Truss Analysis – Method of Sections

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General Procedure for the Analysis of Simple Trusses using the Method of Sections

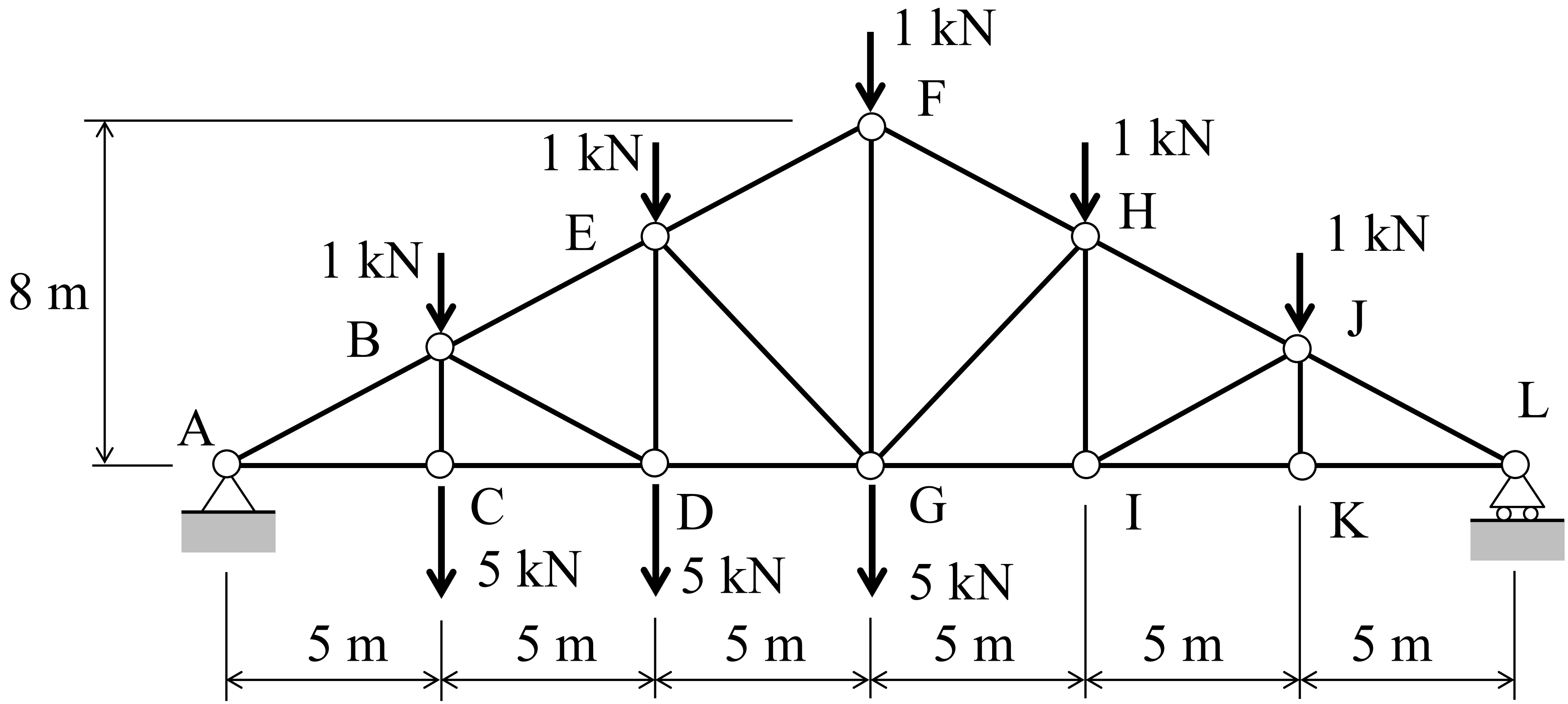
1. Draw a Free Body Diagram (FBD) of the **entire truss** cut loose from its supports and find the **support reactions** using the equations of equilibrium (we will see that for some truss structures this step is not always necessary);

2. Make a cut through the members of the truss that are of interest. The cut must define two separate sections of the truss;

3. Draw a FBD of the section of the truss that is to be analyzed. There are **three equations of equilibrium** available to find unknown truss member forces;

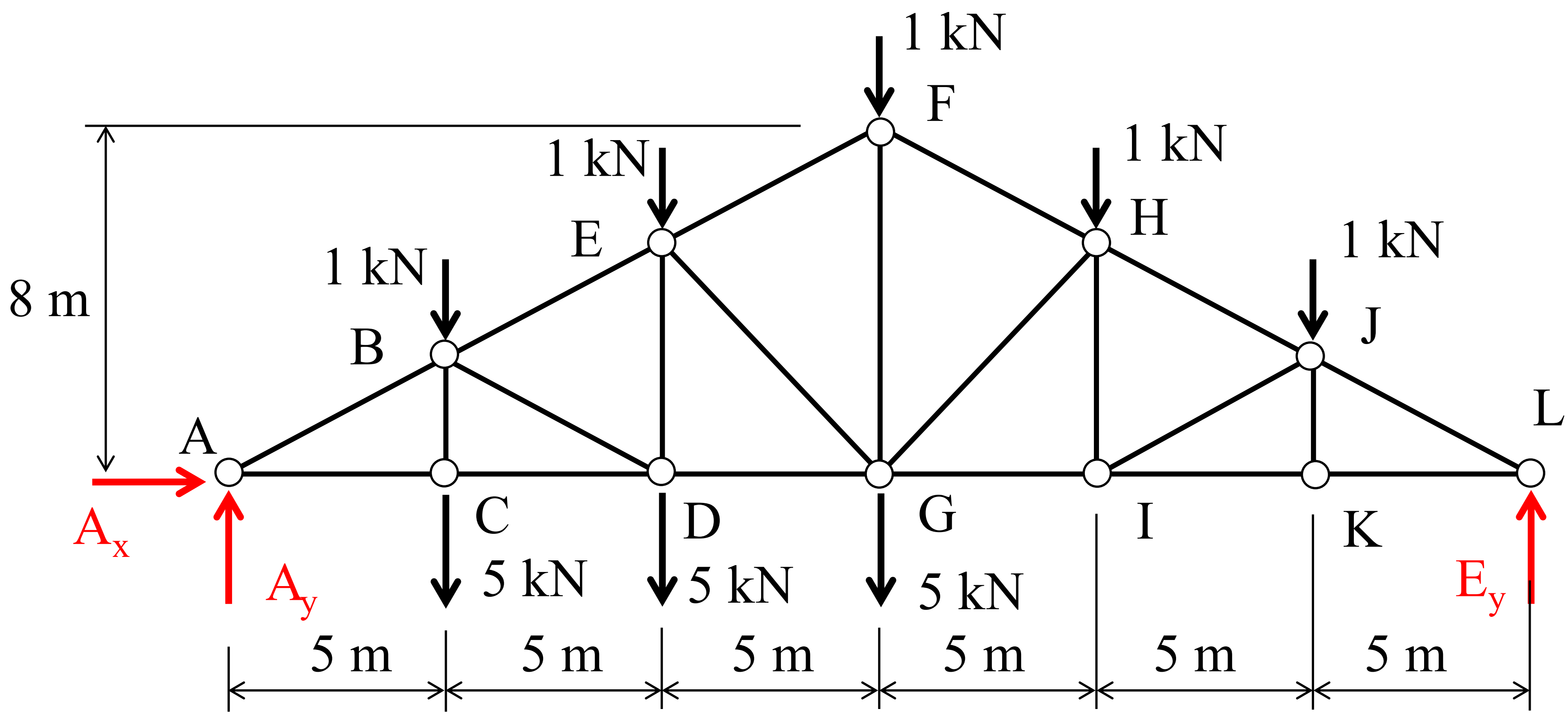
4. Note that due to the geometry of simple trusses, several forces often intersect at a point. These points are often good points to take moment equilibrium about. Often one can isolate one unknown member force with a moment equilibrium equation.

