Universidad de Buenos Aires

FACULTAD DE INGENIERIA

# ESTABILIDAD I

## Clase 7

## Reticulados - Bastidores

Estática de Bedford Fowler

# RETICULADOS

- **DEFINICIÓN:** Estructuras formada por barras vinculadas entre si en sus extremos, constituyendo un sistema rígido e indeformable.

- **BARRA:** Elemento rígido en indeformable con una dimensión predominante respecto de las otras dos.

- **NUDO:** Punto donde se unen entre si las barras.

# *Reticulados*

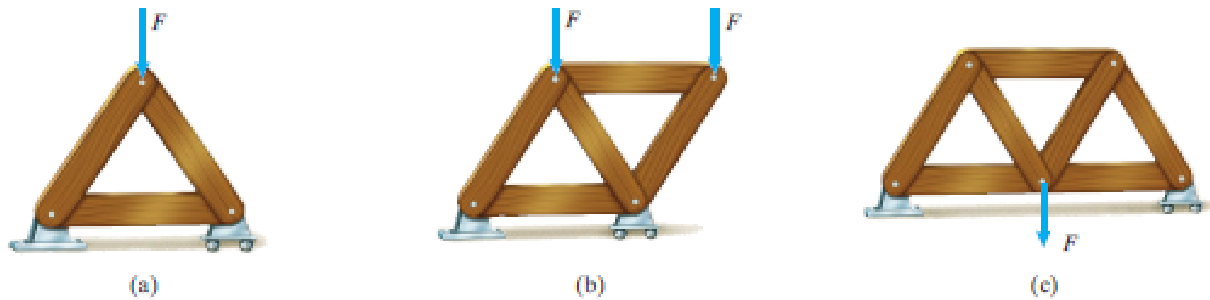



**Figure 6.2**
Making structures by pinning bars together to form triangles.

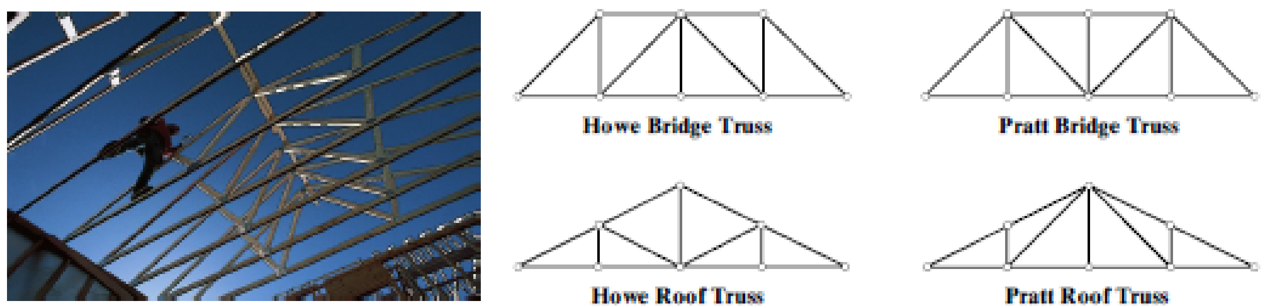



**Figure 6.3**
Simple examples of bridge and roof structures. (The lines represent members, the circles represent joints.)

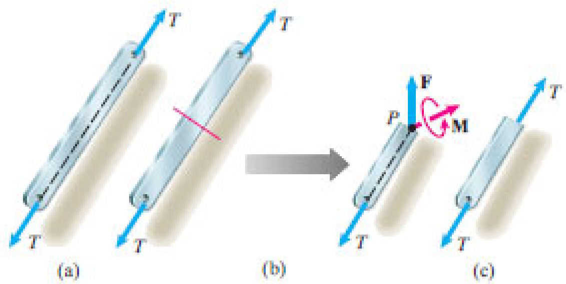
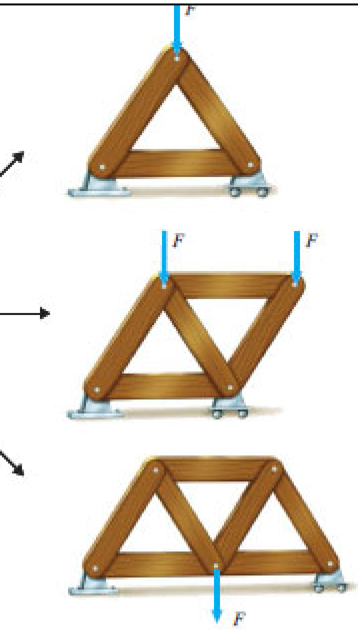



**Figure 6.4**
**(a)** Each member of a truss is a two-force member.
**(b)** Obtaining the free-body diagram of part of the member.
**(c)** The internal force is equal and opposite to the force acting at the joint, and the internal couple is zero.

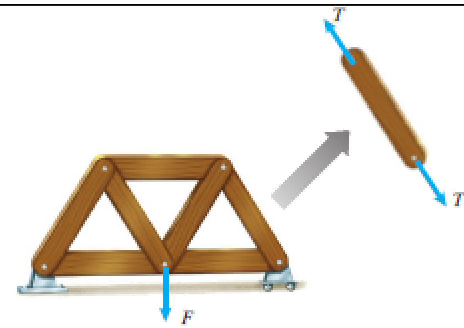
**Figure 6.5**
A joint of a bridge truss.

Although many actual structures, including roof trusses and bridge trusses, consist of bars connected at the ends, very few have pinned joints.
For example, a joint of a bridge truss is shown in Fig. 6.5. The ends of the members are welded at the joint and are not free to rotate. It is obvious that such a joint can exert couples on the members. Why are these structures called trusses?
The reason is that they are designed to function as trusses, meaning that they support loads primarily by subjecting their members to axial forces. They can usually be *modeled* as trusses, treating the joints as pinned connections under the assumption that couples they exert on the members are small in comparison to axial forces. When we refer to structures with riveted joints as trusses in problems, we mean that you can model them as trusses.

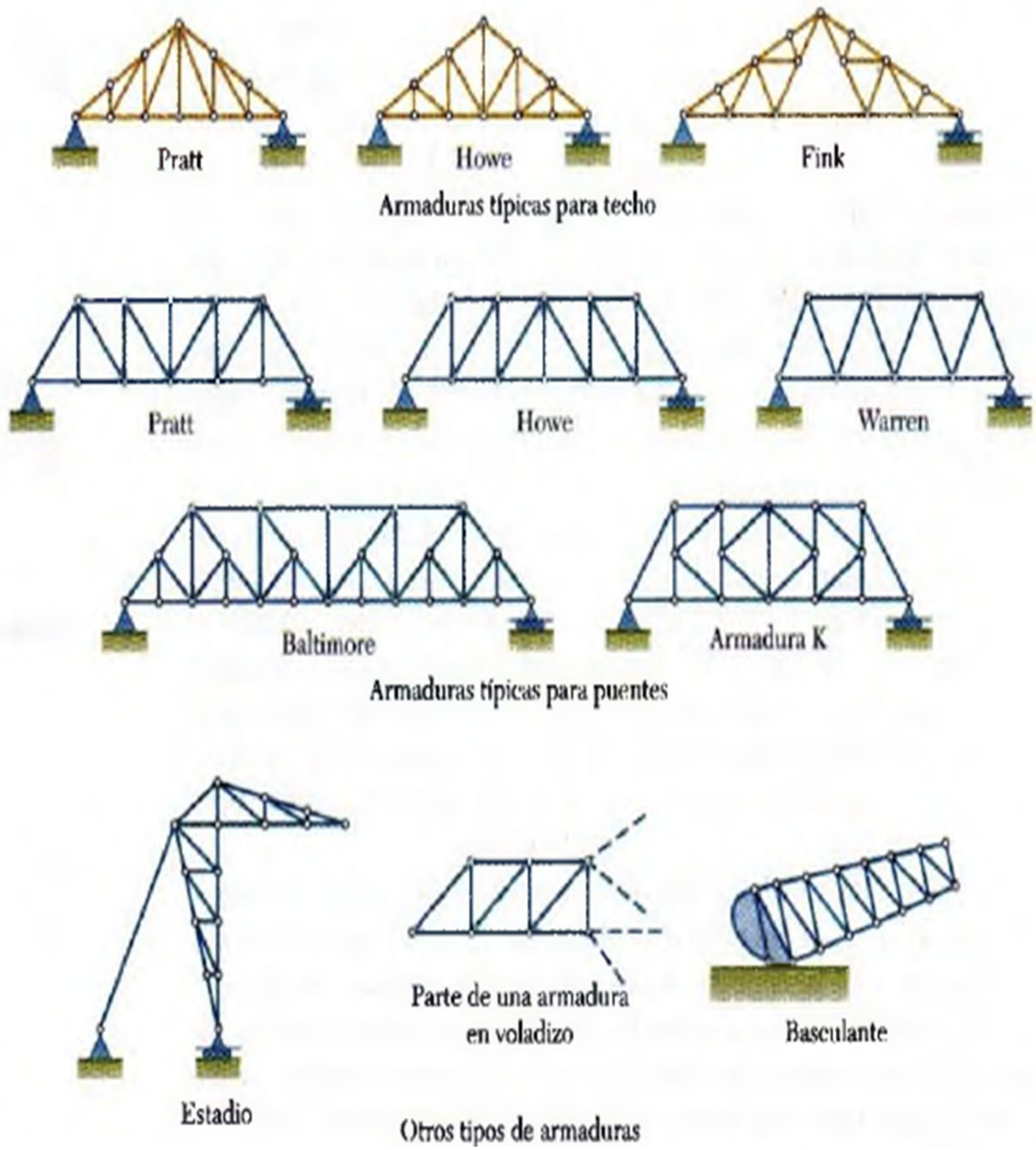
**Trusses**
Structures that consist of straight bars pinned at the ends and are supported and loaded only at the *joints* where the members are connected are called *trusses*. It is assumed that the weights of the members are negligible in comparison to the applied loads.



