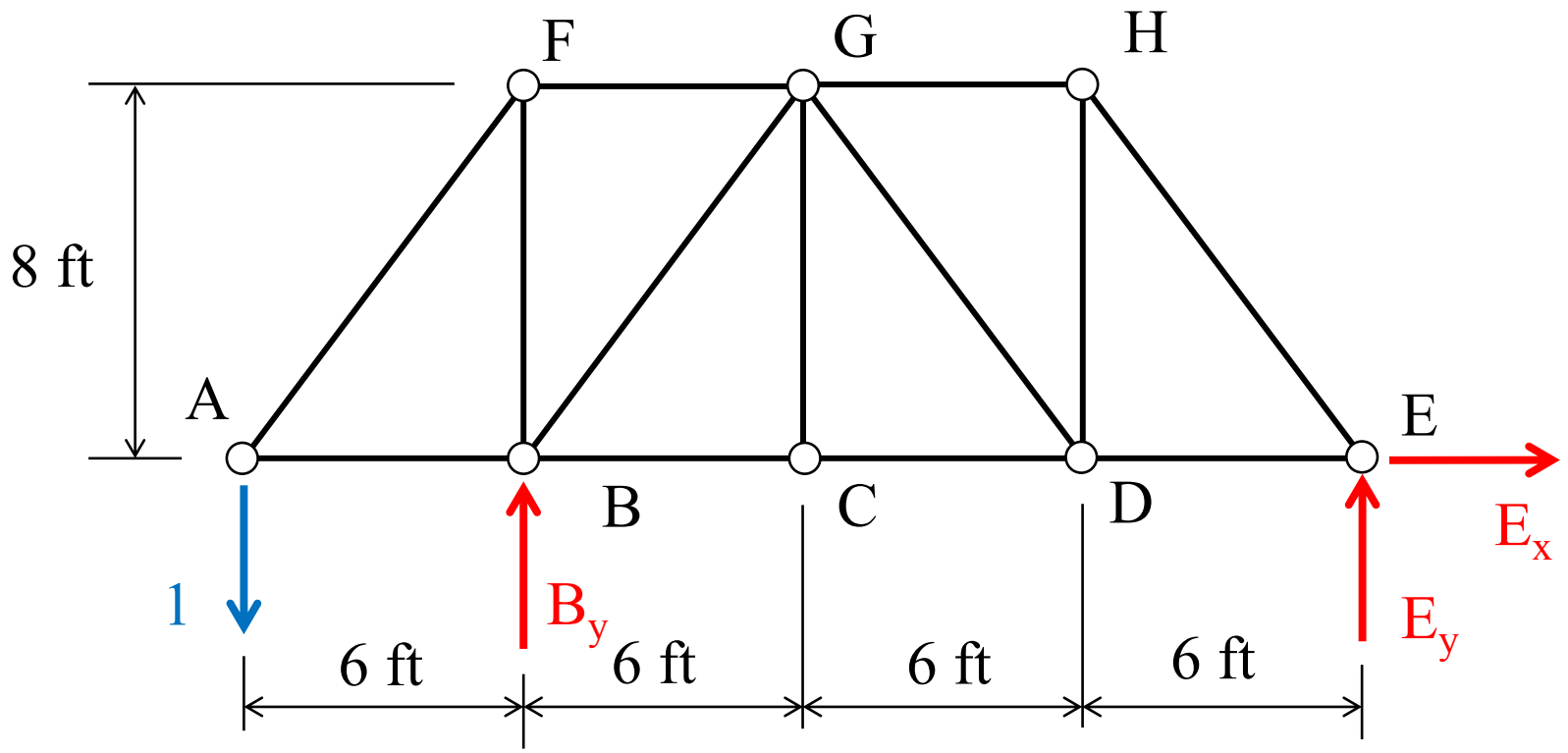


Unit load moves along level of bridge deck

Choose tension positive for axial force in truss members



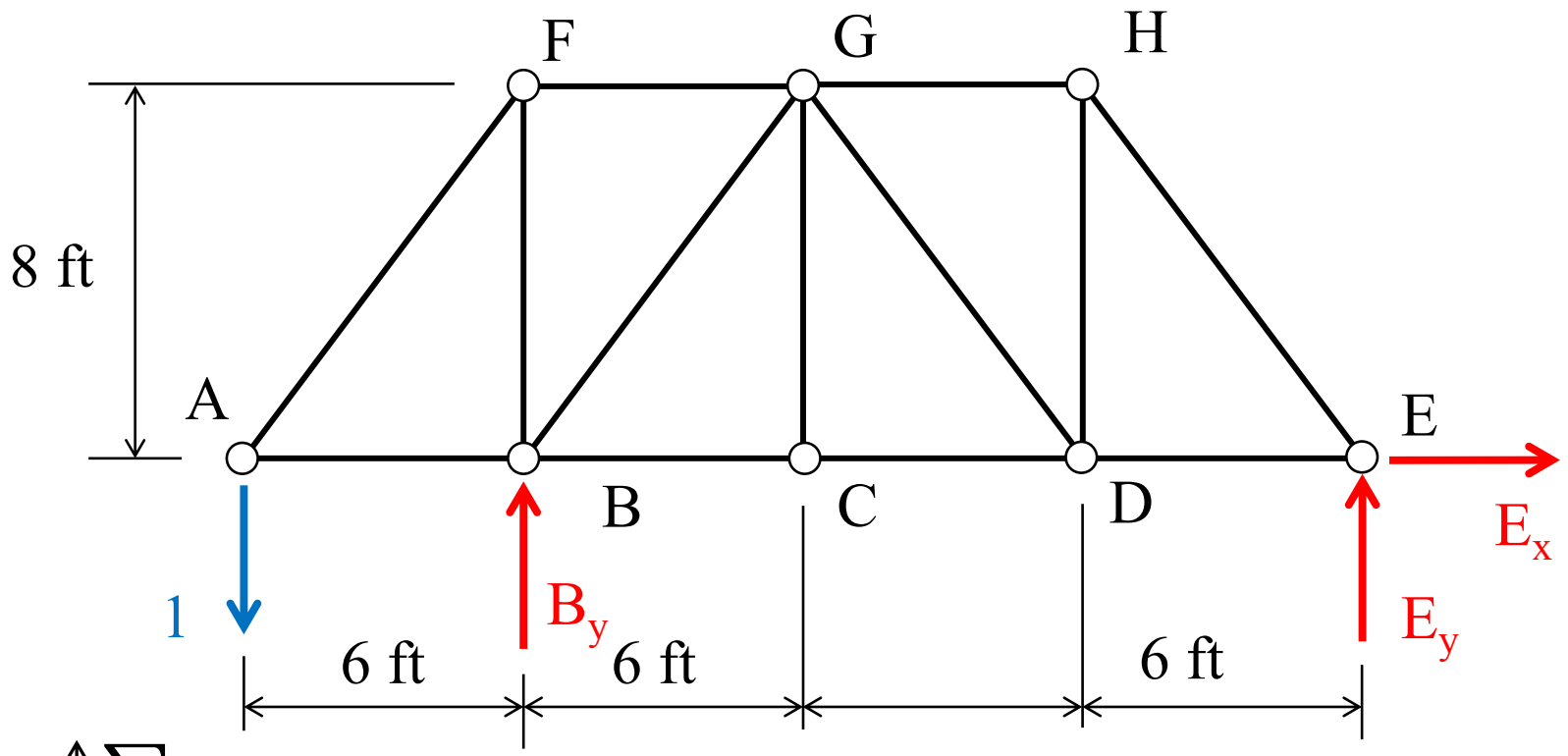
Unit Load at Point A



$$\circlearrowleft + \sum M_B = 0$$

$E_y = -0.333$

Unit Load at Point A

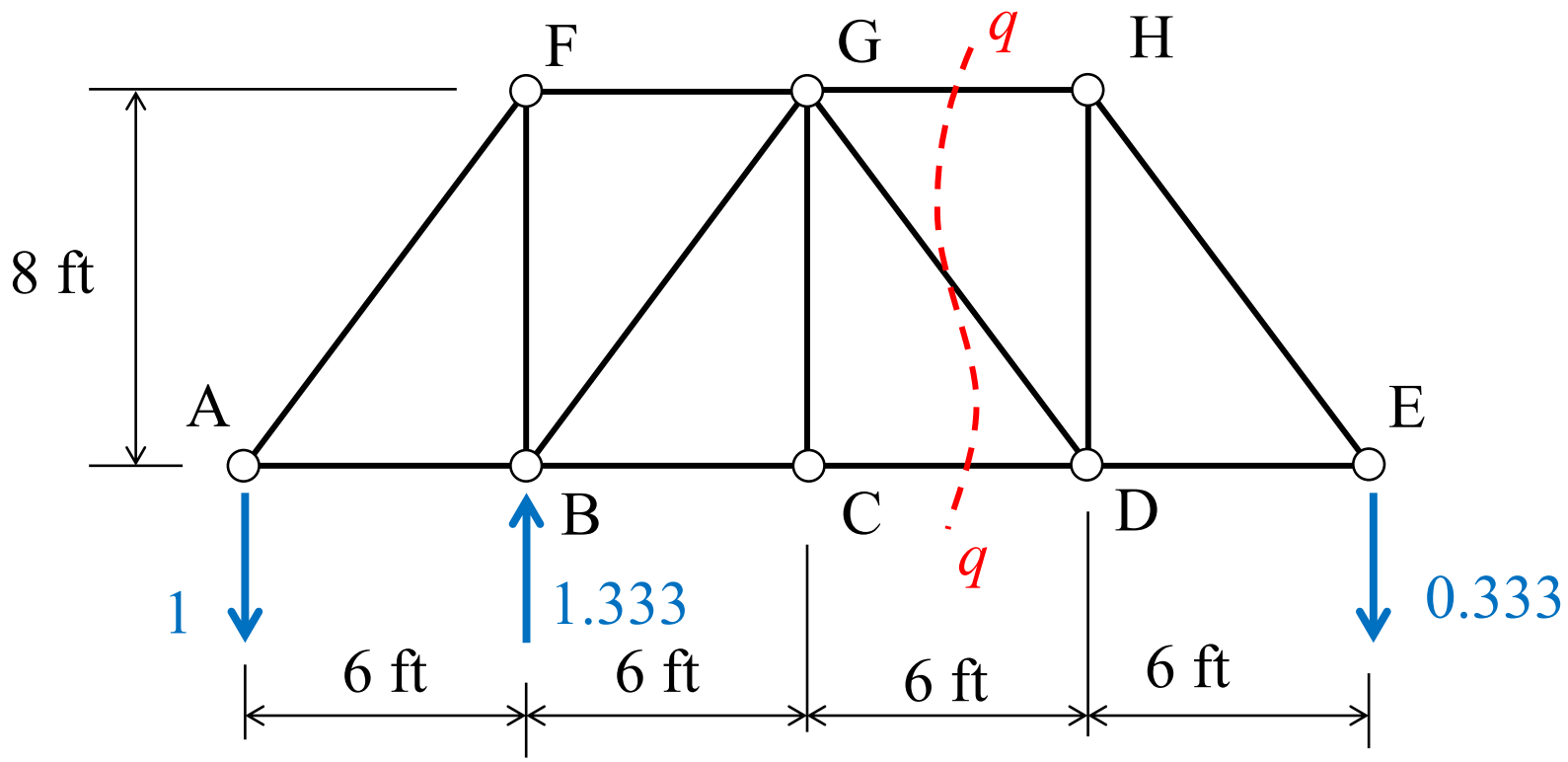


$$+\uparrow \sum F_y = 0$$

$$\xrightarrow{+} \sum F_x = 0$$

$B_y = 1.333$

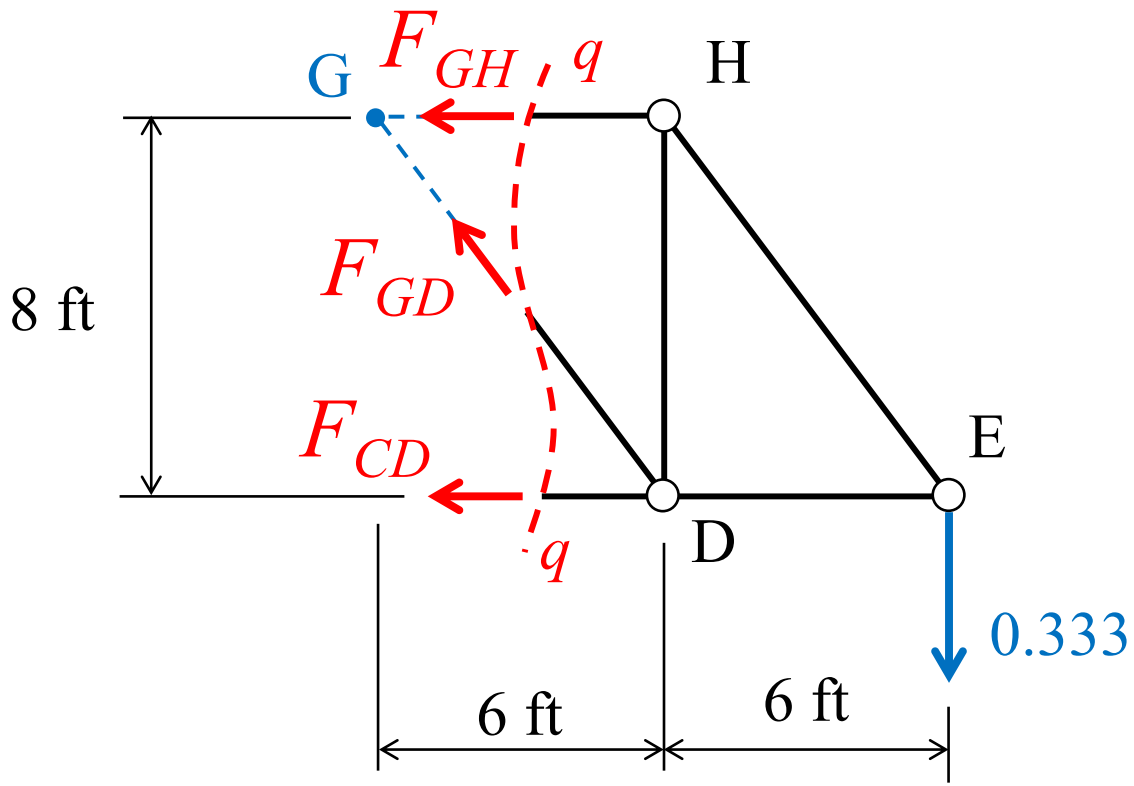