Analysis Example Using the Method of Sections

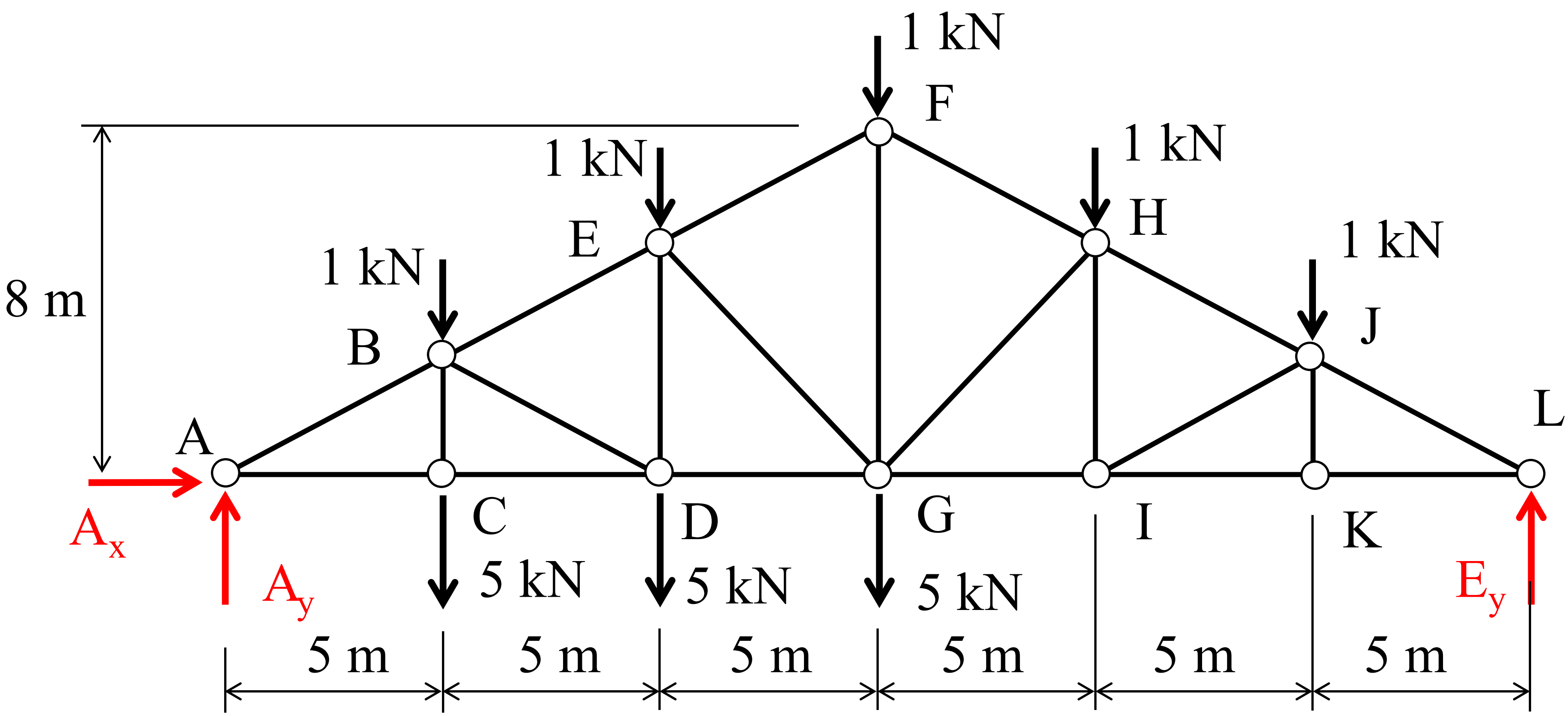


Consider the idealized truss structure with a pin support at A and a roller support at L. The truss is subjected to applied loads shown. Find the truss member forces FH, GH, and GI

1. Draw a Free Body Diagram (FBD) of the **entire truss** cut loose from its supports and find the **support reactions** using the equations of equilibrium (we will see that for some truss structures this step is not always necessary)



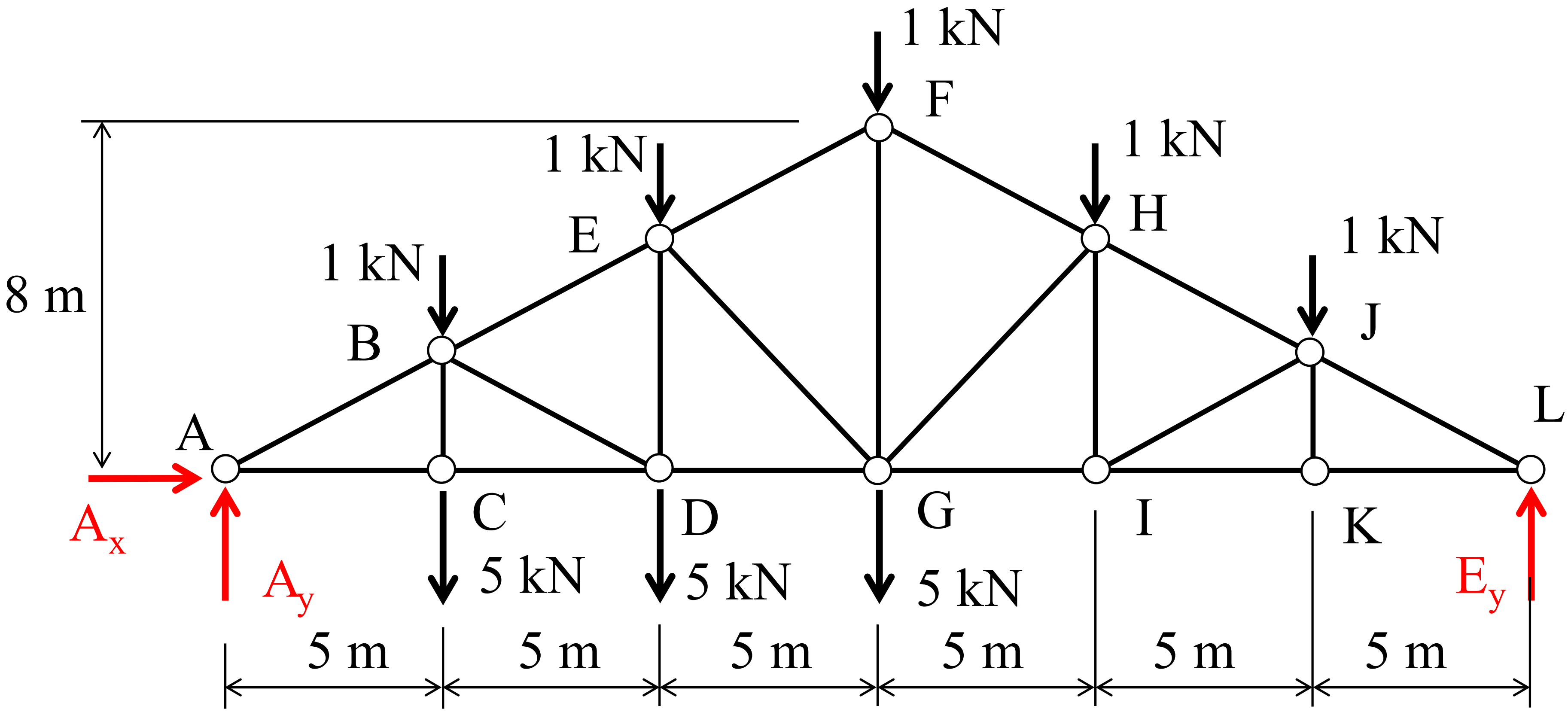
Use Equilibrium to Find Support Reactions