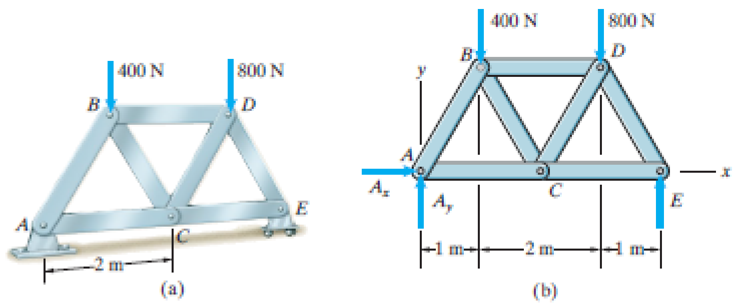

**Free-Body Diagram of an Individual Member**
Because *each member of a truss is a two-force member*, it is subjected only to equal and opposite axial loads. We call the force $T$ the *axial force* in a member. When $T$ is positive in the direction shown (that is, when the forces are directed away from each other), the member is in *tension* (T). When the forces are directed toward each other, the member is in *compression* (C).

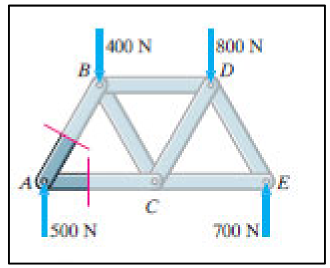


# DISTINTOS TIPOS DE RETICULADOS PLANOS



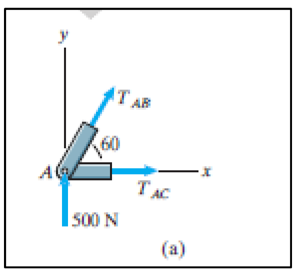
# *Metodo de los Nodos*

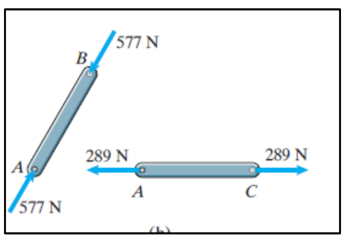


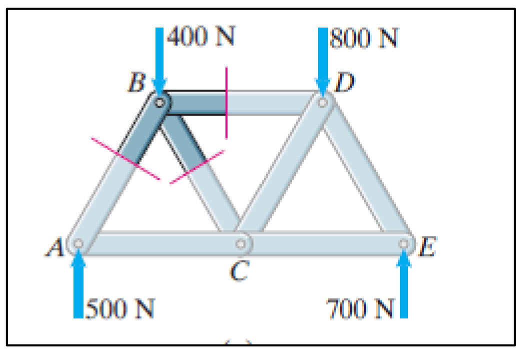



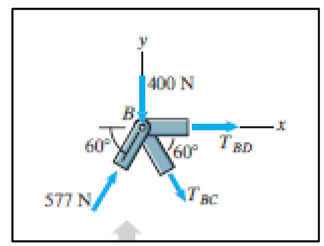

$$\Sigma F_x = A_x = 0,$$
$$\Sigma F_y = A_y + E - 400\ \text{N} - 800\ \text{N} = 0,$$
$$\Sigma M_{\text{point } A} = -(1\ \text{m})(400\ \text{N}) - (3\ \text{m})(800\ \text{N}) + (4\ \text{m})E = 0,$$

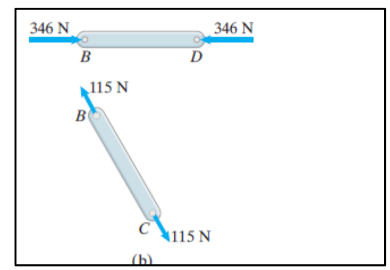
e obtain the reactions $A_x = 0$, $A_y = 500$ N, and $E = 700$ N.




The equilibrium equations for joint *A* are

$$\Sigma F_x = T_{AC} + T_{AB} \cos 60^\circ = 0,$$
$$\Sigma F_y = T_{AB} \sin 60^\circ + 500\ \text{N} = 0.$$

Solving these equations, we obtain the axial forces $T_{AB} = -577$ N and $T_{AC} = 289$ N. Member *AB* is in compression, and member *AC* is in tension

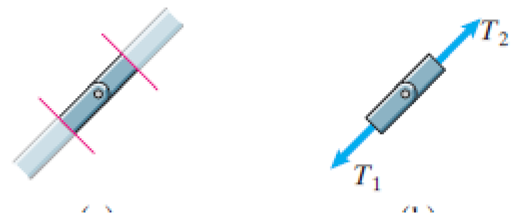
We next obtain a free-body diagram of joint *B* by cutting members *AB*, *BC*, and *BD* (Fig. 6.8a). From the equilibrium equations for joint *B*,

$$\Sigma F_x = T_{BD} + T_{BC} \cos 60^\circ + 577 \cos 60^\circ\ \text{N} = 0,$$
$$\Sigma F_y = -400\ \text{N} + 577 \sin 60^\circ\ \text{N} - T_{BC} \sin 60^\circ = 0,$$

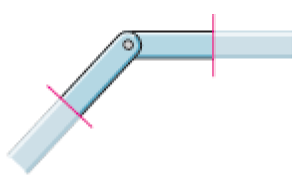
we obtain $T_{BC} = 115$ N and $T_{BD} = -346$ N. Member *BC* is in tension, and member *BD* is in compression (Fig. 6.8b). By continuing to draw free-body diagrams of the joints, we can determine the axial forces in all of the members.

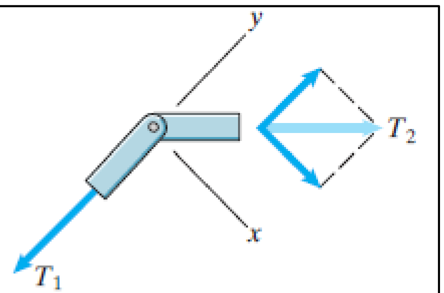
# *Metodo de los Nodos*

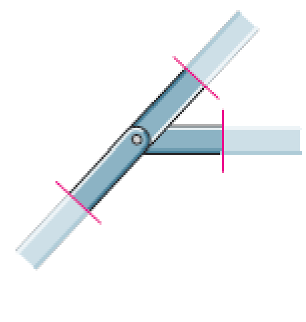
- **Truss joints with two collinear members and no load** (Fig. 6.9). The sum of the forces must equal zero, $T_1 = T_2$. The axial forces are equal.
- **Truss joints with two noncollinear members and no load** (Fig. 6.10). Because the sum of the forces in the $x$ direction must equal zero, $T_2 = 0$. Therefore $T_1$ must also equal zero. The axial forces are zero.
- **Truss joints with three members, two of which are collinear, and no load** (Fig. 6.11). Because the sum of the forces in the $x$ direction must equal zero, $T_3 = 0$. The sum of the forces in the $y$ direction must equal zero, so $T_1 = T_2$. The axial forces in the collinear members are equal, and the axial force in the third member is zero.

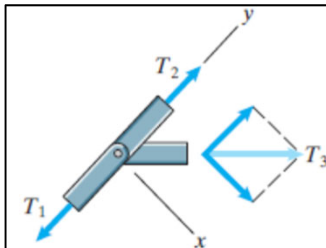



(a) A joint with two collinear members and no load.
(b) Free-body diagram of the joint.

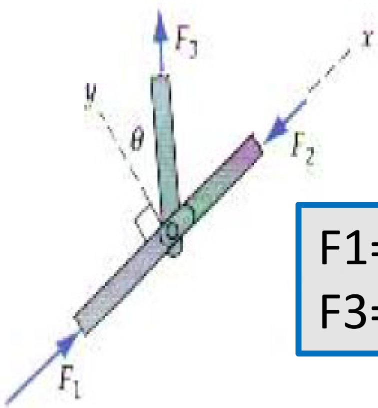




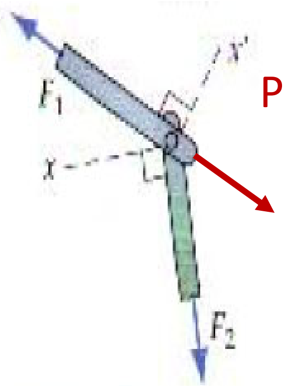





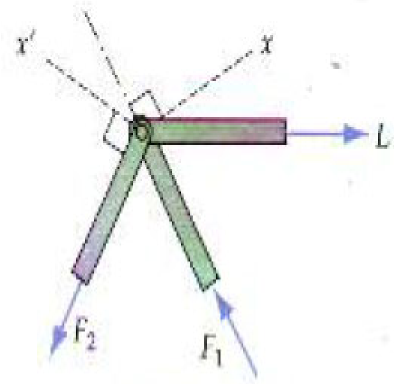
# BARRAS INACTIVAS y CASOS PARTICULARES

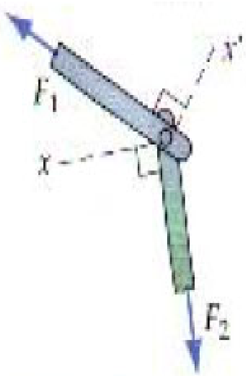



F1=F2
F3=0

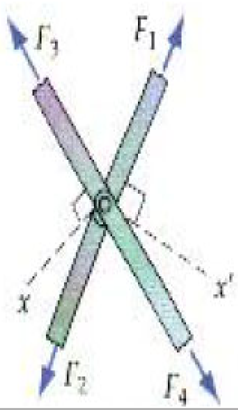



F1= P
F2=0




F1=0
F2=0

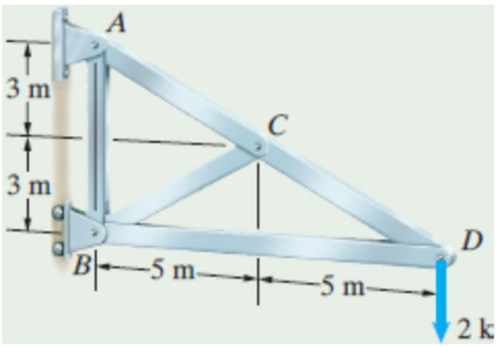


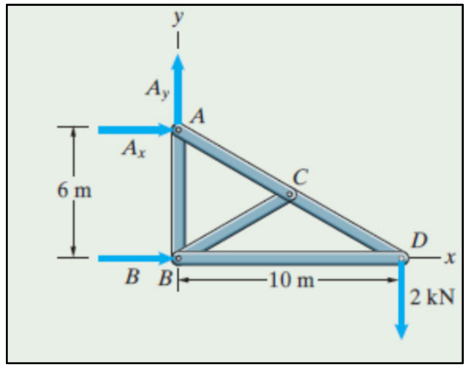

F1= F2
F3= F4

ELECCIÓN DE EJES CONVENIENTES, OBTENCIÓN DE UN SISTEMA DE ECUACIONES DESACOPLADAS

*Metodo de los Nodos*

Determine the axial forces in members *AB* and *AC* of the truss.