Unit Load at Point A



We can use the method of sections to find member forces GH, GD, and CD.

Note that for the unit load at A, GC is a zero-force member

FBD of the Section to the Right of Cut *q-q*



$$\circlearrowleft + \sum M_G = 0$$

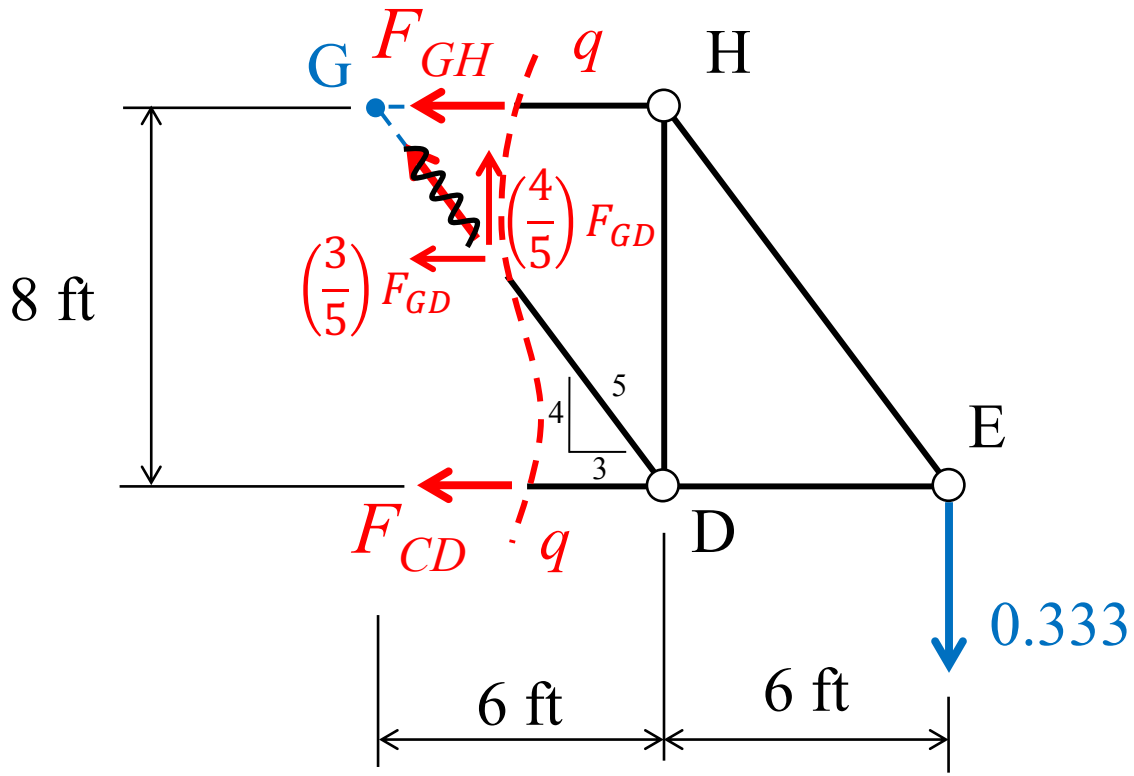
$$\circlearrowleft + \sum M_D = 0$$

$F_{CD} = -0.50$

$F_{GH} = 0.25$

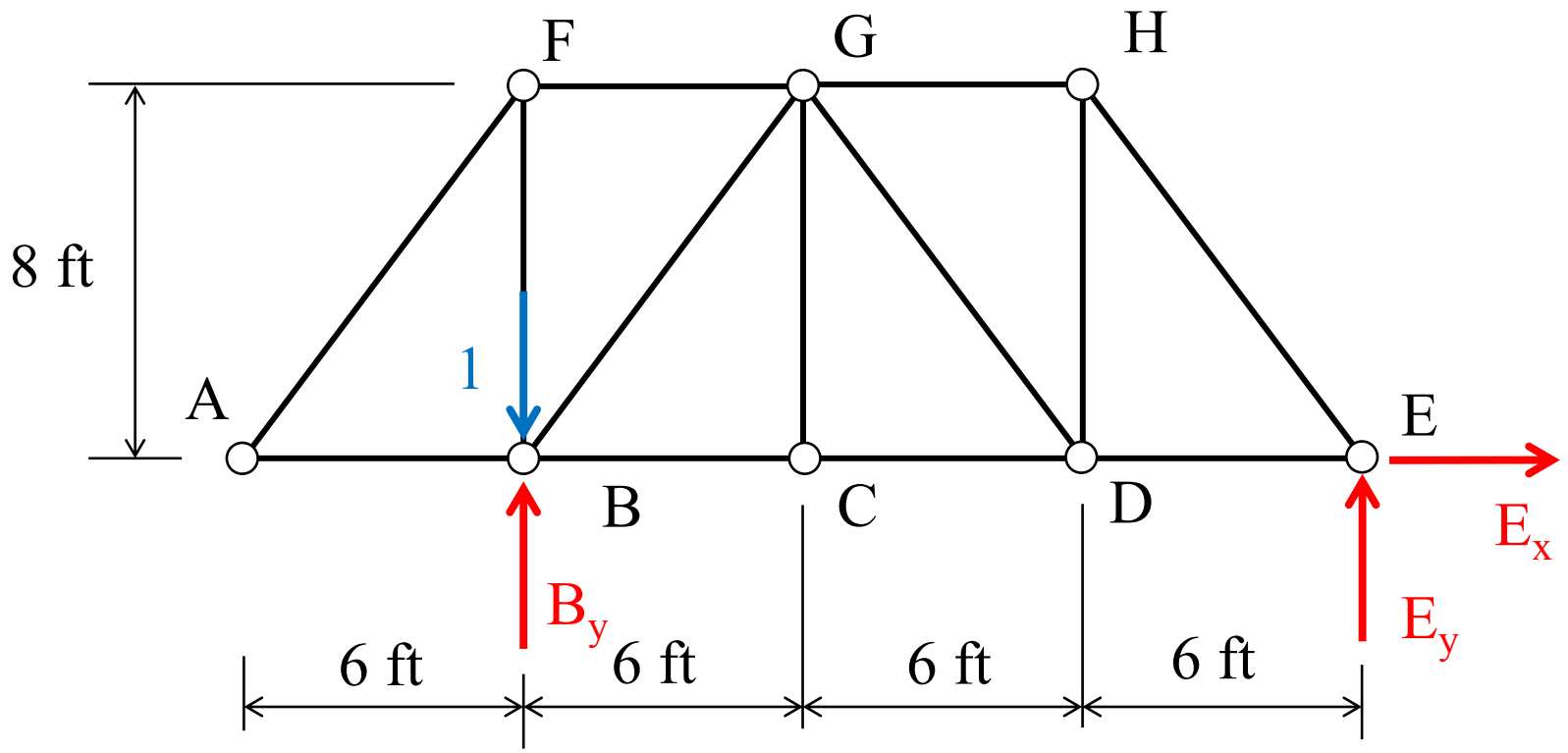
FBD of the Section to the Right of Cut *q-q*