$$\circlearrowleft + \sum M_A = 0$$

$L_y = 7.5$ kN

Use Equilibrium to Find Support Reactions

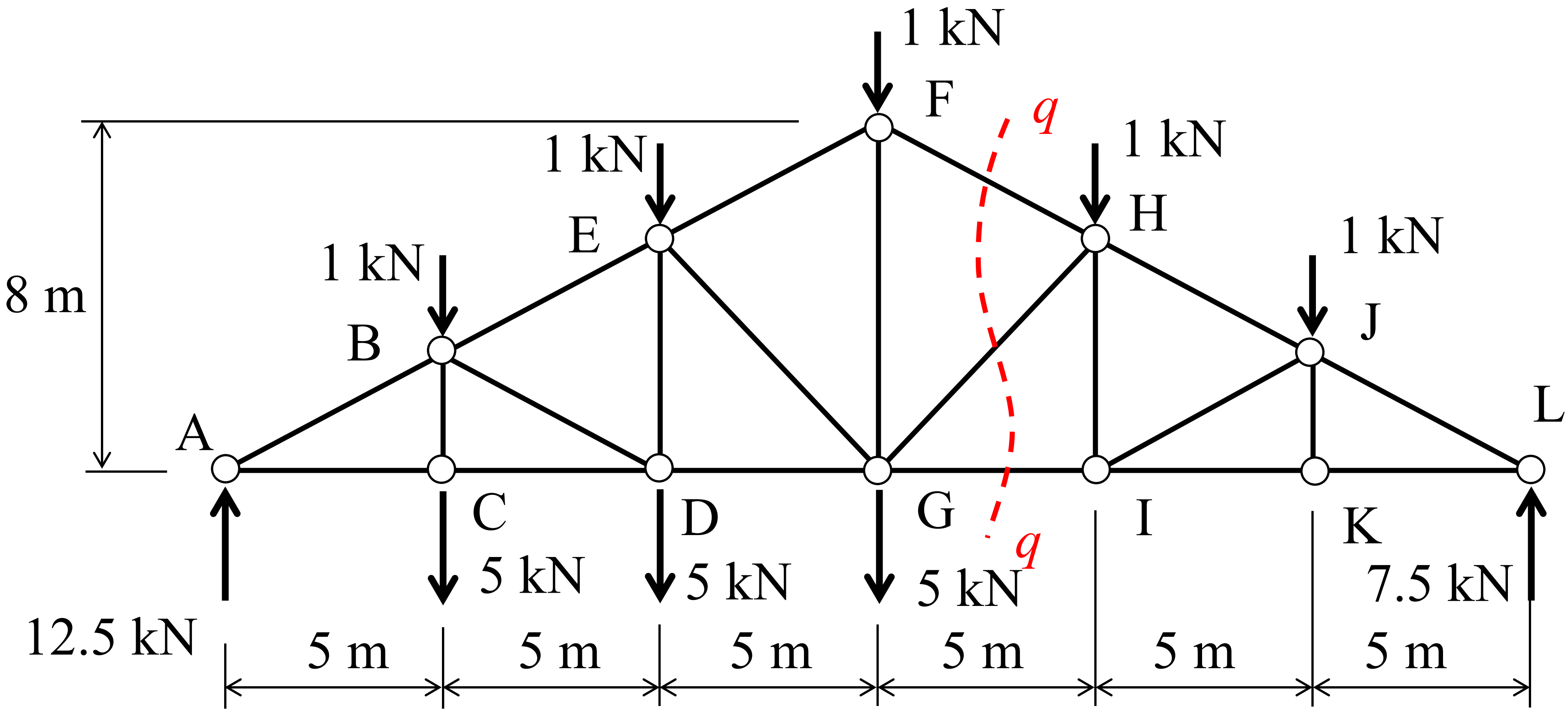


$$+\uparrow \sum F_y = 0$$

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

$A_y = 12.5$ kN

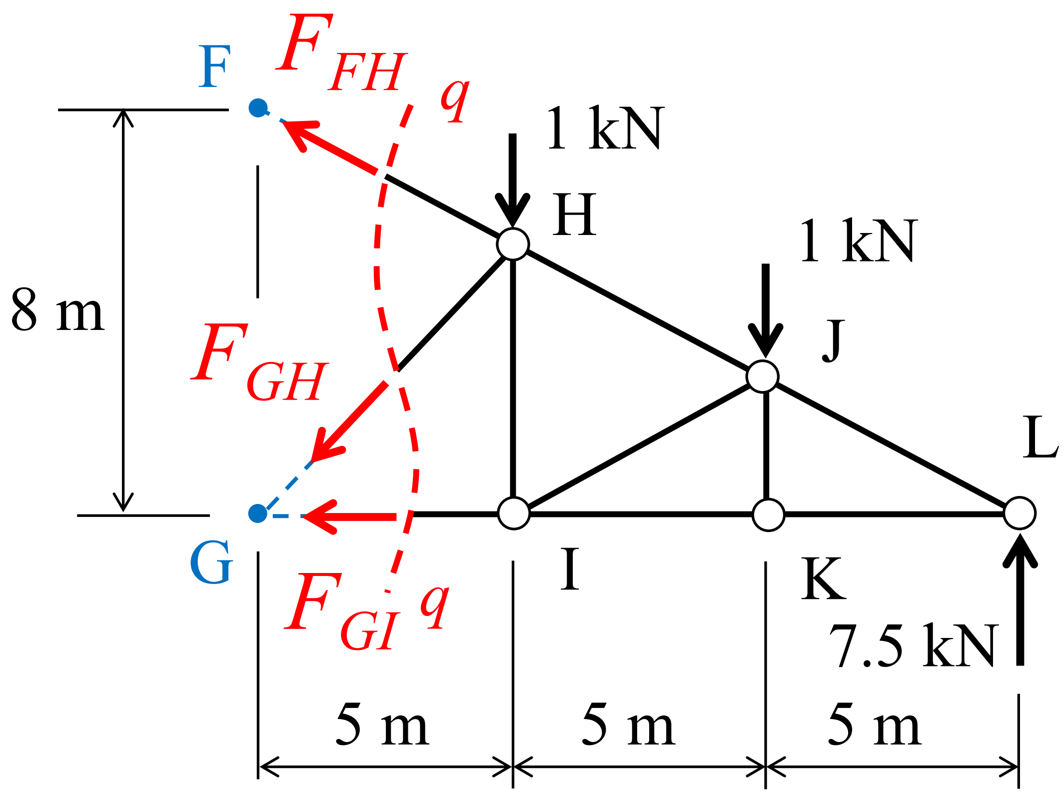
FBD Showing Support Reactions



2. Make a cut through the members of the truss that are of interest. The cut must define two separate sections of the truss;