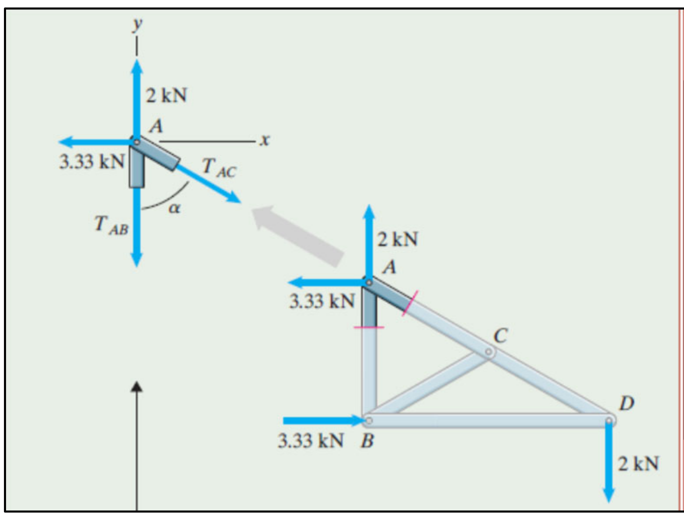




$\Sigma F_x = A_x + B = 0,$

$\Sigma F_y = A_y - 2 \text{ kN} = 0,$

$\Sigma M_{\text{point } B} = -(6 \text{ m}) A_x - (10 \text{ m})(2 \text{ kN}) = 0.$

Solving yields $A_x = -3.33$ kN, $A_y = 2$ kN, and $B = 3.33$ kN.




The angle $\alpha = \arctan(5/3) = 59.0°$.

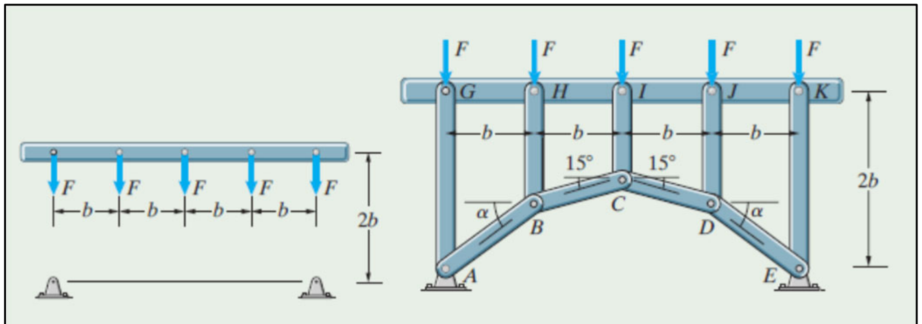
$\Sigma F_x = T_{AC} \sin\alpha - 3.33 \text{ kN} = 0,$

$\Sigma F_y = 2 \text{ kN} - T_{AB} - T_{AC} \cos\alpha = 0.$

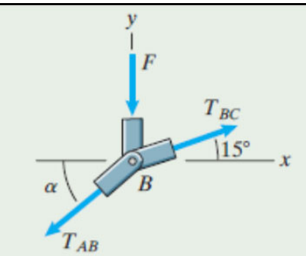
Solving yields $T_{AB} = 0$ and $T_{AC} = 3.89$ kN. The axial force in member *AB* is zero and the axial force in member *AC* is 3.89 kN in tension, which we write as

*AB*: zero, *AC*: 3.89 kN (T).

The loads a bridge structure must support and pin supports where the structure is to be attached are shown in Fig. 1. Assigned to design the structure, a civil engineering student proposes the structure shown in Fig. 2. What are the axial forces in the members?




(1) (2)




(a) Free-body diagram of joint *B*.

| Members | Axial Force |
|---|---|
| *AG*, *BH*, *CI*, *DJ*, *EK* | *F* (C) |
| *AB*, *DE* | 2.39*F* (C) |
| *BC*, *CD* | 1.93*F* (C) |

From the equilibrium equations

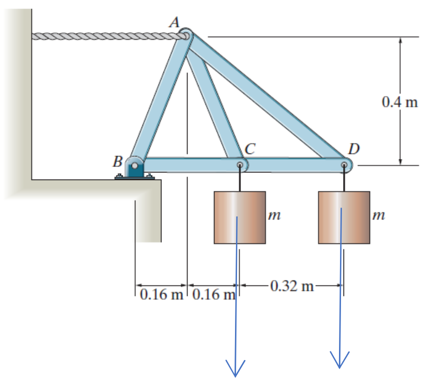
$$\Sigma F_x = -T_{AB}\cos\alpha + T_{BC}\cos 15^\circ = 0,$$

$$\Sigma F_y = -T_{AB}\sin\alpha + T_{BC}\sin 15^\circ - F = 0,$$

we obtain $T_{AB} = -2.39F$ and $\alpha = 38.8^\circ$. By symmetry, $T_{DE} = T_{AB}$. The axial forces in the members are shown in the table.

# Método de los nudos

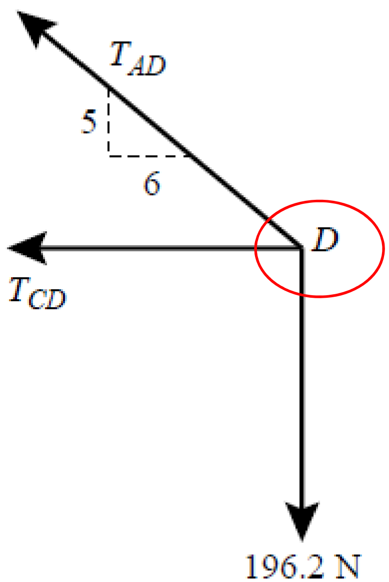
m=20 kg => P=196.2 N




$$\sum F_y : \frac{5}{\sqrt{61}} T_{AD} - 196.2 \text{ N} = 0$$

$$\sum F_x : -\frac{6}{\sqrt{61}} T_{AD} - T_{CD} = 0$$

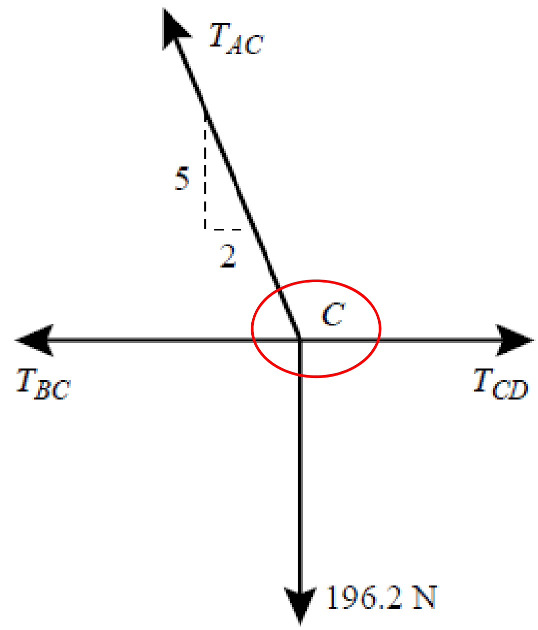
Solving: $T_{AD} = 306 \text{ N}, \ T_{CD} = -235 \text{ N}$




$$\sum F_y : \frac{5}{\sqrt{29}} T_{AC} - 196.2 \text{ N} = 0$$

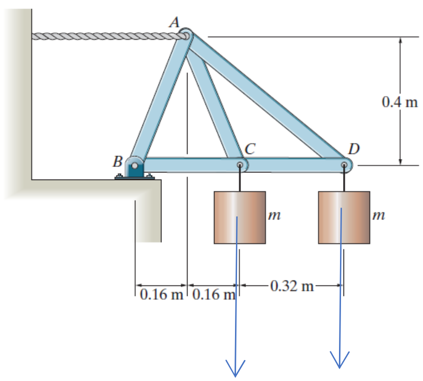
$$\sum F_x : -\frac{2}{\sqrt{29}} T_{AC} - T_{BC} + T_{CD} = 0$$

Solving: $T_{AC} = 211 \text{ N}, \ T_{BC} = -313 \text{ N}$



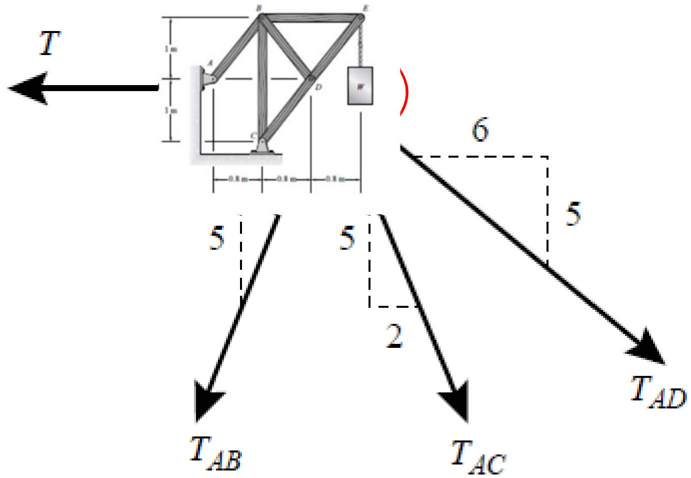
# Método de los nudos

m=20 kg => P=196.2 N




$$\sum F_y : -\frac{5}{\sqrt{29}}(T_{AB}+T_{AC}) - \frac{5}{\sqrt{61}}T_{AD} = 0$$