$$+\uparrow \sum F_y = 0$$



$F_{GD} = 0.4167$

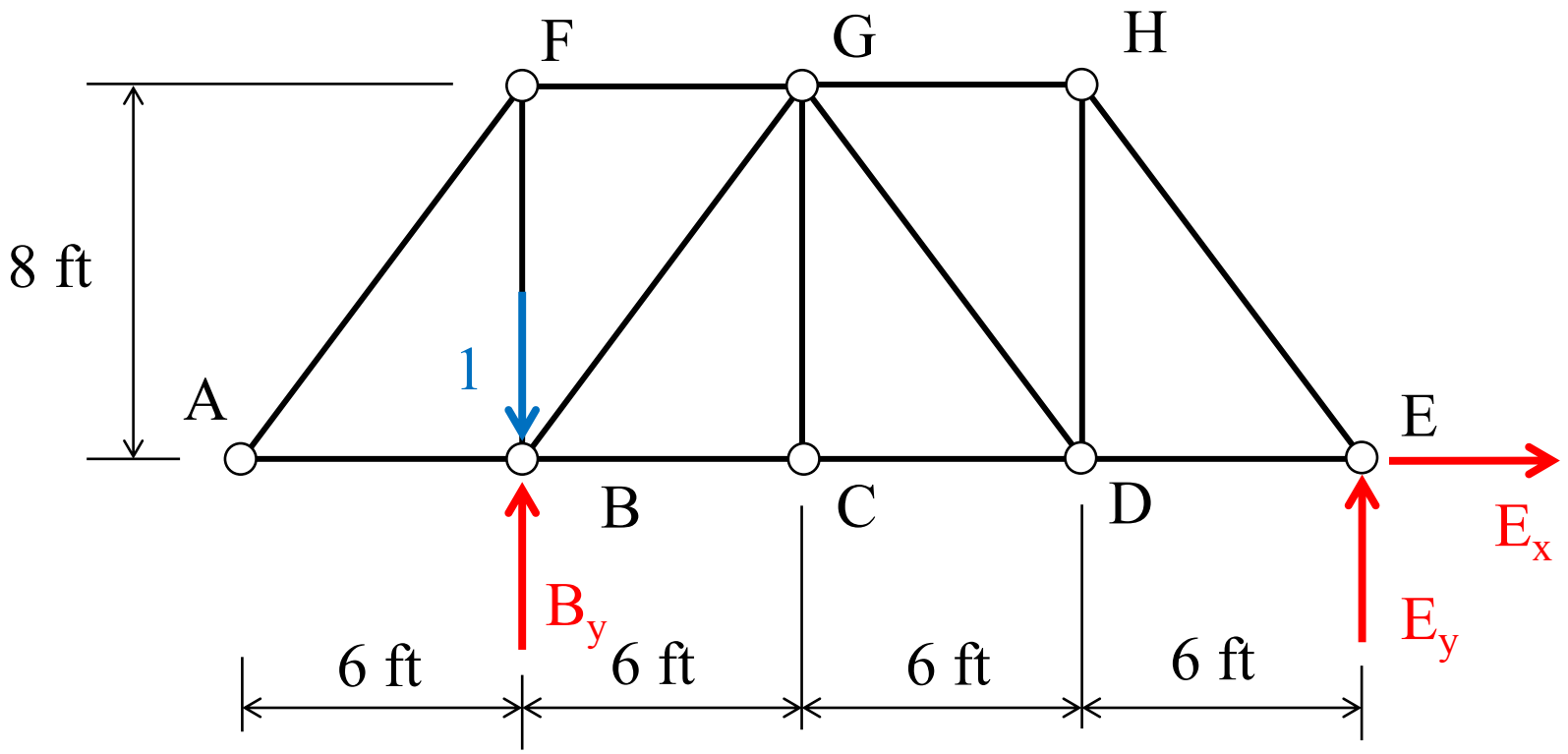
Unit Load at Point B



$$\circlearrowleft + \sum M_B = 0$$

$E_y = 0$

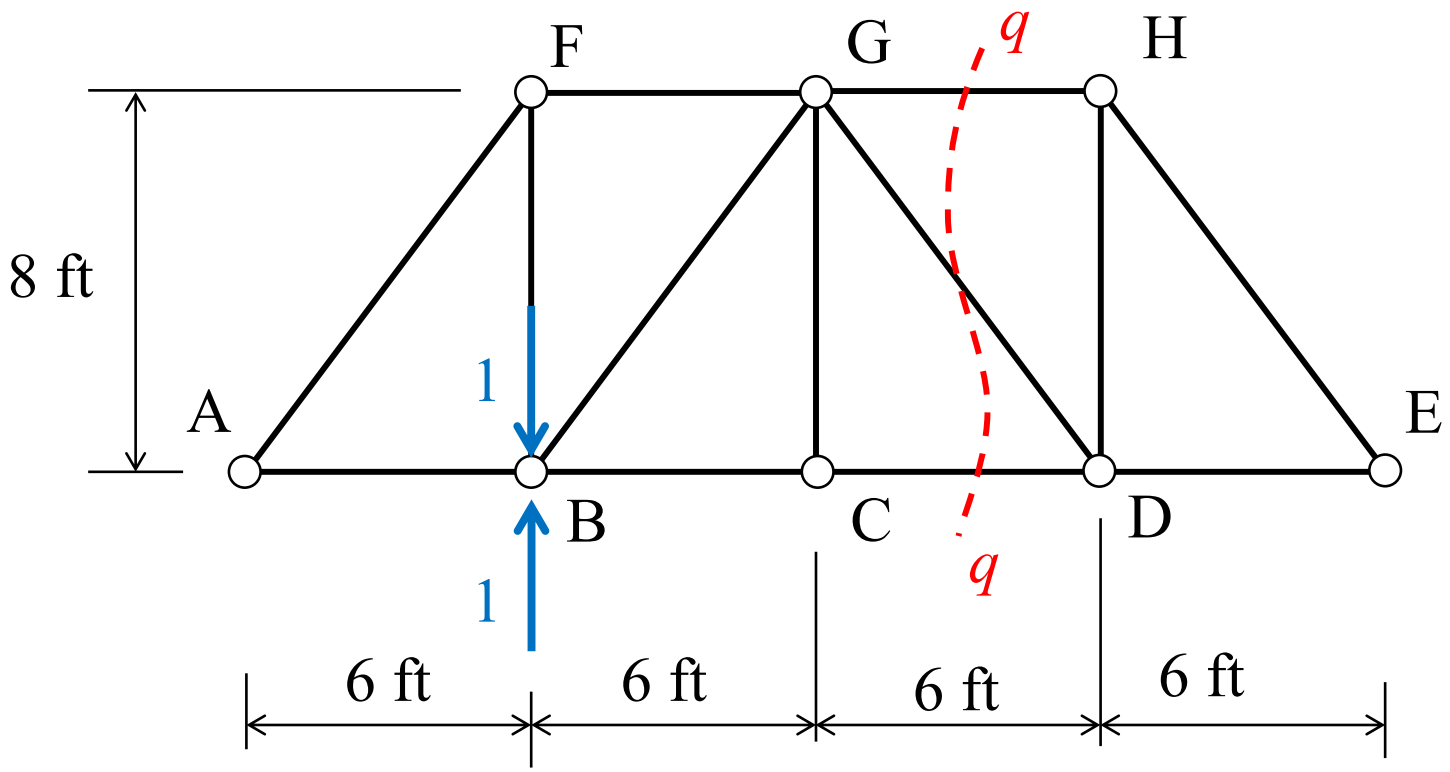
Unit Load at Point B



$$+\uparrow \sum F_y = 0$$

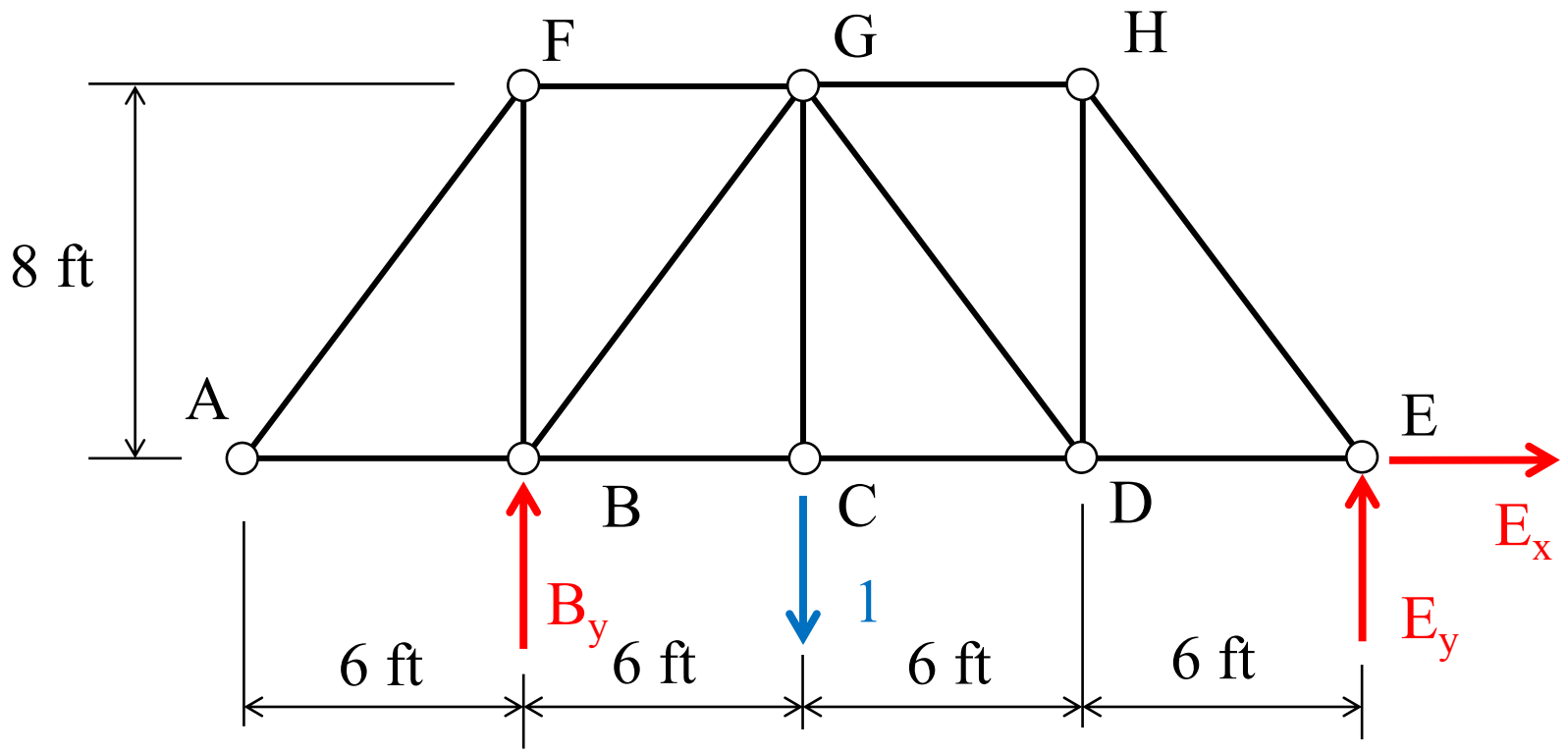
$B_y = 1$

Unit Load at Point B



Note that for the unit load at roller support B, no axial forces are developed in any of the the truss members.