Can use a FBD of either section to find unknown member forces

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



Notes:

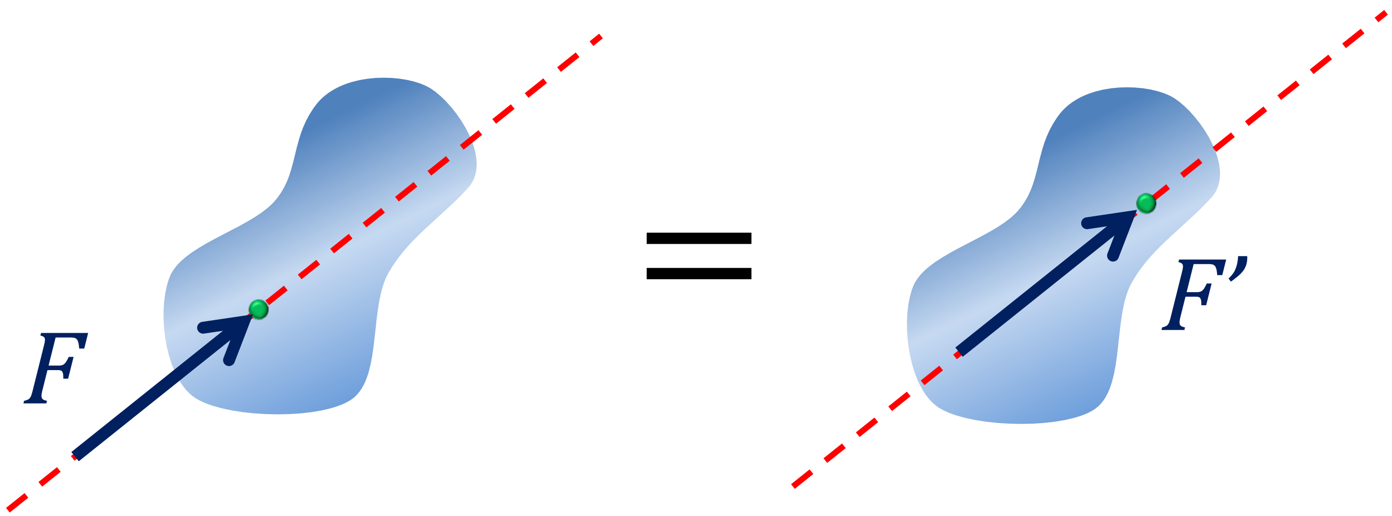
- Unknown truss member forces are assumed to act in tension (pulling away form the joint);
- Members GH and GI intersect at G;
- Members FH and GI intersect at L;
- Members GH and FH intersect at H.

3. Draw a FBD of the section of the truss that is to be analyzed. There are **three equations of equilibrium** available to find unknown truss member forces;

The Principle of Transmissibility

The **Principle of Transmissibility** states:

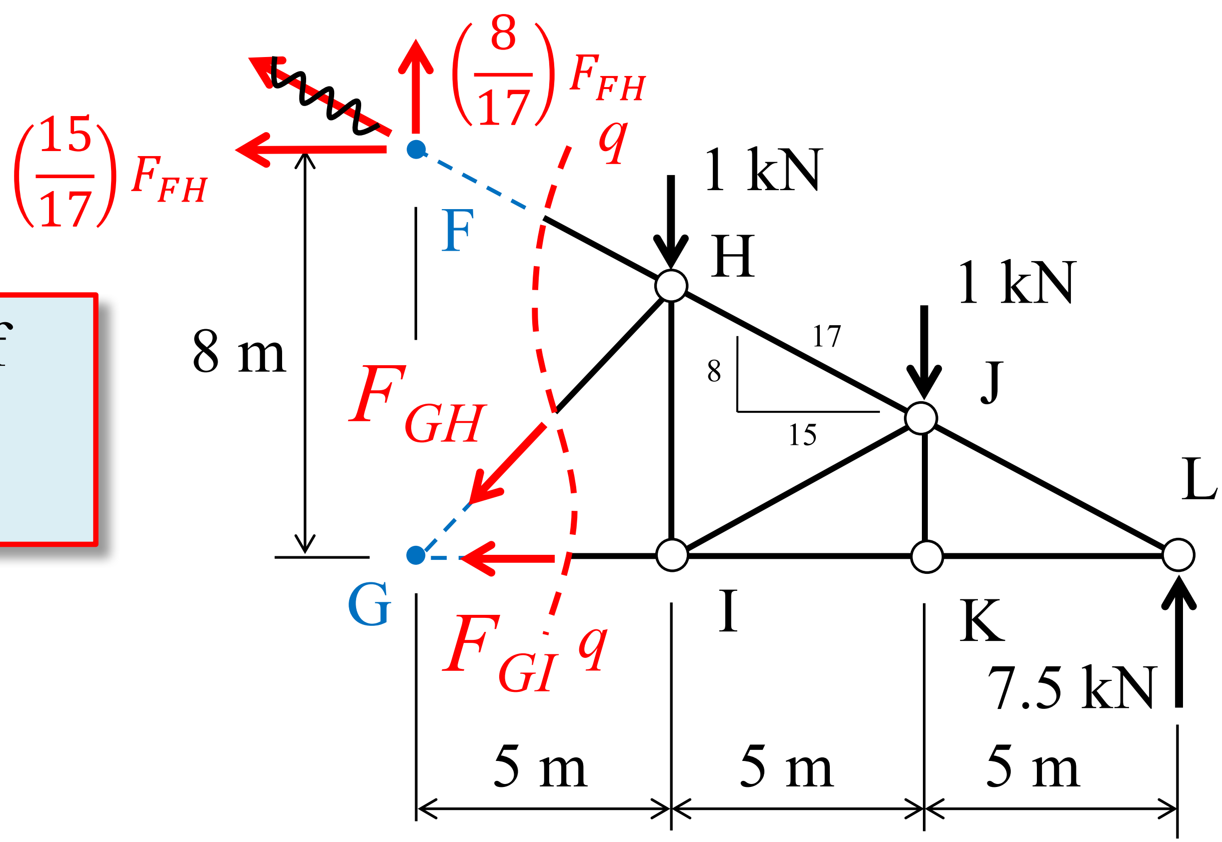
The condition of equilibrium (or motion) of a body remain unchanged if force ***F*** acting at a given point on a rigid body is replaced by a force ***F'*** that has the same magnitude, line of action, and sense but acts at a different point.