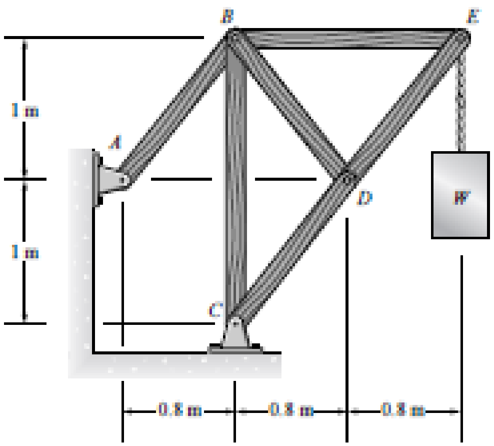
$$\Rightarrow T_{AB} = -423 \text{ N}$$




$$T_{AB} = 423 \text{ N}(C)$$
$$T_{AC} = 211 \text{ N}(T)$$
$$T_{AD} = 306 \text{ N}(T)$$
$$T_{BC} = 314 \text{ N}(C)$$
$$T_{CD} = 235 \text{ N}(C)$$

# Metodo de los Nodos

38.66 Dada la Estructura de la Figura, establezca cual es la maxima carga que soporta si la maxima fuerza en traccion de las barras es 5 kN, y la maxima fuerza en compression es 7 kN




*Joint B*:

$$\sum F_x = BE - AB \sin\alpha - BD \sin\alpha = 0,$$

from which $\boxed{AB = \dfrac{BE}{\sin\alpha} = 1.28W(T)}$

$$\sum F_y = -AB \cos\alpha - BC = 0,$$

from which $\boxed{BC = -AB\cos\alpha = -W(C)}$

-

*Joint E*:

$$\sum F_y = -DE \cos\alpha - W = 0,$$

from which $\boxed{DE = -1.28W\ (C)}$.

$$\sum F_y = -BE - DE \sin\alpha = 0,$$

from which $\boxed{BE = 0.8W\ (T)}$

*Joint D*:

$$\sum F_x = DE \cos\alpha + BD \cos\alpha - CD \cos\alpha = 0,$$

from which $BD - CD = -DE$.

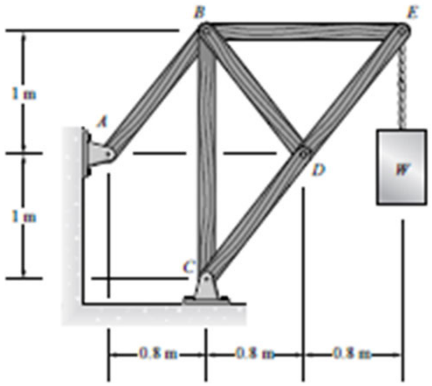
$$\sum F_y = -BD \sin\alpha + DE \sin\alpha - CD \sin\alpha = 0,$$

from which $BD + CD = DE$.

Solving these two equations in two unknowns:

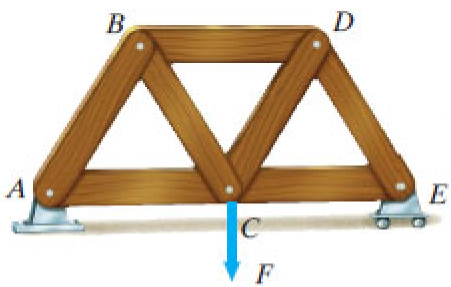
$\boxed{CD = DE = -1.28W\ (C)}$, $\boxed{BD = 0}$

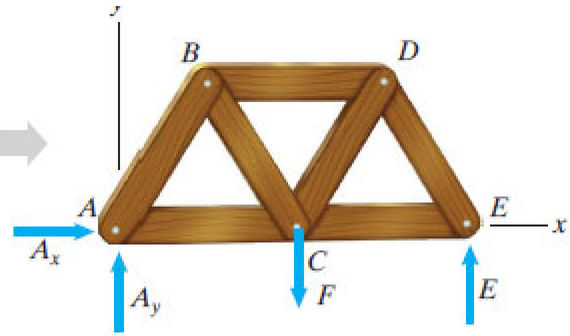
# *Metodo de los Nodos*

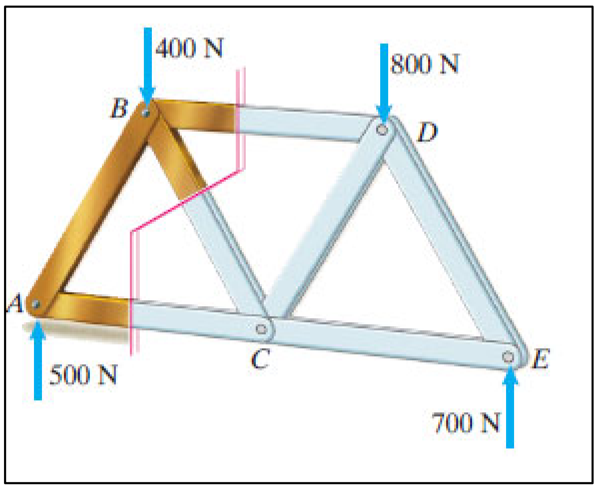


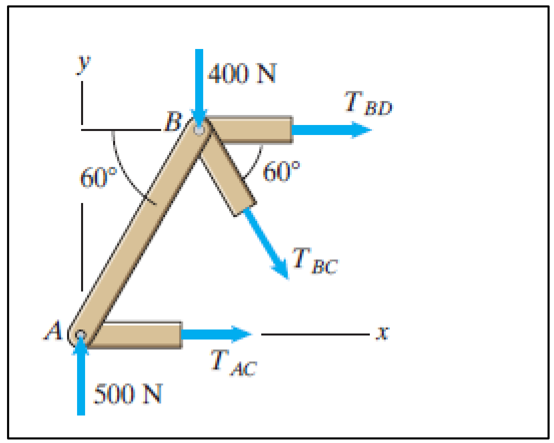

| | | | | F admisible | W max |
|---|---|---|---|---|---|
| AB | 1.28 W | T | 1.28 | 5 | 3.90625 |
| BC | W | C | -1 | | |
| CD | 1.28W | C | -1.28 | | |
| DE | 1.28W | C | -1.28 | -7 | 5.46875 |
| BE | 0.8 W | T | 0.8 | | |

# *Método de las Secciones*

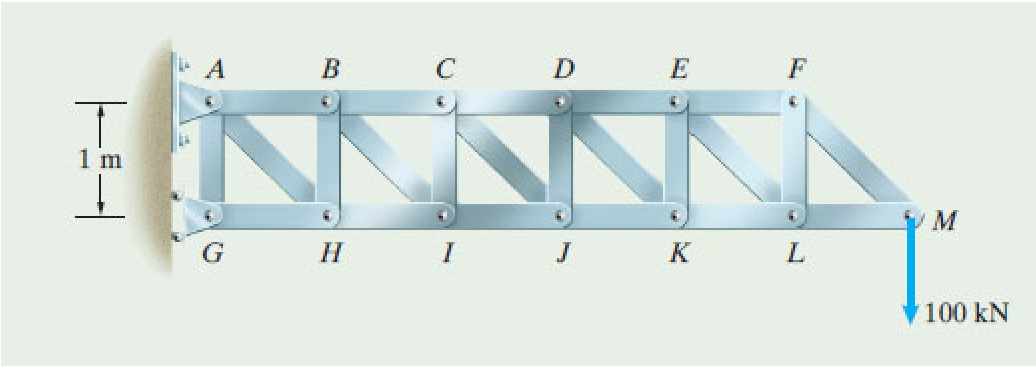


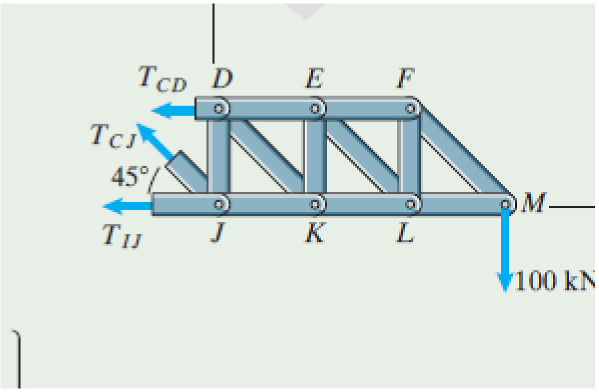



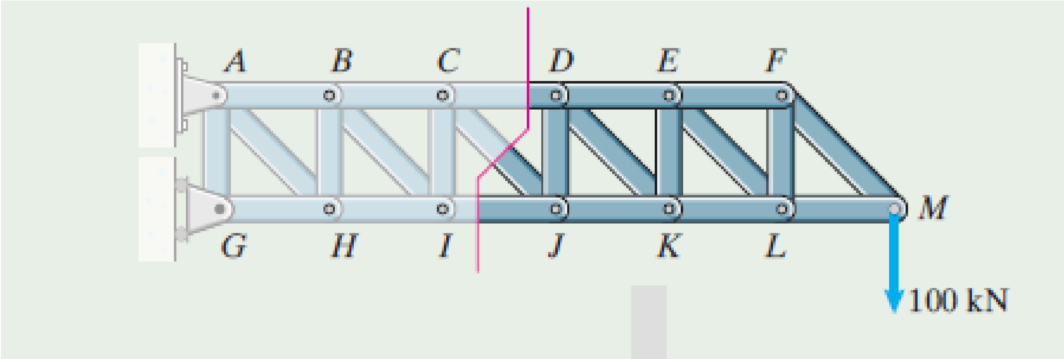



The horizontal members of the truss are each 1 m in length. Determine the axial forces in members *CD*, *CJ*, and *IJ*.