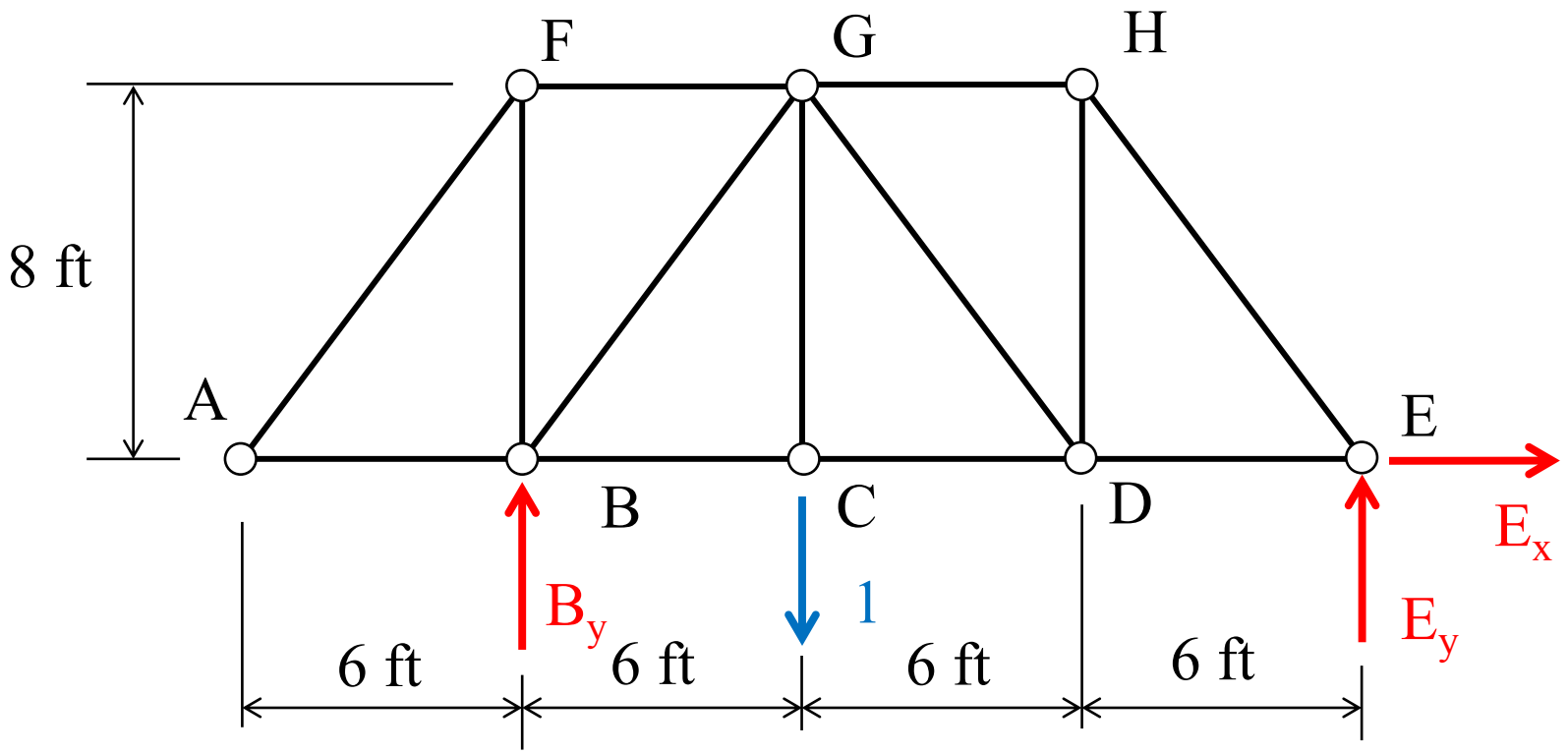
Unit Load at Point C



$$\circlearrowleft + \sum M_B = 0$$

$E_y = 0.333$

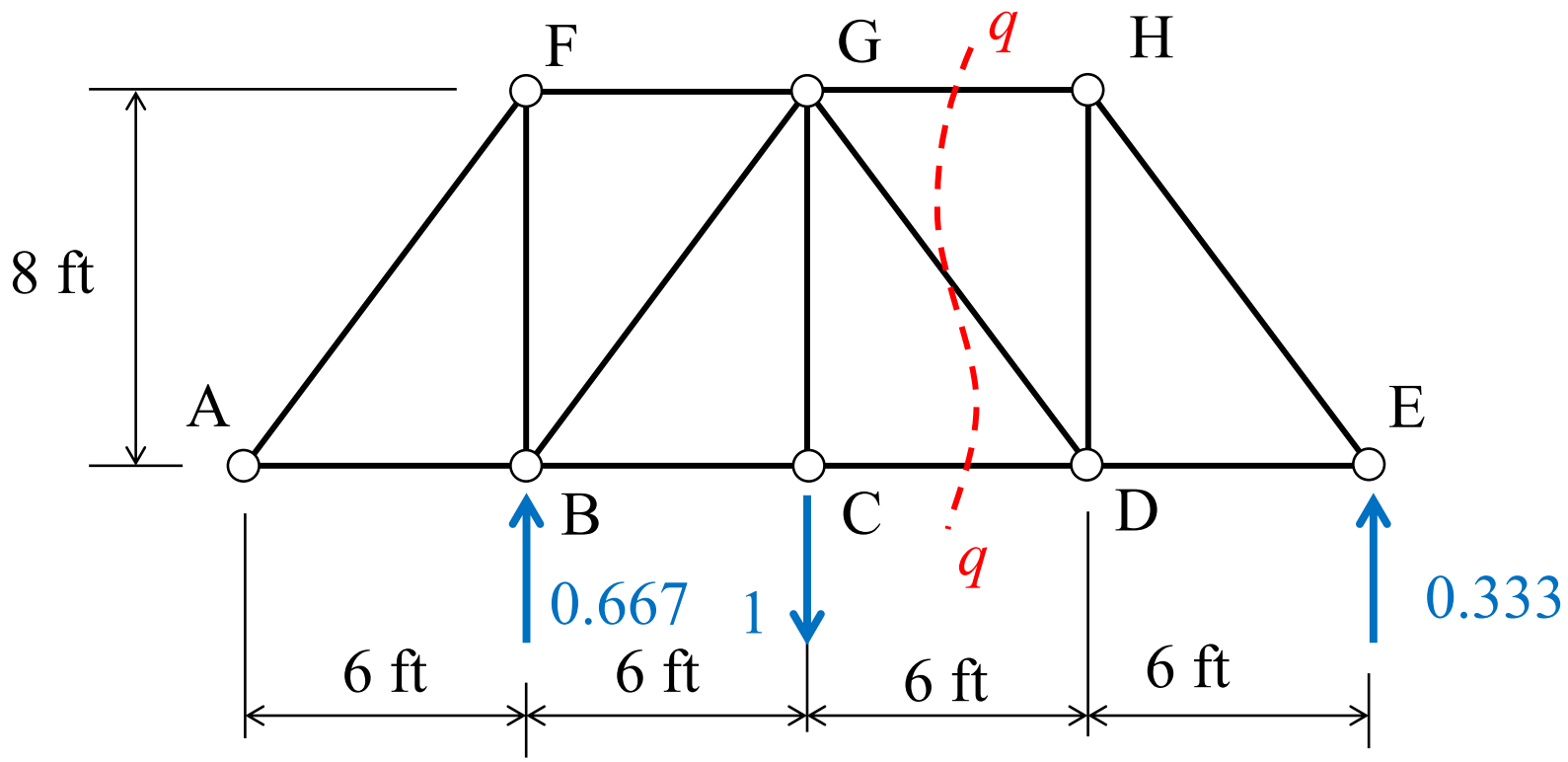
Unit Load at Point C



$$+\uparrow \sum F_y = 0$$

$B_y = 0.667$

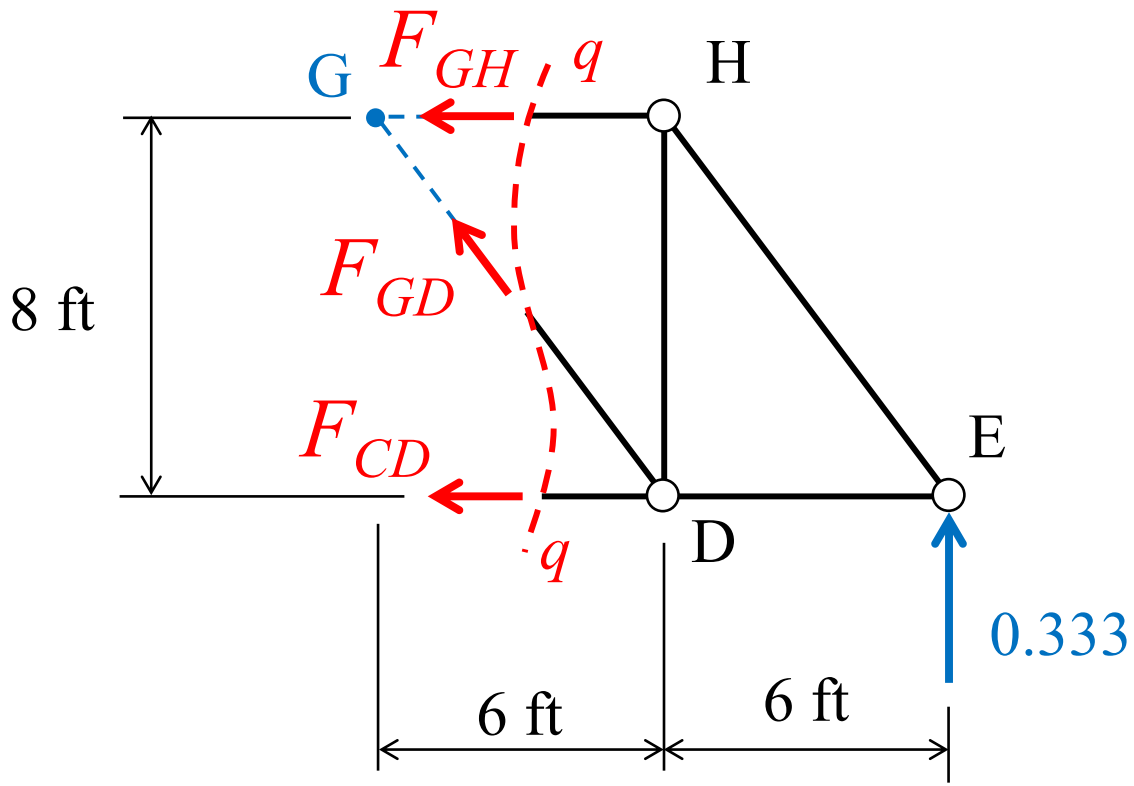
Unit Load at Point C



We can use the method of sections to find member forces GH, GD, and CD.