Find Force in Member FH

Using the Principle of Transmissibility, slide F_{FH} to point F

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

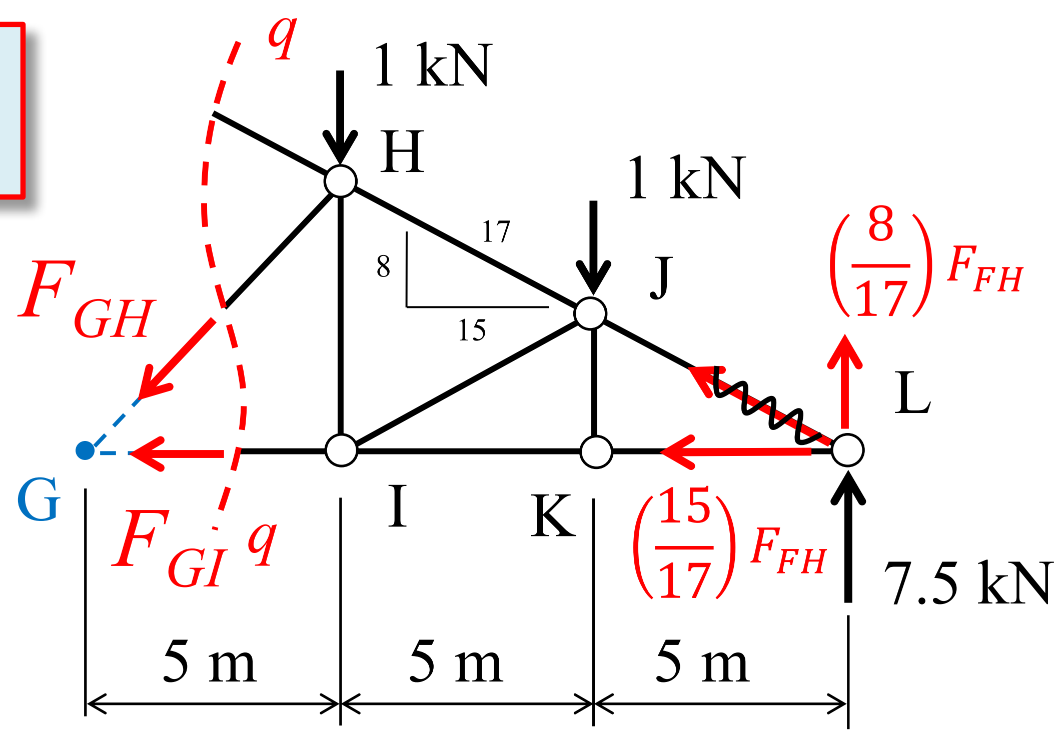


F_{FH} = -13.8125 kN

Find Force in Member FH

Note that we could also have slid F_{FH} to point L

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



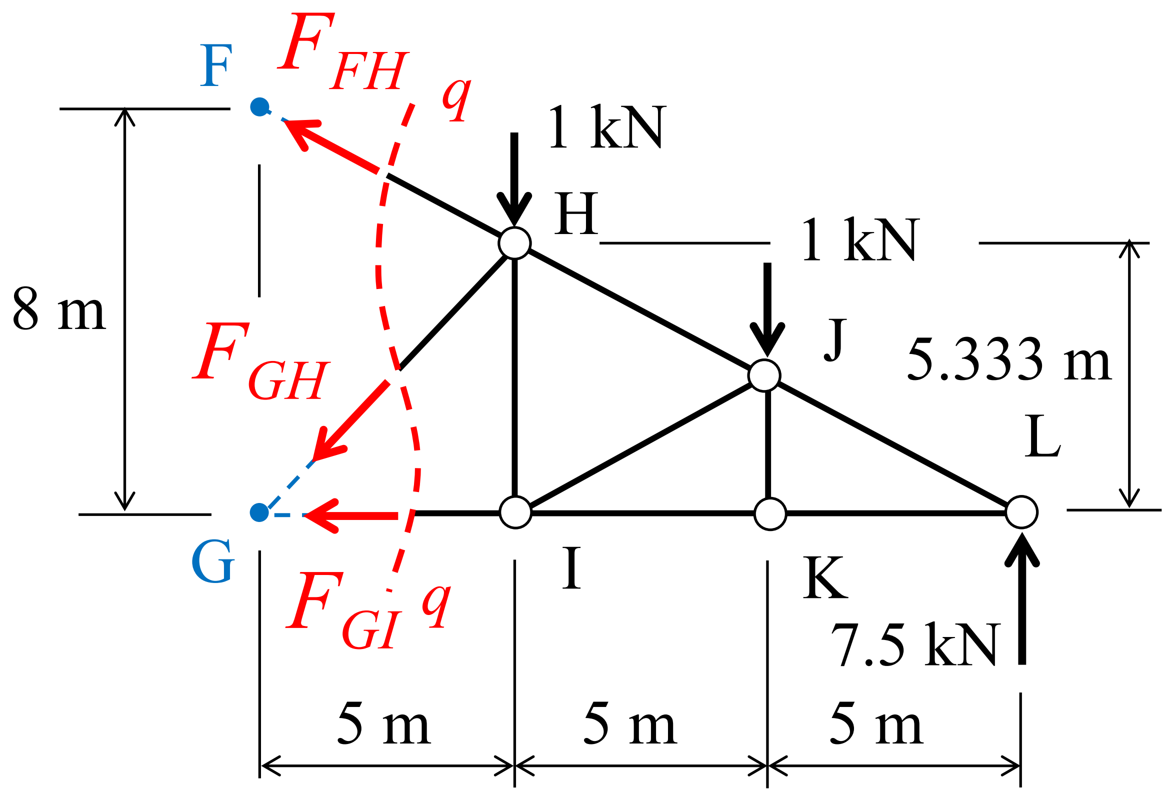
F_{FH} = -13.8125 kN

Find Force in Member GI

$$\frac{8}{15} = \frac{L_{HI}}{10}$$

$$L_{HI} = 5.333 \text{ m}$$

$$\circlearrowleft + \sum M_H = 0$$



$F_{GI} = 13.125$ kN

Find Force in Member GH

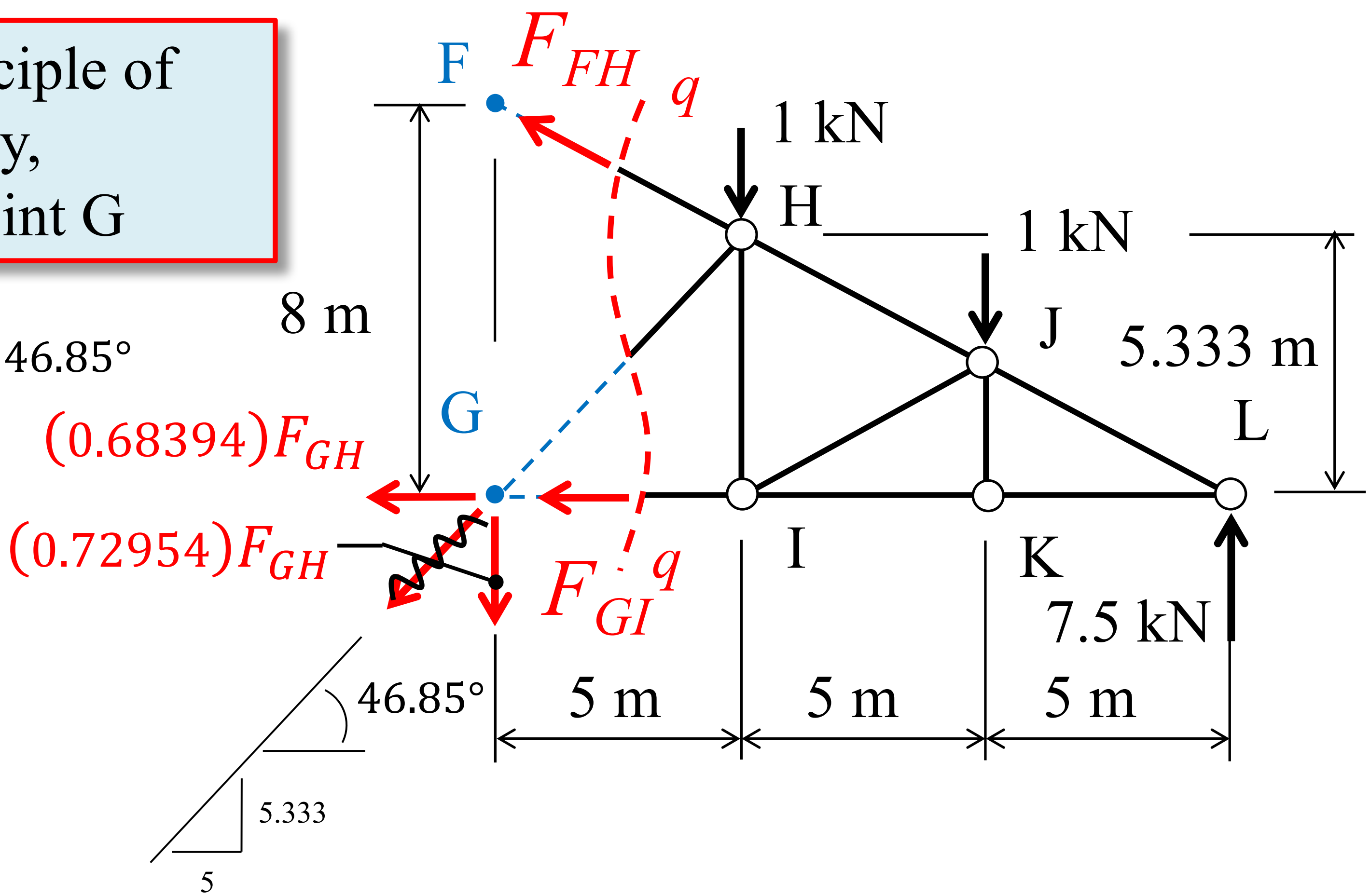
Using the Principle of Transmissibility, slide F_{GH} to point G