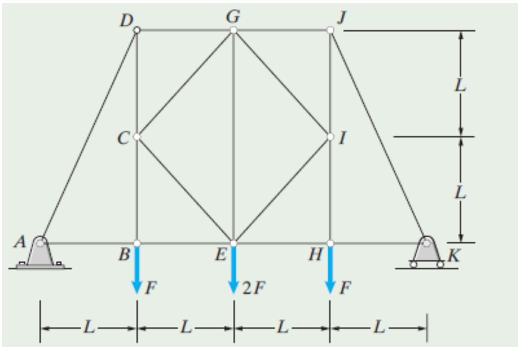

$$\Sigma F_x = -T_{CD} - T_{CJ}\cos 45^\circ - T_{IJ} = 0,$$

$$\Sigma F_y = T_{CJ}\sin 45^\circ - 100 \text{ kN} = 0,$$

$$\Sigma M_{\text{point } J} = (1 \text{ m})T_{CD} - (3 \text{ m})(100 \text{ kN}) = 0.$$

Solving yields $T_{CD} = 300$ kN, $T_{CJ} = 141$ kN, and $T_{IJ} = -400$ kN. The axial loads are *CD*: 300 kN (T), *CJ*: 141 kN (T), *IJ*: 400 kN (C).

Determine the axial forces in members $DG$ and $BE$ of the truss.

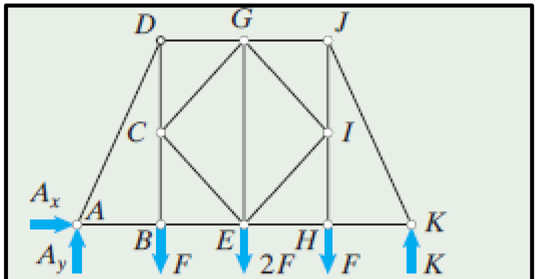



$$\Sigma F_x = A_x = 0,$$

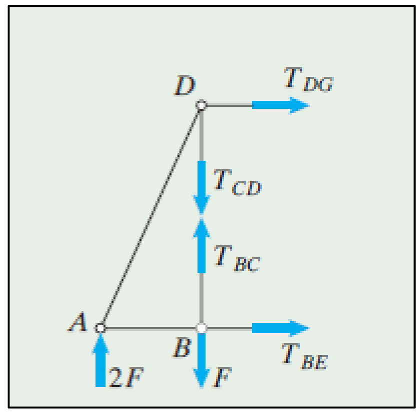
$$\Sigma F_y = A_y + K - F - 2F - F = 0,$$

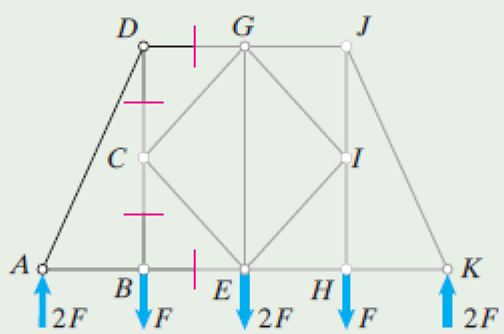
$$\Sigma M_{\text{point } A} = -LF - (2L)(2F) - (3L)F + (4L)K = 0,$$

we obtain the reactions $A_x = 0$, $A_y = 2F$, and $K = 2F$.




**(a)** Free-body diagram of the entire truss.



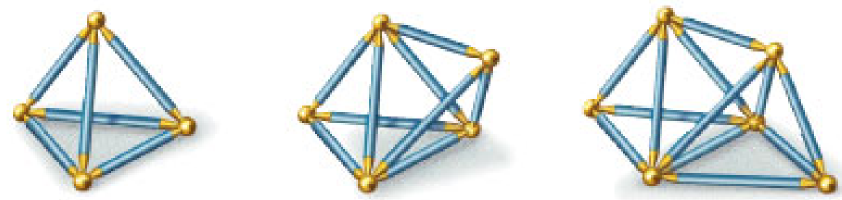

$$\Sigma M_{\text{point } B} = -L(2F) - (2L)T_{DG} = 0.$$

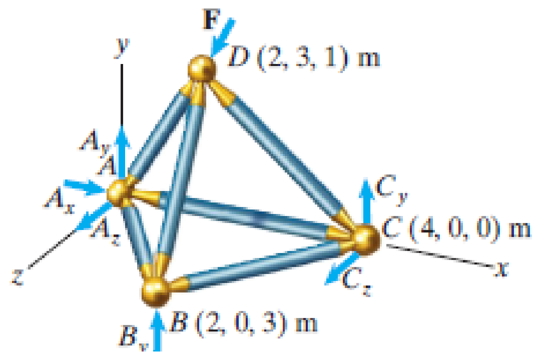
The axial force $T_{DG} = -F$. Then, from the equilibrium equation

$$\Sigma F_x = T_{DG} + T_{BE} = 0,$$

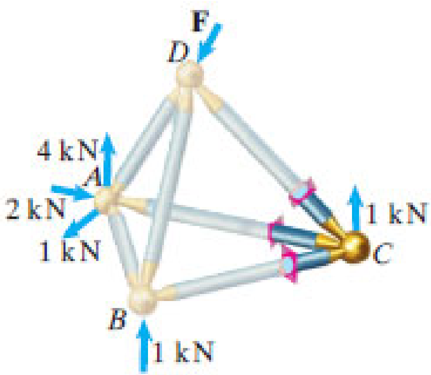
we see that $T_{BE} = -T_{DG} = F$. Member $DG$ is in compression, and member $BE$ is in tension.

# Reticulados Espaciales



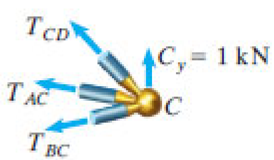



$$\Sigma F_x = A_x - 2 = 0,$$
$$\Sigma F_y = A_y + B_y + C_y - 6 = 0,$$
$$\Sigma F_z = A_z + C_z - 1 = 0,$$
$$\Sigma M_{\text{point } A} = (\mathbf{r}_{AB} \times B_y \mathbf{j}) + [\mathbf{r}_{AC} \times (C_y \mathbf{j} + C_z \mathbf{k})] + (\mathbf{r}_{AD} \times \mathbf{F})$$
$$= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & 0 & 3 \\ 0 & B_y & 0 \end{vmatrix} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 4 & 0 & 0 \\ 0 & C_y & C_z \end{vmatrix} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & 3 & 1 \\ -2 & -6 & -1 \end{vmatrix}$$
$$= (-3B_y + 3)\mathbf{i} + (-4C_z)\mathbf{j}$$
$$+ (2B_y + 4C_y - 6)\mathbf{k} = 0.$$




$$\mathbf{r}_{CB} = (2 - 4)\mathbf{i} + (0 - 0)\mathbf{j} + (3 - 0)\mathbf{k} = -2\mathbf{i} + 3\mathbf{k}\,(\text{m}).$$
$$\mathbf{e}_{CB} = \frac{\mathbf{r}_{CB}}{|\mathbf{r}_{CB}|} = -0.555\mathbf{i} + 0.832\mathbf{k},$$

$$T_{BC}\,\mathbf{e}_{CB} = T_{BC}(-0.555\mathbf{i} + 0.832\mathbf{k}).$$
$$T_{CD}(-0.535\mathbf{i} + 0.802\mathbf{j} + 0.267\mathbf{k}).$$

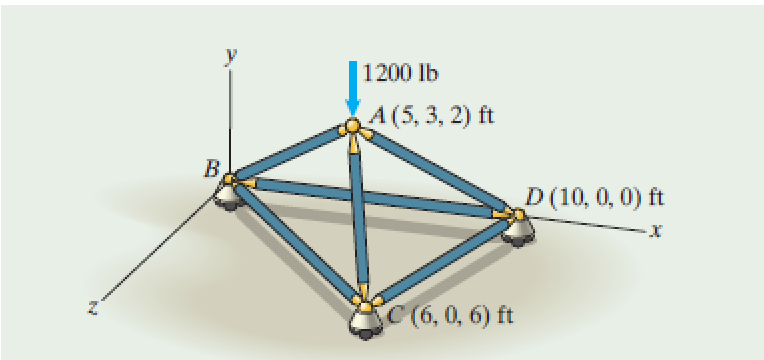


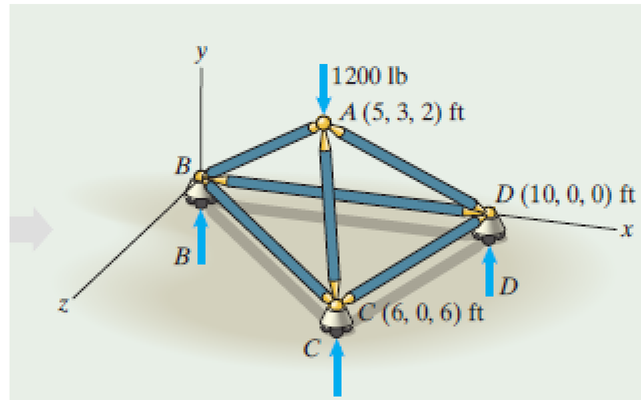
(c)

$$-T_{AC}\,\mathbf{i} + T_{BC}(-0.555\mathbf{i} + 0.832\mathbf{k})$$
$$+T_{CD}(-0.535\mathbf{i} + 0.802\mathbf{j} + 0.267\mathbf{k}) + (1\text{ kN})\,\mathbf{j} = 0,$$

$$\Sigma F_x = -T_{AC} - 0.555T_{BC} - 0.535T_{CD} = 0,$$
$$\Sigma F_y = 0.802T_{CD} + 1\text{ kN} = 0,$$
$$\Sigma F_z = 0.832T_{BC} + 0.267T_{CD} = 0.$$