We can use method of joints to find the member force GC.

FBD of the Section to the Right of Cut *q-q*



$$\circlearrowleft + \sum M_G = 0$$

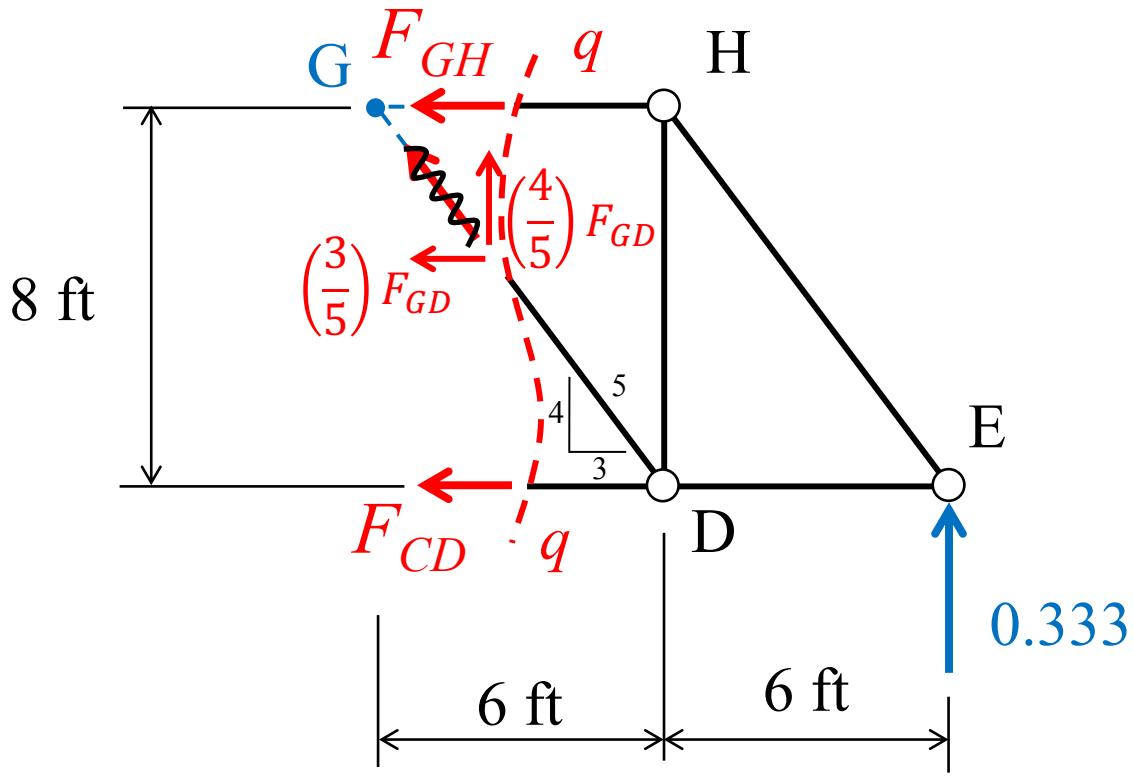
$$\circlearrowleft + \sum M_D = 0$$

$F_{CD} = 0.50$

$F_{GH} = -0.25$

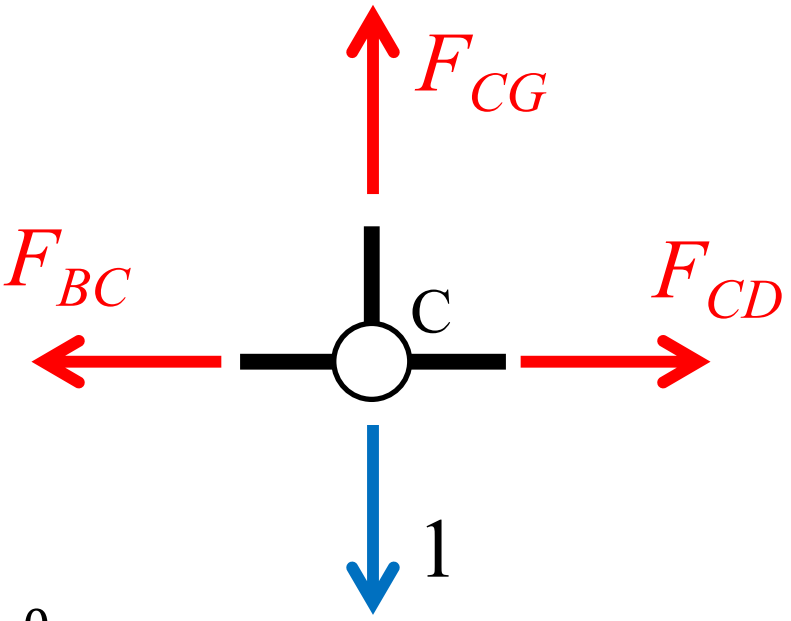
FBD of the Section to the Right of Cut *q-q*