$$\theta = \tan^{-1}\frac{5.333}{5} = 46.85°$$

$$\sin\theta = 0.72954$$

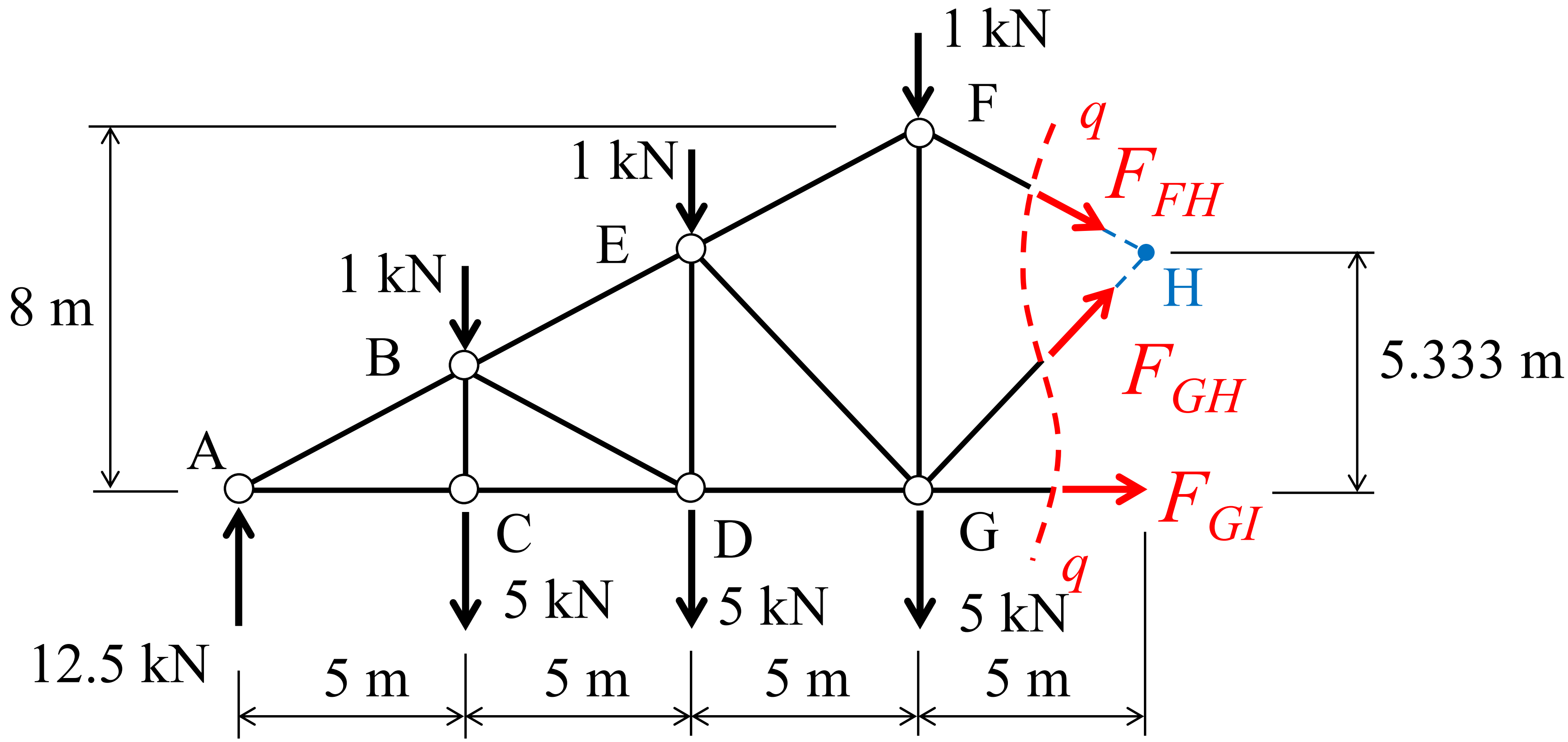
$$\cos\theta = 0.68394$$

$$\circlearrowleft + \sum M_L = 0$$



$F_{GH} = -1.3707$ kN

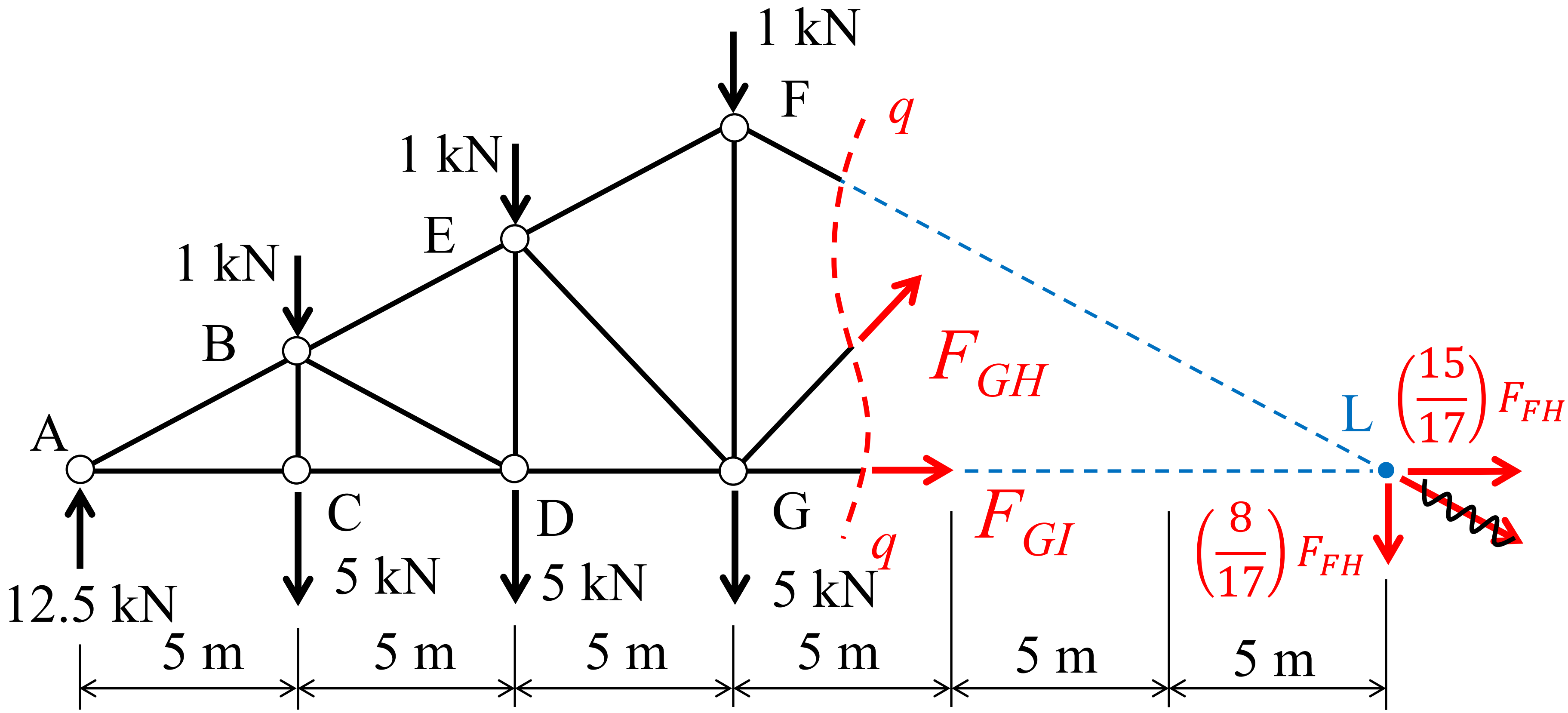
FBD of the Section to the Left of Cut *q-q*