Calcular los esfuerzos en AD, BD, y CD



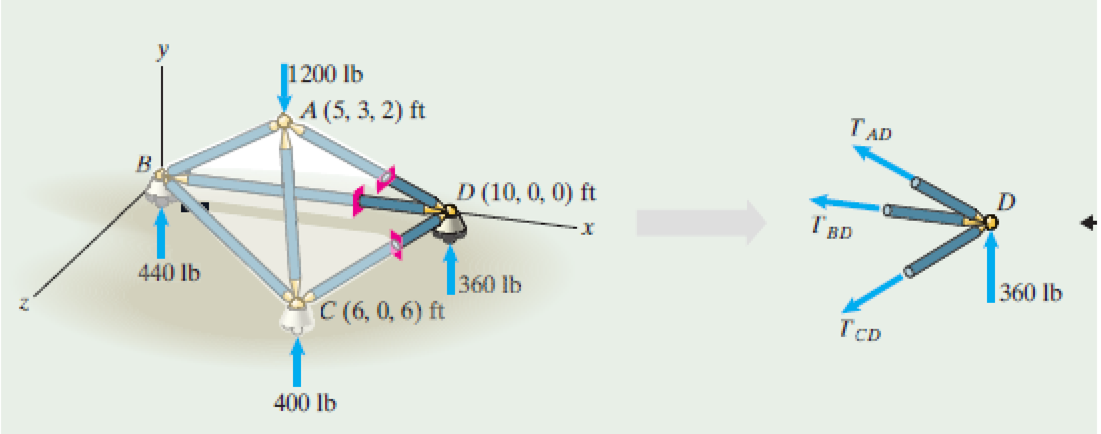

$$\Sigma F_y = B + C + D - 1200 \text{ lb} = 0,$$

$$\Sigma M_{\text{point } B} = \mathbf{r}_{BA} \times [-1200\mathbf{j}\,(\text{lb})] + \mathbf{r}_{BC} \times C\mathbf{j} + \mathbf{r}_{BD} \times D\mathbf{j}$$

$$= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 5 & 3 & 2 \\ 0 & -1200 & 0 \end{vmatrix} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 6 & 0 & 6 \\ 0 & C & 0 \end{vmatrix} + \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 10 & 0 & 0 \\ 0 & D & 0 \end{vmatrix}$$

$$= (2400 - 6C)\mathbf{i} + (-6000 + 6C + 10D)\mathbf{k} = 0.$$

Solving yields $B = 440$ lb, $C = 400$ lb, and $D = 360$ lb.




$$\mathbf{r}_{DA} = -5\mathbf{i} + 3\mathbf{j} + 2\mathbf{k} \text{ (ft)}.$$

$$\mathbf{e}_{DA} = \frac{\mathbf{r}_{DA}}{|\mathbf{r}_{DA}|} = -0.811\mathbf{i} + 0.487\mathbf{j} + 0.324\mathbf{k}.$$

$$T_{AD}\mathbf{e}_{DA} = T_{AD}(-0.811\mathbf{i} + 0.487\mathbf{j} + 0.324\mathbf{k}),$$

$$T_{BD}\mathbf{e}_{DB} = -T_{BD}\mathbf{i},$$

$$T_{CD}\mathbf{e}_{DC} = T_{CD}(-0.555\mathbf{i} + 0.832\mathbf{k}).$$

$$T_{AD}\mathbf{e}_{DA} + T_{BD}\mathbf{e}_{DB} + T_{CD}\mathbf{e}_{DC} + (360 \text{ lb})\mathbf{j} = 0.$$

The **i**, **j**, and **k** components of this equation must each equal zero, resulting in the three equations

$$-0.811T_{AD} - T_{BD} - 0.555T_{CD} = 0,$$

$$0.487T_{AD} + 360 \text{ lb} = 0,$$

$$0.324T_{AD} + 0.832T_{CD} = 0.$$

Solving yields $T_{AD} = -740$ lb, $T_{BD} = 440$ lb, and $T_{CD} = 288$ lb. The axial forces are *AD*: 740 lb (C), *BD*: 440 lb (T), *CD*: 288 lb (T).

**Problem 6.66** The free-body diagram of the part of the construction crane to the left of the plane is shown. The coordinates (in meters) of the joints $A$, $B$, and $C$ are (1.5, 1.5, 0), (0, 0, 1), and (0, 0, −1), respectively. The axial forces $P_1$, $P_2$, and $P_3$ are parallel to the $x$ axis. The axial forces $P_4$, $P_5$, and $P_6$ point in the directions of the unit vectors

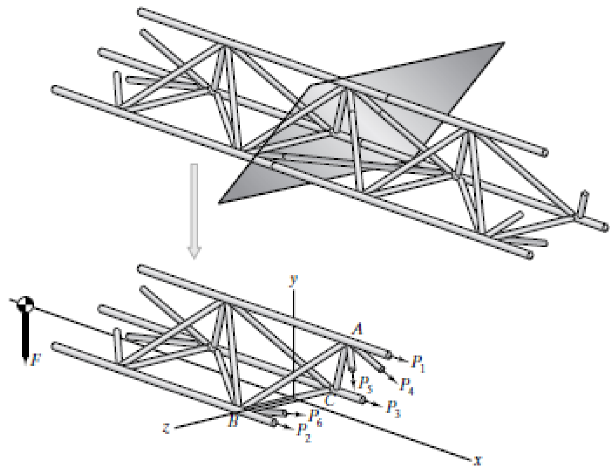
$$\mathbf{e}_4 = 0.640\mathbf{i} - 0.640\mathbf{j} - 0.426\mathbf{k},$$

$$\mathbf{e}_5 = 0.640\mathbf{i} - 0.640\mathbf{j} - 0.426\mathbf{k},$$

$$\mathbf{e}_6 = 0.832\mathbf{i} - 0.555\mathbf{k}.$$

The total force exerted on the free-body diagram by the weight of the crane and the load it supports is $-F\mathbf{j} = -44\mathbf{j}$ (kN) acting at the point (−20, 0, 0) m. What is the axial force $P_3$?

**Strategy:** Use the fact that the moment about the line that passes through joints $A$ and $B$ equals zero.




The position vector from $B$ to $A$ is

$$\mathbf{r}_{BA} = 1.5\mathbf{i} + 1.5\mathbf{j} - \mathbf{k} \text{ (m)},$$

and the unit vector that points from $B$ toward $A$ is

$$\mathbf{e}_{BA} = \frac{\mathbf{r}_{BA}}{|\mathbf{r}_{BA}|} = 0.640\mathbf{i} + 0.640\mathbf{j} - 0.426\mathbf{k}.$$

$$\mathbf{M}_B = \begin{bmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ -20 & 0 & -1 \\ 0 & -44 & 0 \end{bmatrix} + \begin{bmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 0 & 0 & -2 \\ P_3 & 0 & 0 \end{bmatrix}$$

$$= -44\mathbf{i} - 2P_3\mathbf{j} + 880\mathbf{k} \text{ (kN-m)}.$$

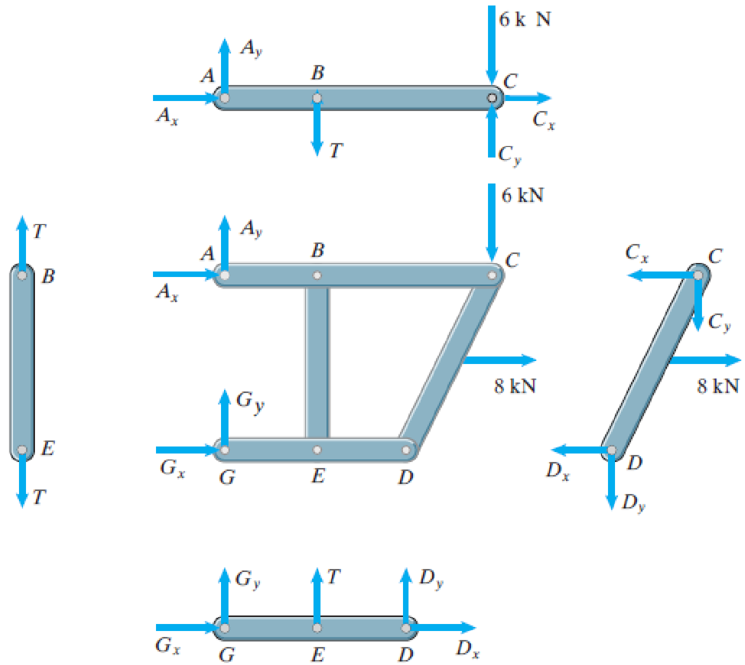
From the condition that

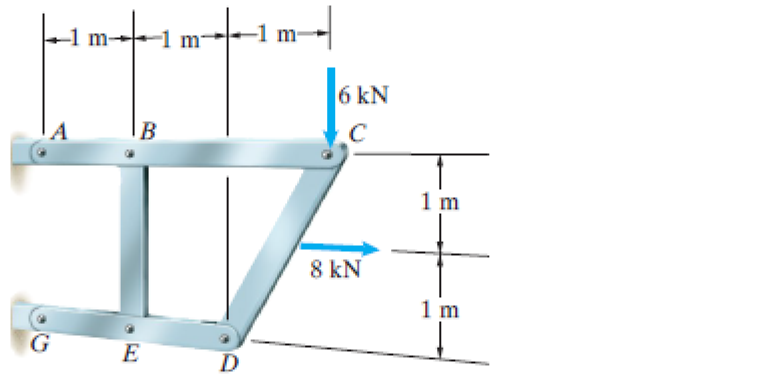
$$\mathbf{e}_{BA} \cdot \mathbf{M}_B = 0.640(-44) + 0.640(-2P_3)$$

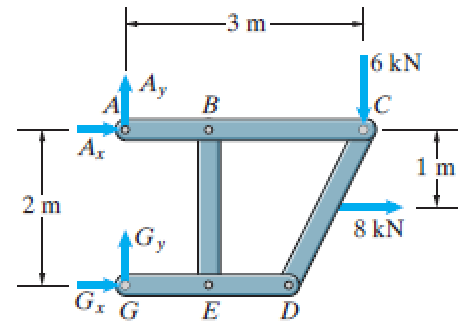
$$- 0.426(880) = 0,$$

we obtain $P_3 = -315$ kN.