$$+\uparrow \sum F_y = 0$$



$F_{GD} = -0.4167$

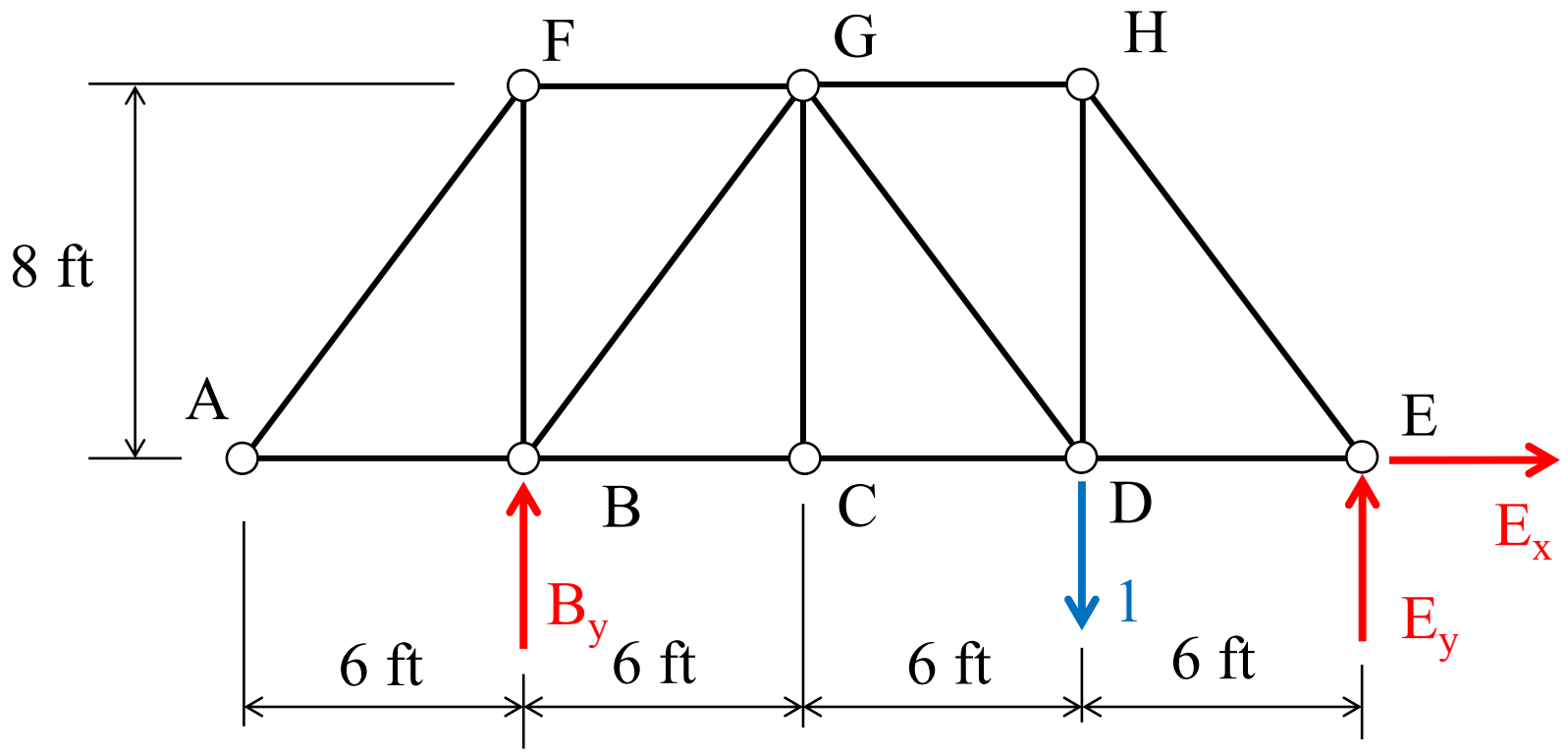
FBD of Joint C



$$+\uparrow \sum F_y = 0$$

$F_{CG} = 1$

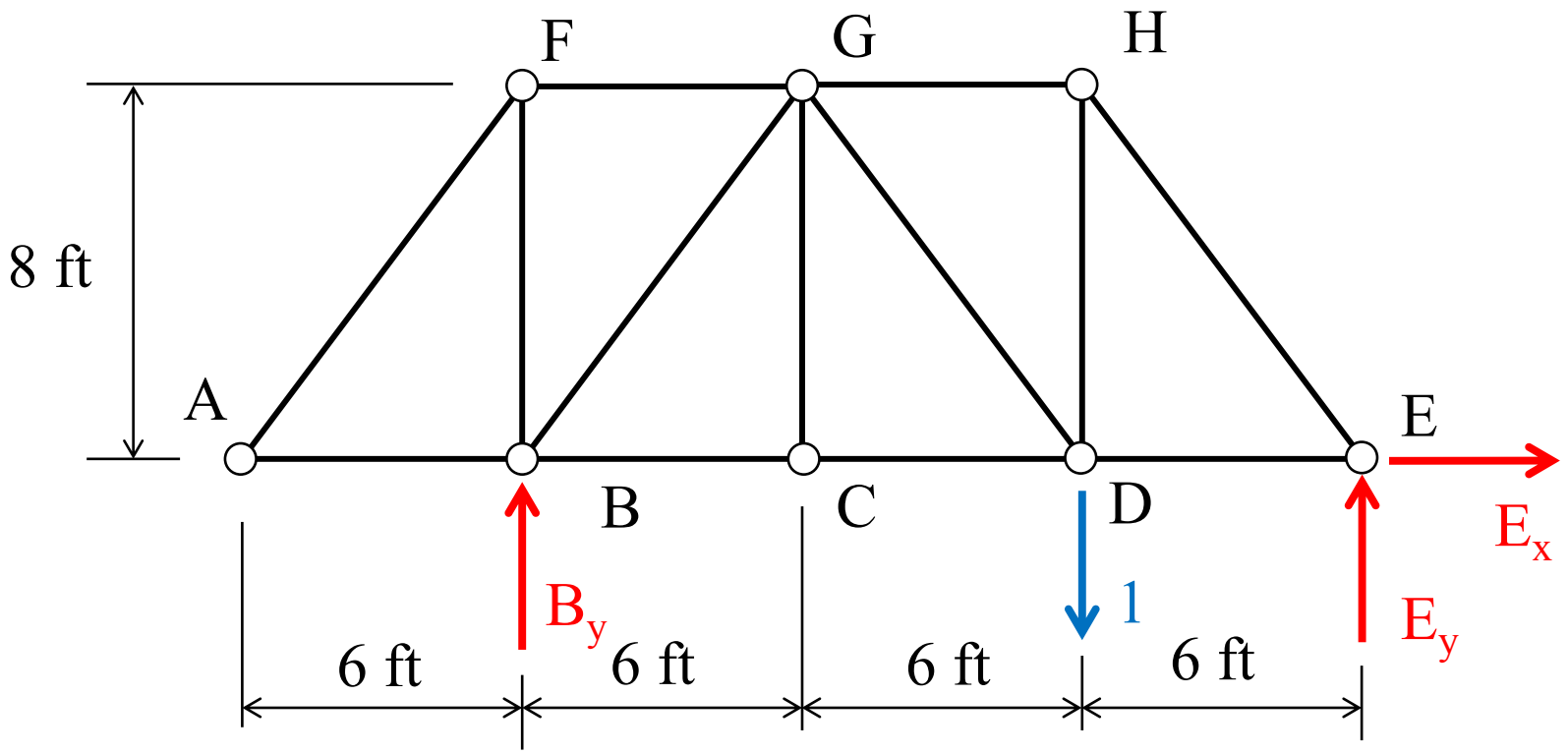
Unit Load at Point D



$$\circlearrowleft + \sum M_B = 0$$

$E_y = 0.667$

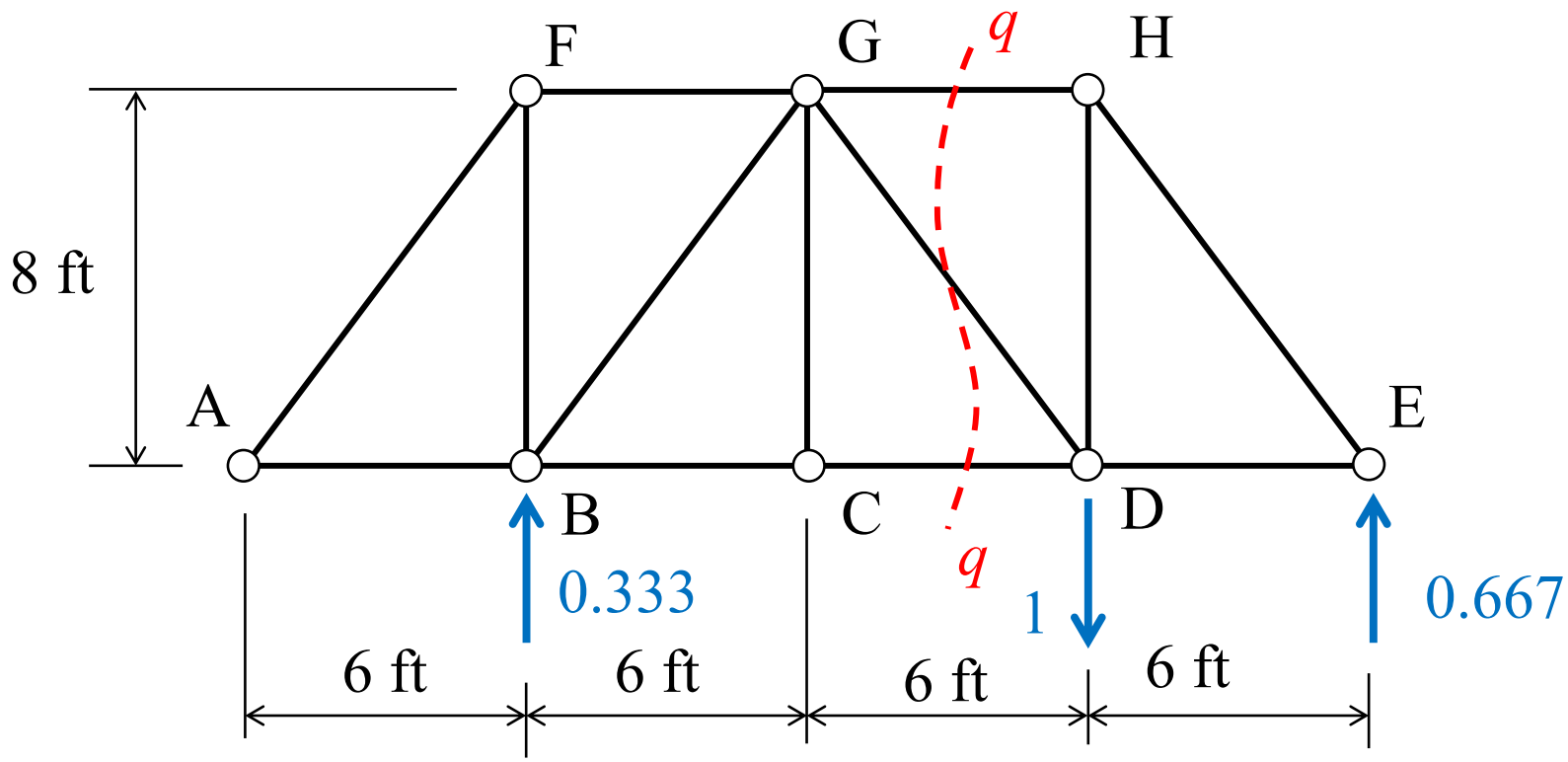
Unit Load at Point D



$$+\uparrow \sum F_y = 0$$

$B_y = 0.333$

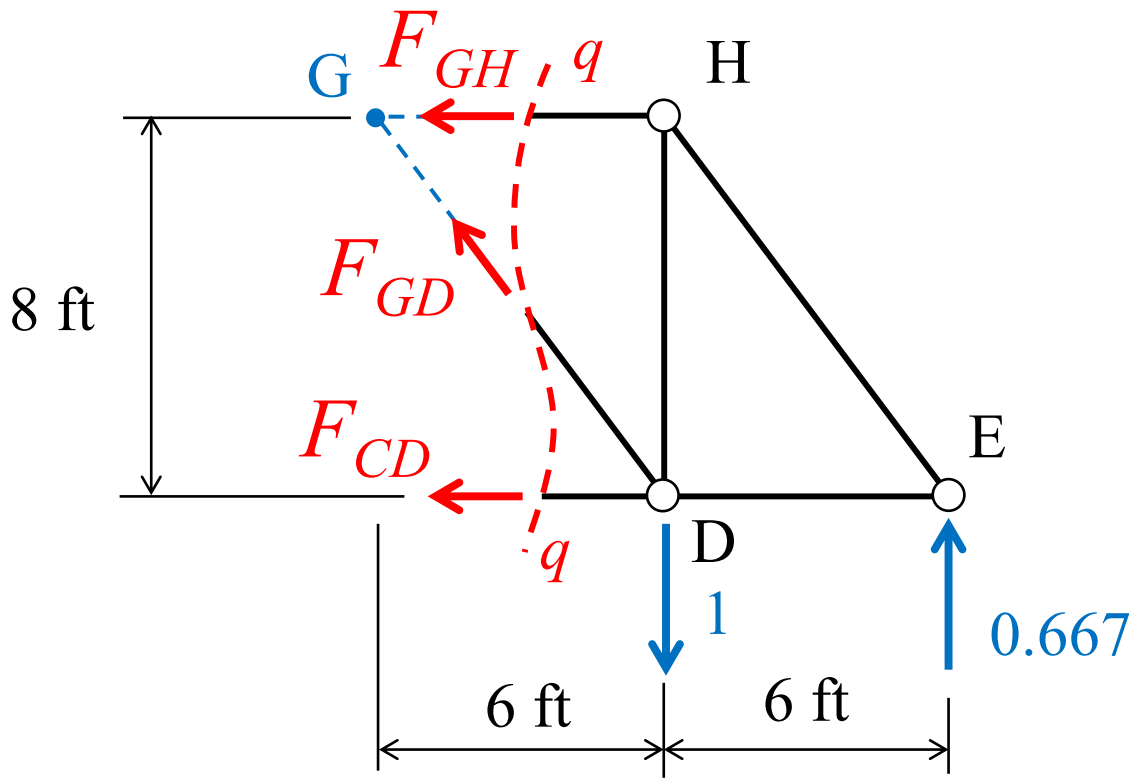
Unit Load at Point D



We can use method of sections to find member forces GH, GD, and CD.