$$\circlearrowleft + \sum M_H = 0$$

$F_{GI} = 13.125$ kN

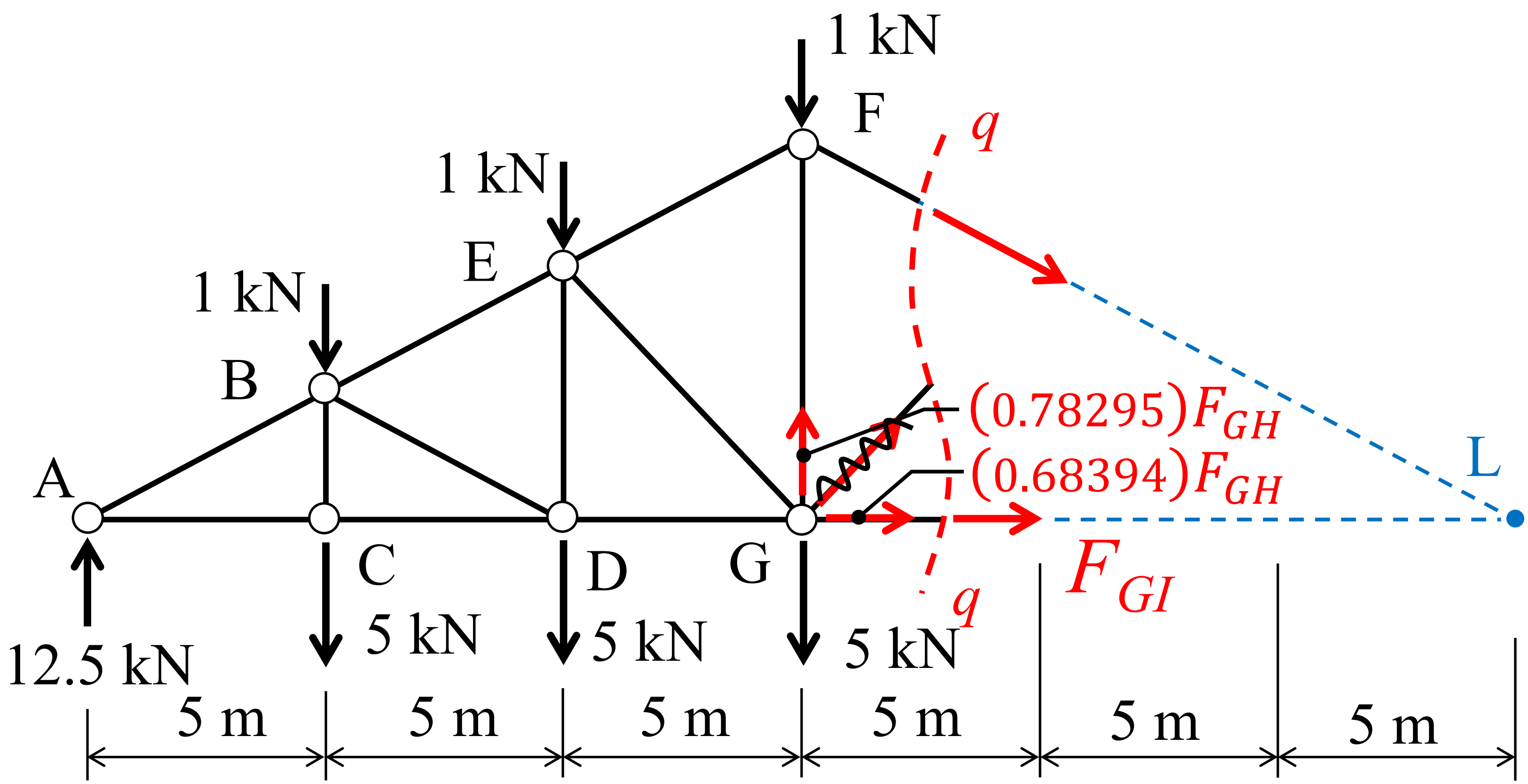
Confirm Force in Member FH



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

$F_{FH} = -13.8125$ kN

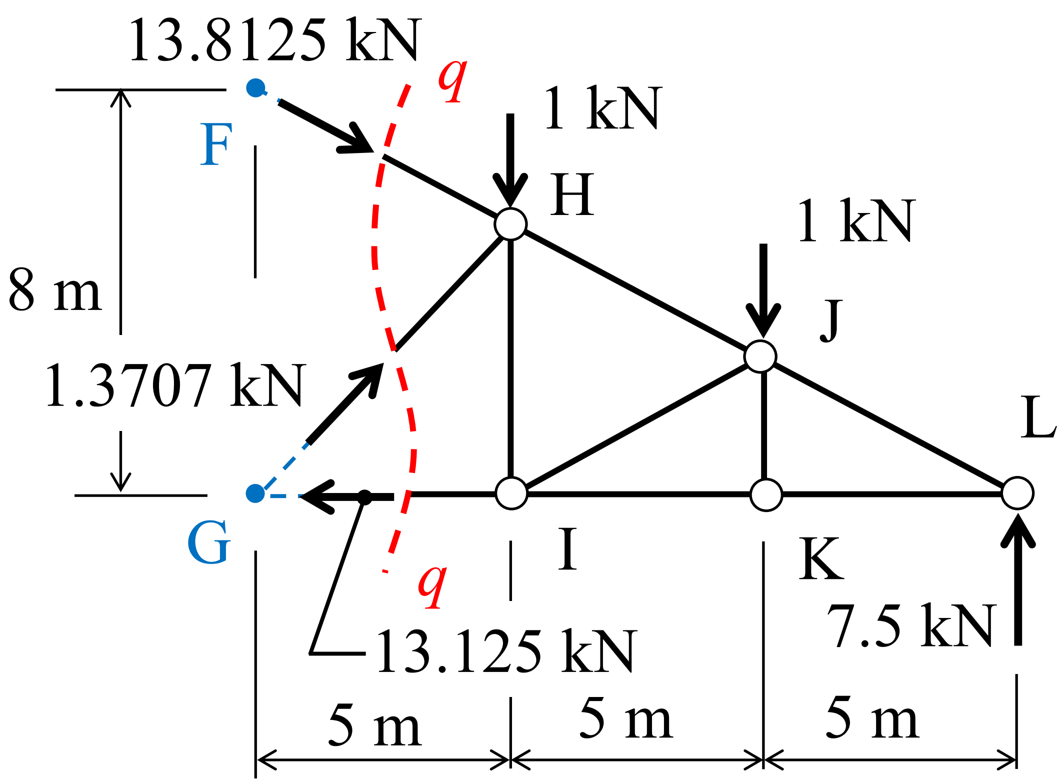
Confirm Force in Member GH



$$\circlearrowleft + \sum M_L = 0$$

F_{GH} = -1.3707 kN

Use Force Equilibrium to Check Results

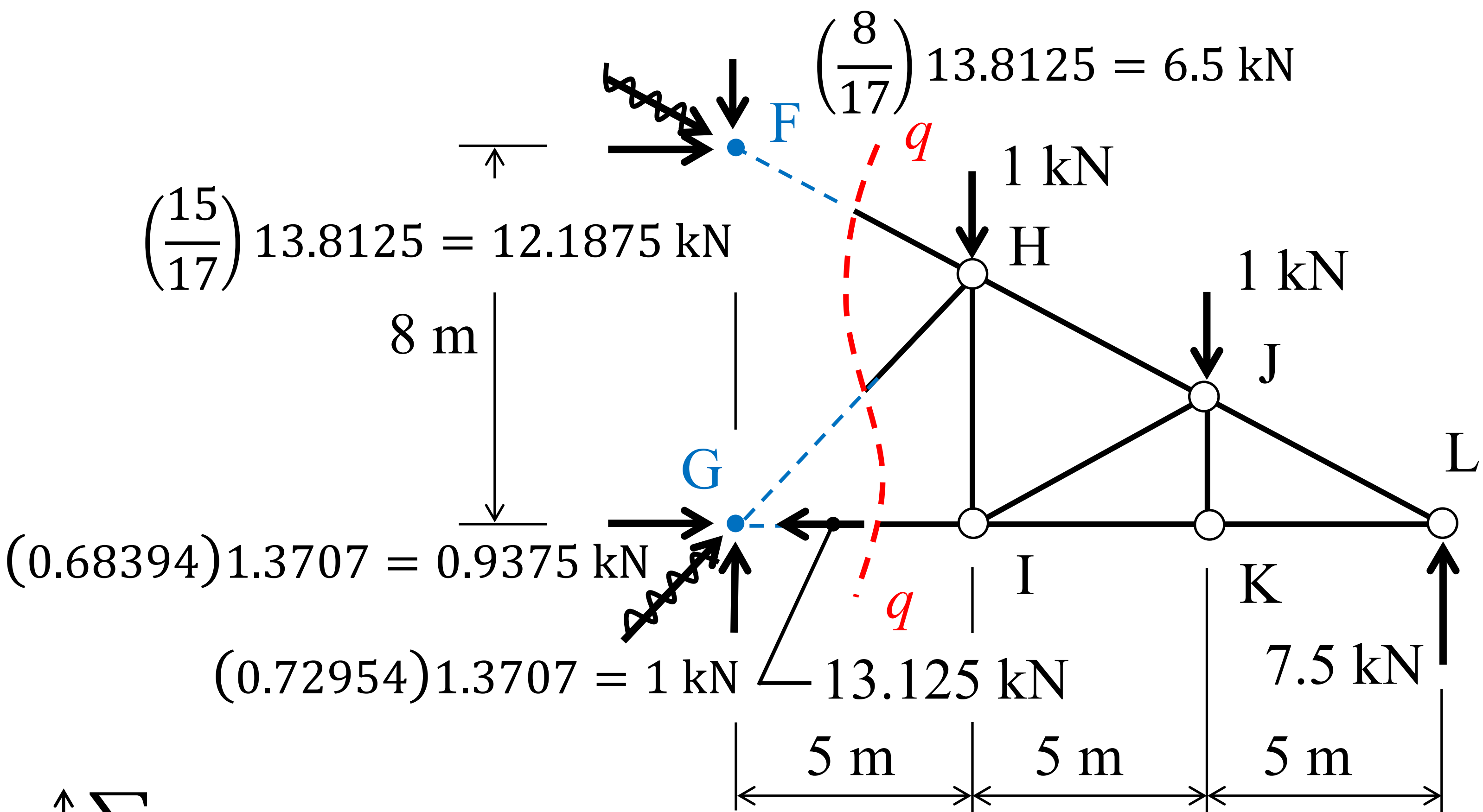


Notes:

- Show known member forces in their actual directions;
- Member GI is in tension;
- Member GH is in compression;
- Member FH is in compression.

Express the inclined member forces in terms of horizontal and vertical components, and examine force equilibrium of the section.

Use Force Equilibrium to Check Results



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

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