# Bastidores y Marcos



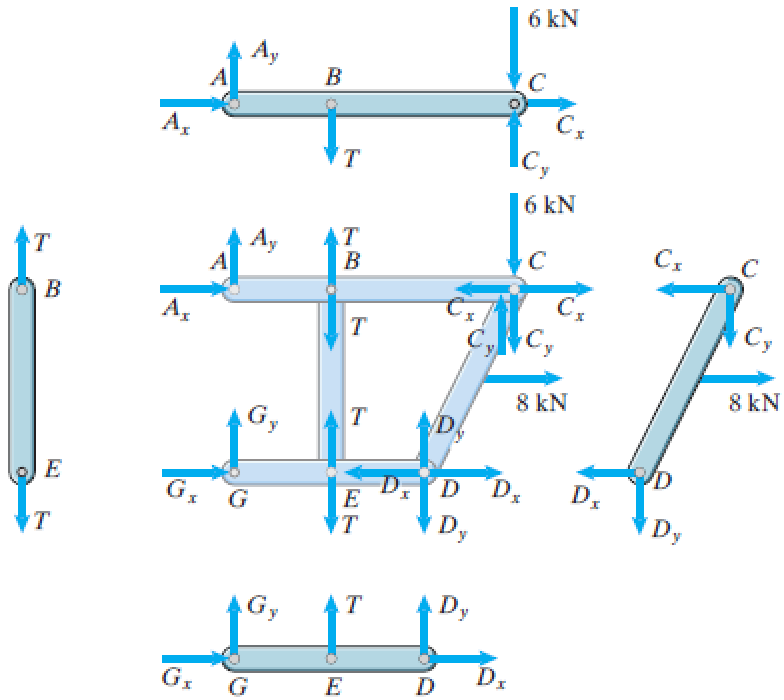

$$\Sigma M_{\text{point } A} = (2\text{ m})G_x + (1\text{ m})(8\text{ kN}) - (3\text{ m})(6\text{ kN}) = 0,$$

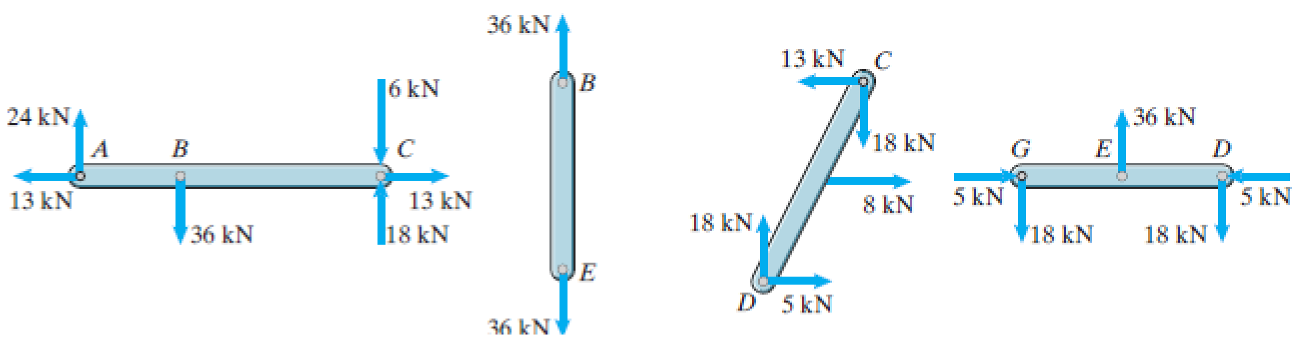
and we obtain the reaction $G_x = 5$ kN. Then, from the equilibrium equation

$$\Sigma F_x = A_x + G_x + 8\text{ kN} = 0,$$

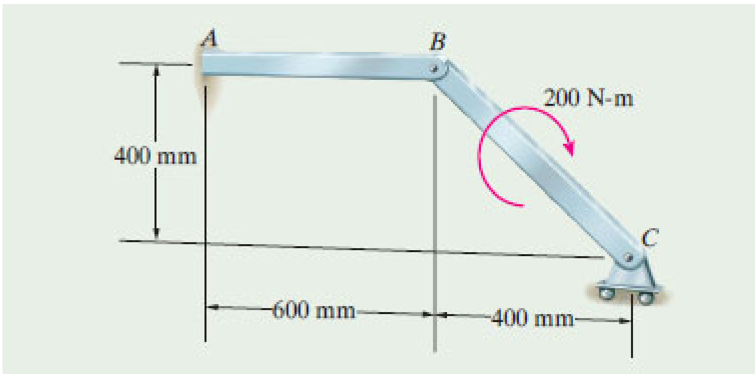
we obtain the reaction $A_x = -13$ kN. Although we cannot determine $A_y$ or $G_y$ from the free-body diagram of the entire structure, we can do so by analyzing the individual members.