Note that for the unit load at D, GC is a zero-force member

FBD of the Section to the Right of Cut *q-q*



$$\circlearrowleft + \sum M_G = 0$$

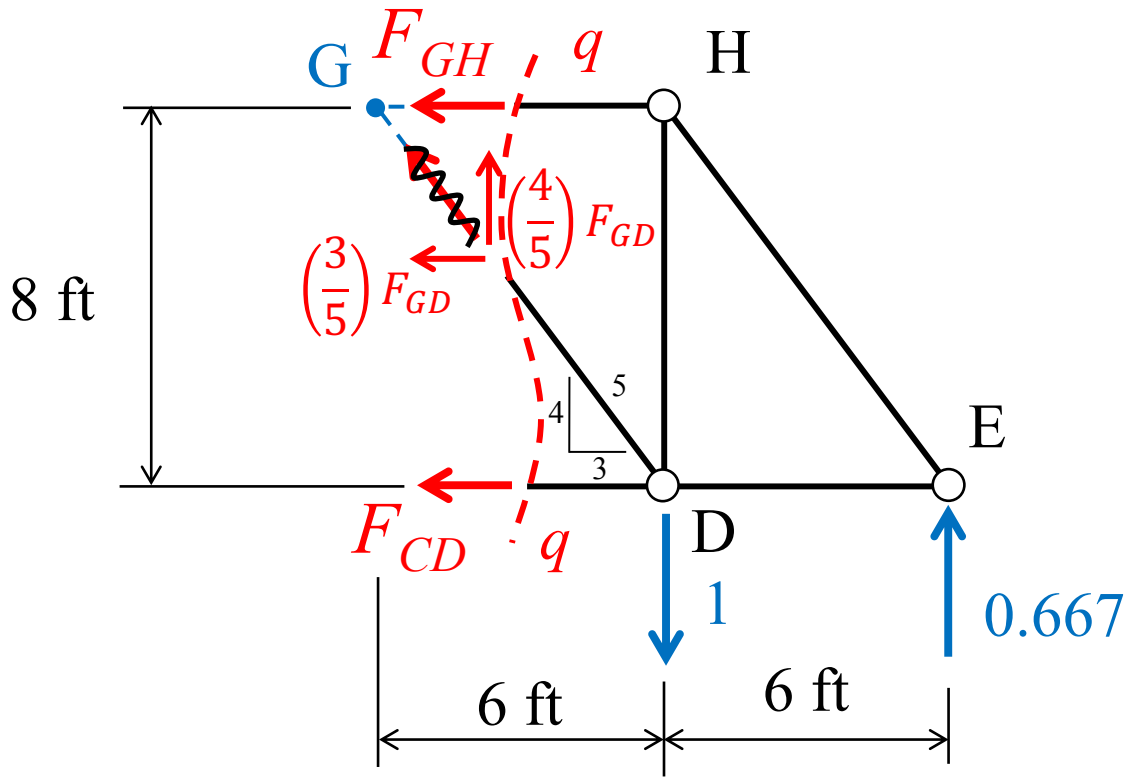
$$\circlearrowleft + \sum M_D = 0$$

$F_{CD} = 0.25$

$F_{GH} = -0.5$

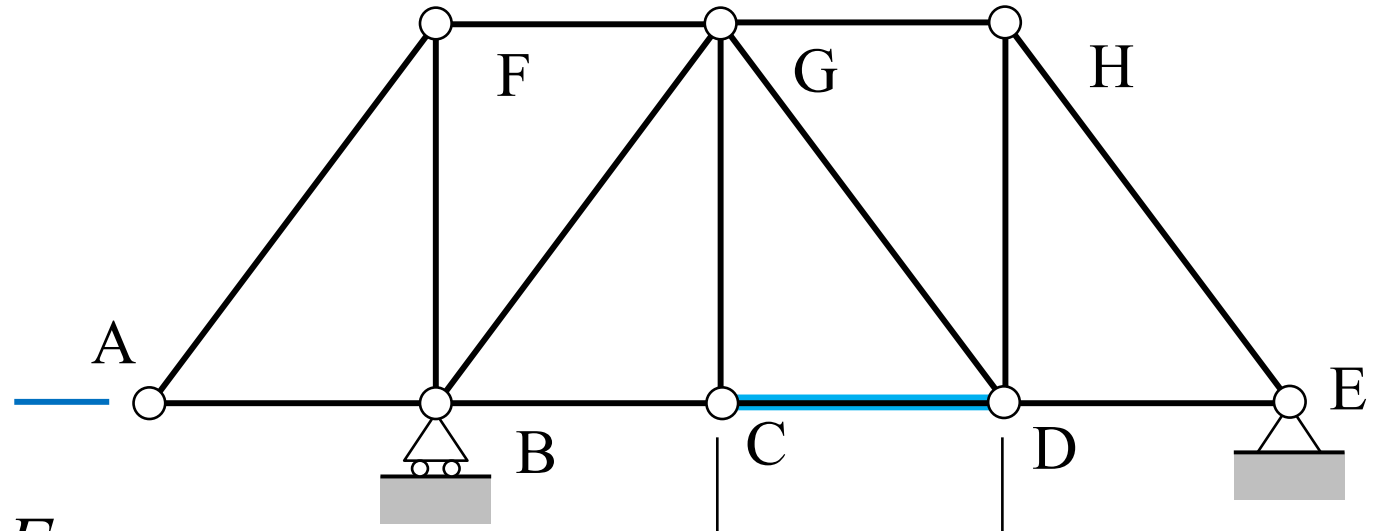
FBD of the Section to the Right of Cut *q-q*

$$+\uparrow \sum F_y = 0$$

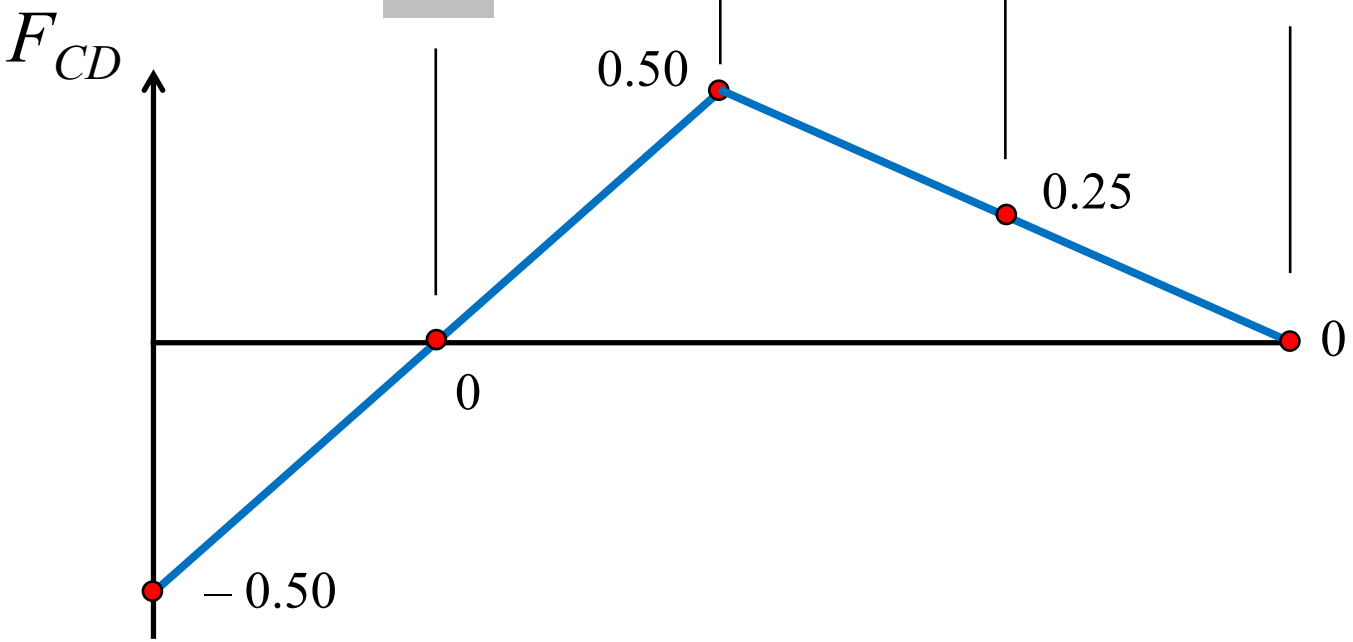


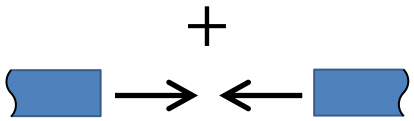
$F_{GD} = 0.4167$

Plot the Influence Line for F_{CD}

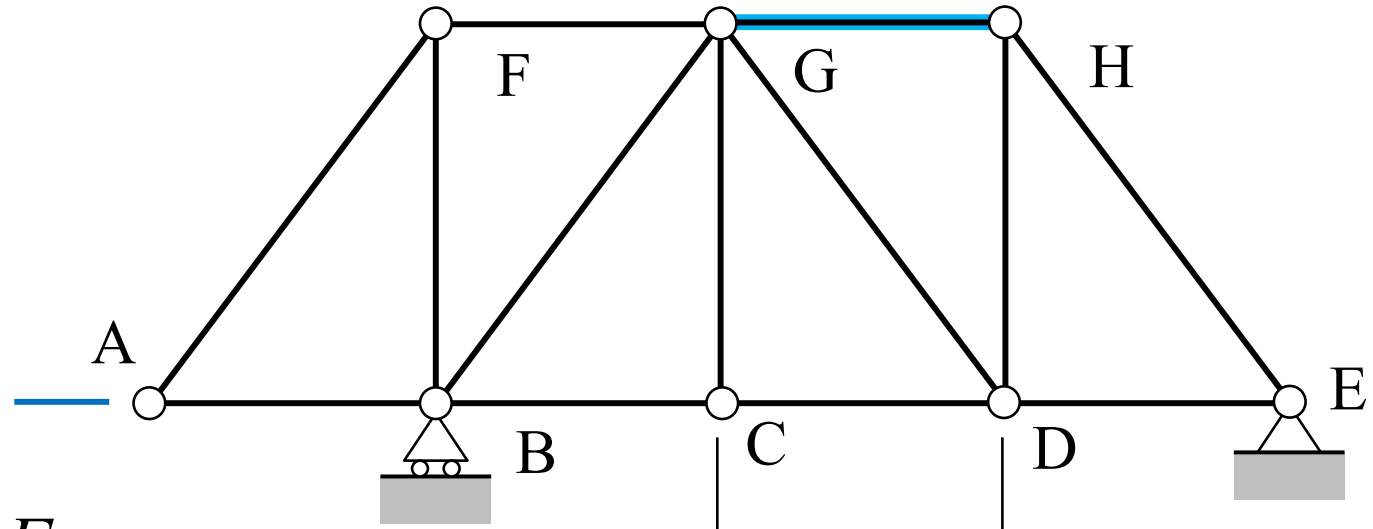


x =	F_{CD}
0 (A)	– 0.50
6 ft (B)	0
12 ft (C)	0.50
18 (D)	0.25
24 (E)	0

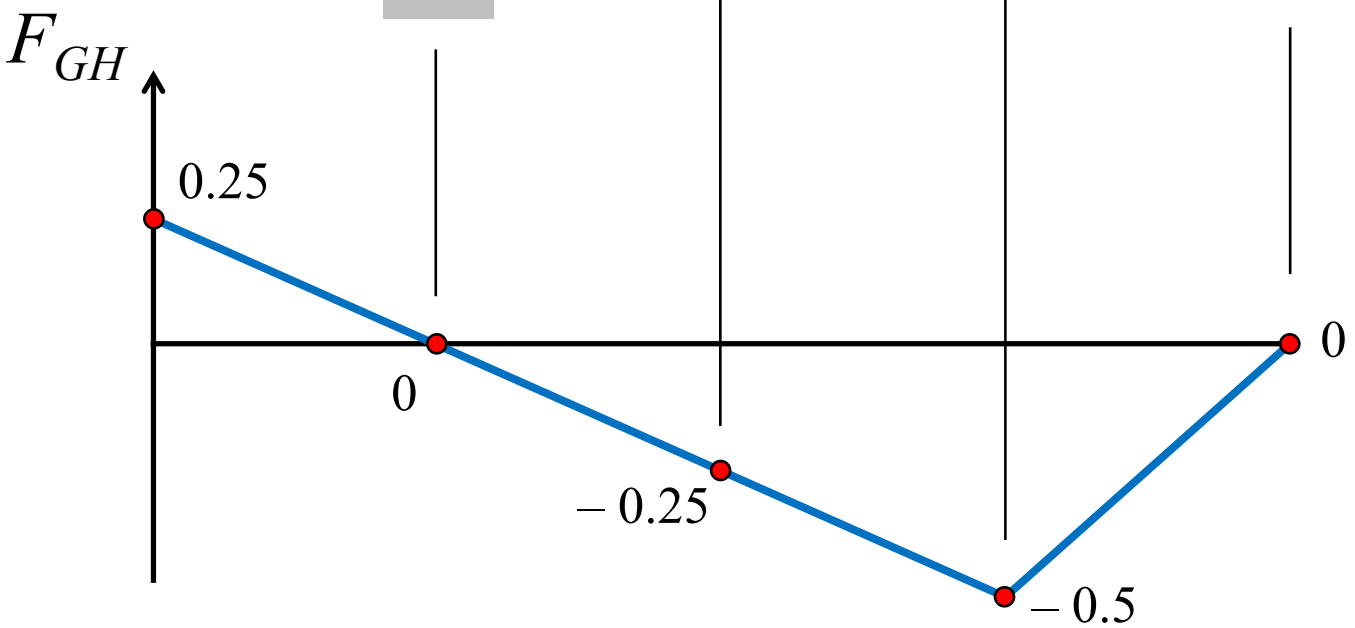


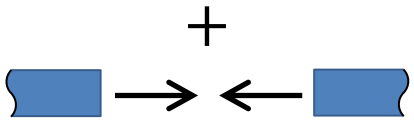


Plot the Influence Line for F_{GH}

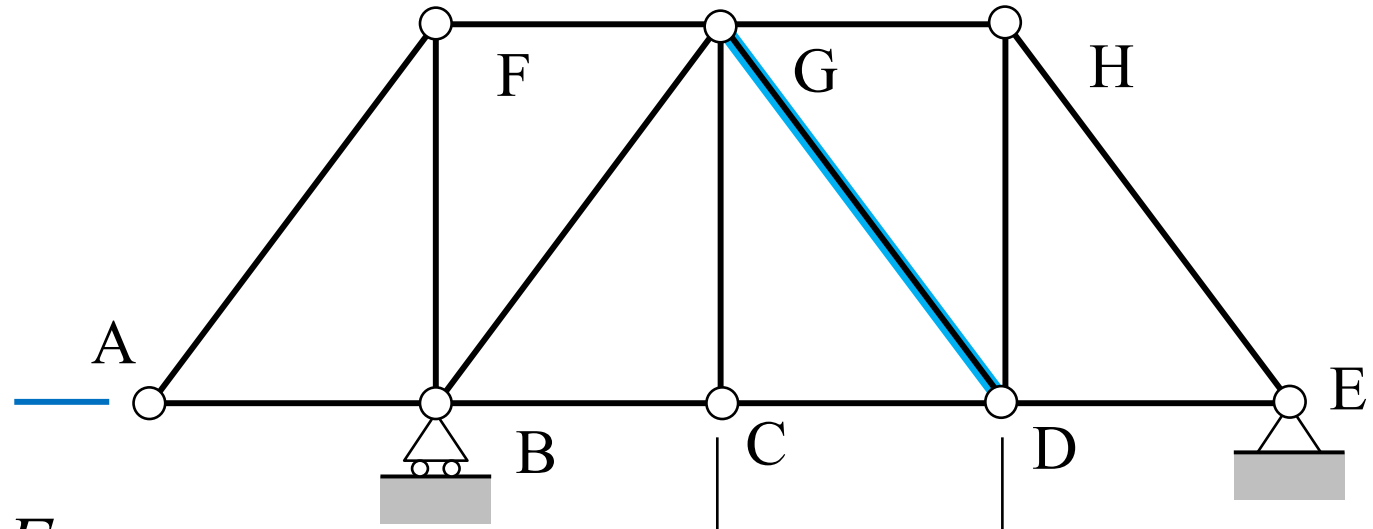


x =	F_{GH}
0 (A)	0.25
6 ft (B)	0
12 ft (C)	– 0.25
18 (D)	– 0.5
24 (E)	0

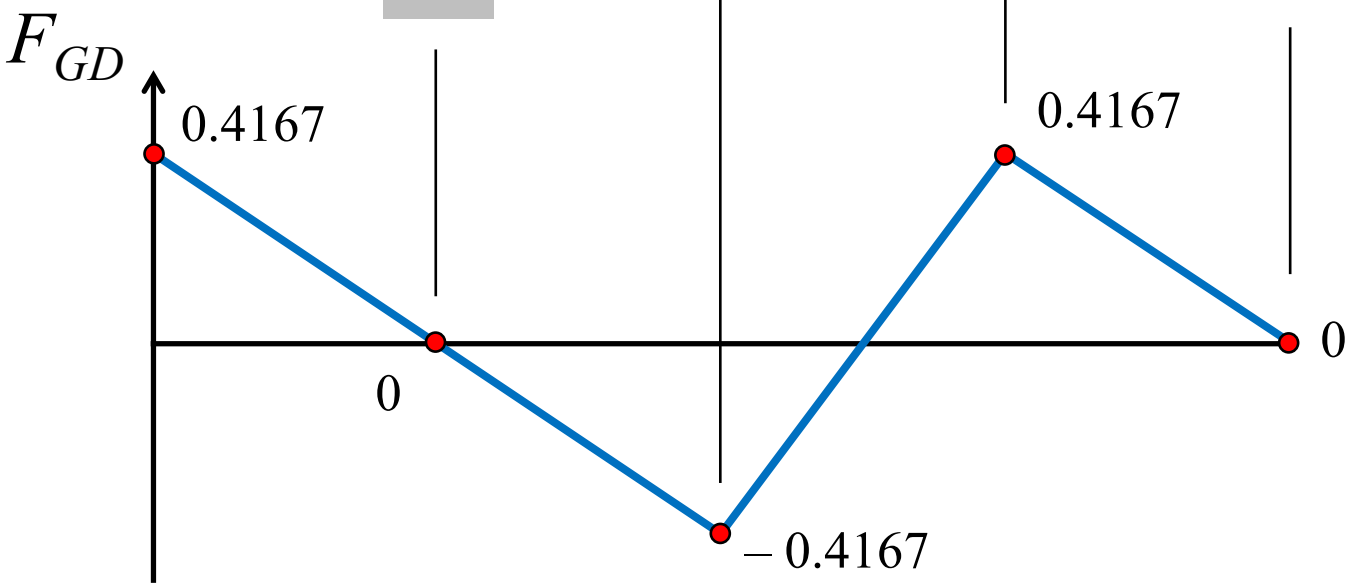


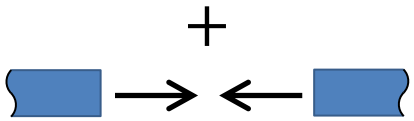


Plot the Influence Line for F_{GD}

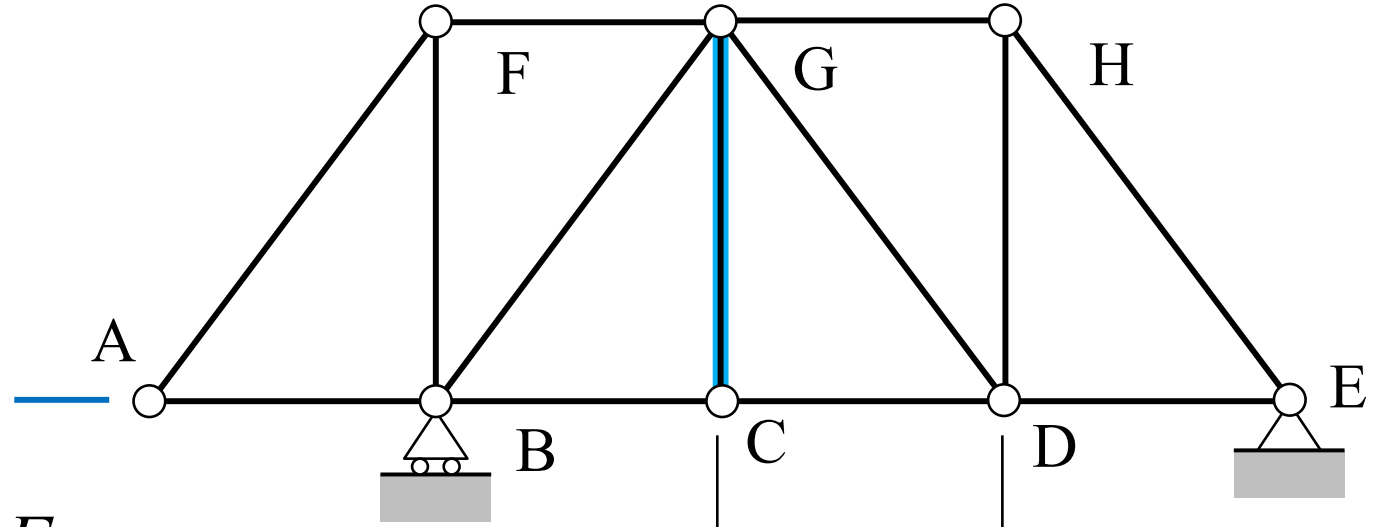


x =	F_{GD}
0 (A)	0.4167
6 ft (B)	0
12 ft (C)	– 0.4167
18 (D)	0.4167
24 (E)	0





Plot the Influence Line for F_{GC}



x =	F_{GC}
0 (A)	0
6 ft (B)	0
12 ft (C)	1
18 (D)	0
24 (E)	0