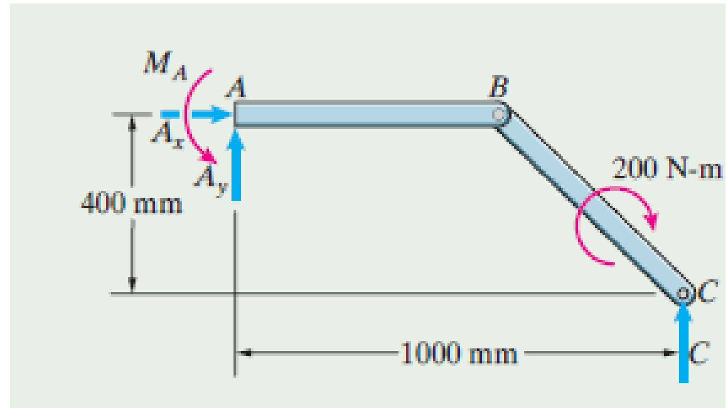
Tengo Ax= -13 y Gx=5

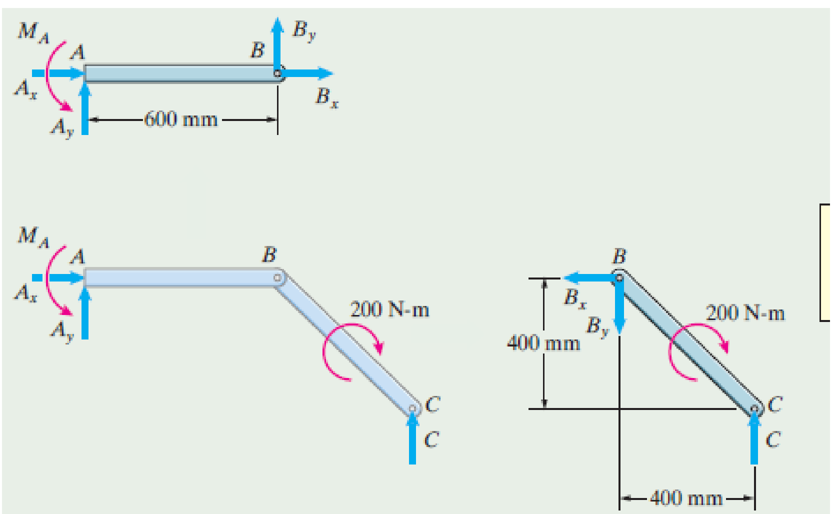


Resuelva



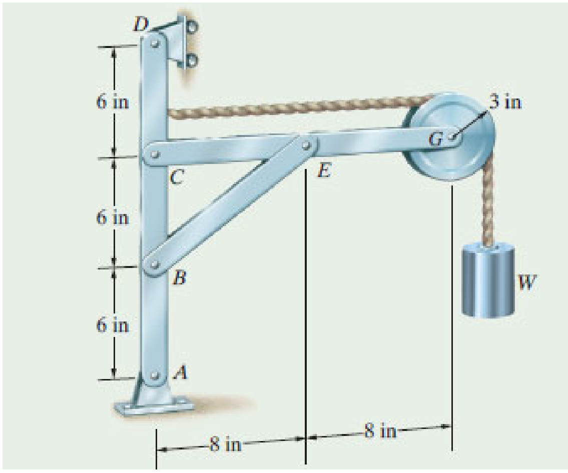



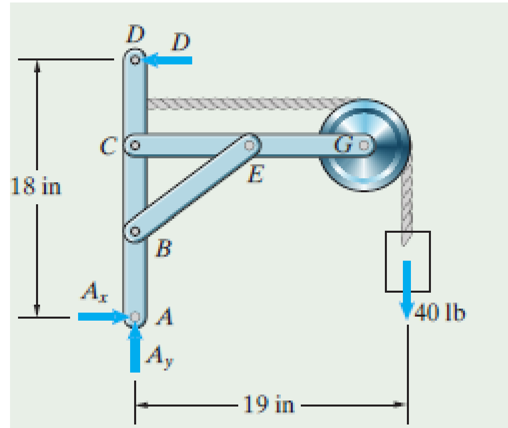

$$\Sigma F_x = A_x = 0,$$

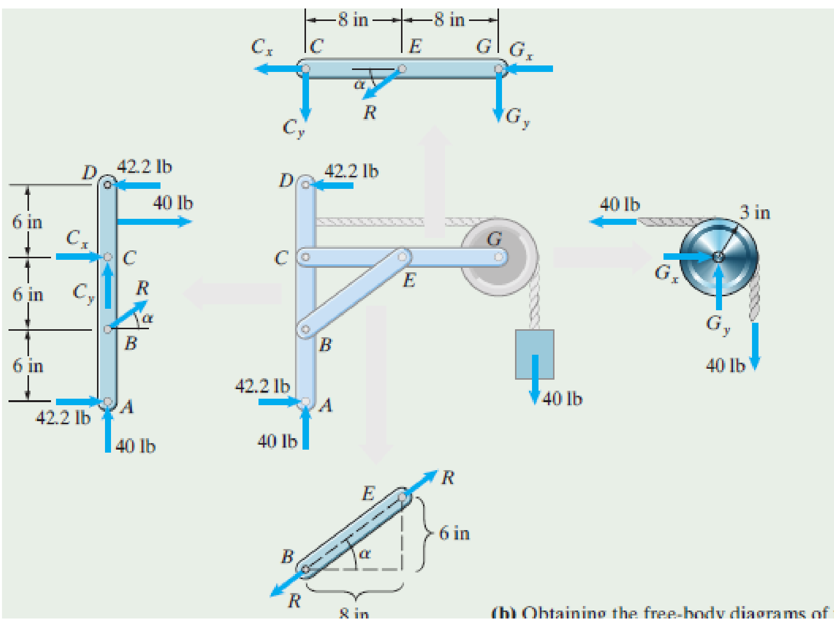
$$\Sigma F_y = A_y + C = 0,$$

$$\Sigma M_{\text{point } A} = M_A - 200 \text{ N-m} + (1.0 \text{ m})C = 0.$$

# *Resuelva*



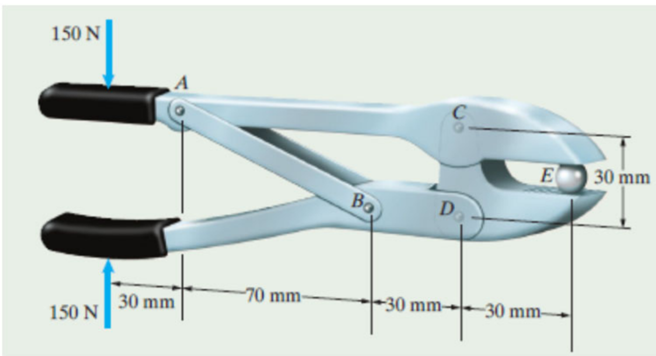



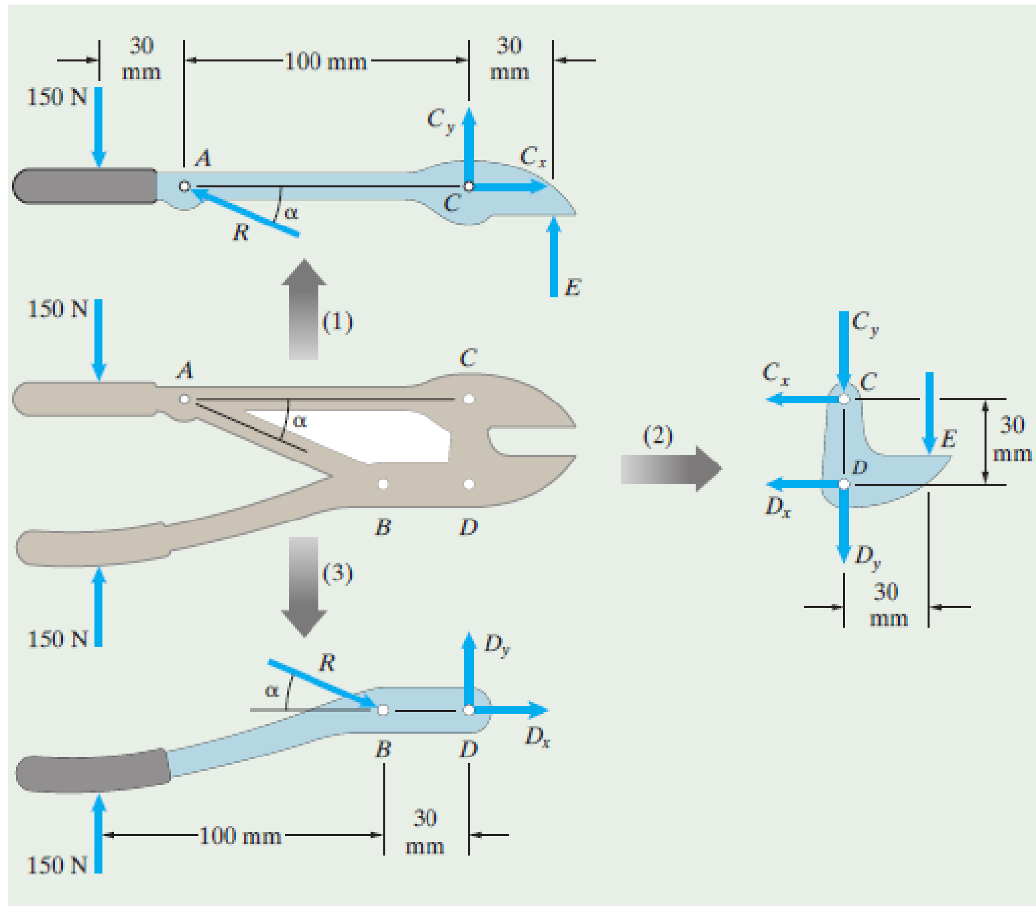




$$\Sigma F_x = A_x - D = 0,$$
$$\Sigma F_y = A_y - 40\text{ lb} = 0,$$
$$\Sigma M_{\text{point }A} = (18\text{ in})D - (19\text{ in})(40\text{ lb}) = 0,$$

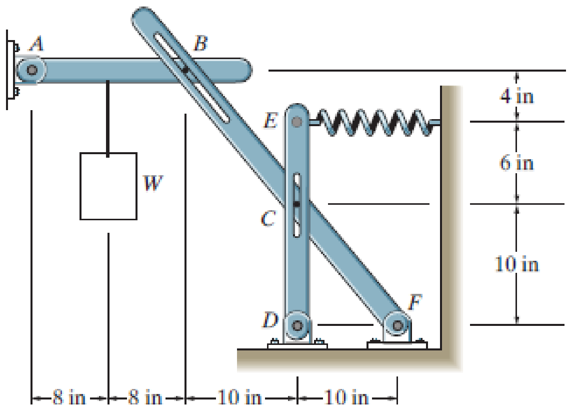
we obtain the reactions $A_x = 42.2$ lb, $A_y = 40$ lb, and $D = 42.2$ lb.

*Resuelva*

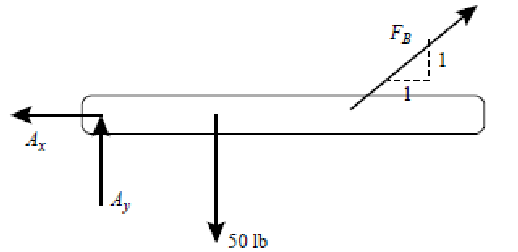

150 N
A
C
E
30 mm
B
D
150 N
30 mm
70 mm
30 mm
30 mm


30
mm
100 mm
30
mm
150 N
$C_y$
$C_x$
A
C
α
R
E
150 N
(1)
A
C
α
(2)
B
D
(3)
150 N
$C_y$
$C_x$
C
E
30
mm
D
$D_x$
$D_y$
30
mm
R
$D_y$
α
B
D
$D_x$
150 N
100 mm
30
mm

# *Calcule la fuerza en el Resorte*




$$\sum M_A : -(50\text{ lb})(8\text{ in}) + \frac{1}{\sqrt{2}} F_B (16\text{ in}) = 0 \Rightarrow F_B = 35.4\text{ lb}$$

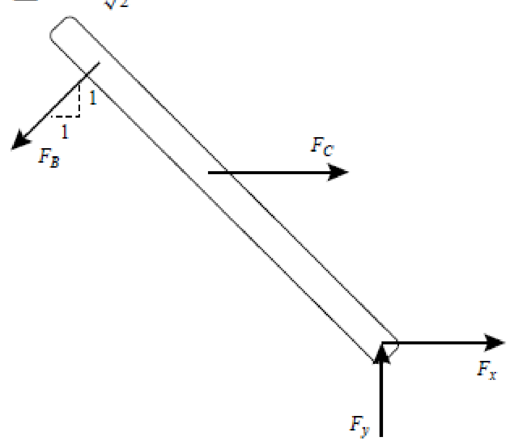



Now examine $BCF$

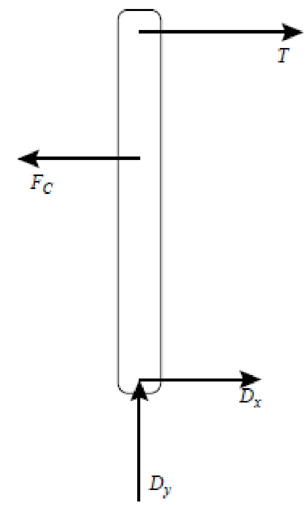
$$\sum M_F : F_B (20\sqrt{2})\text{ in} - F_C (10\text{ in}) = 0 \Rightarrow F_C = 100\text{ lb}$$

$$\sum F_x : -\frac{1}{\sqrt{2}} F_B + F_C + F_x = 0 \Rightarrow F_x = -75\text{ lb}$$

$$\sum F_y : -\frac{1}{\sqrt{2}} F_B + F_y = 0 \Rightarrow F_y = 25\text{ lb}$$



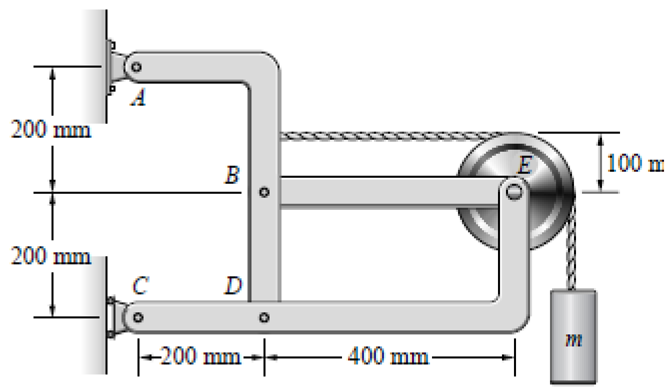

$$\sum M_D : -T(16\text{ in}) + F_C (10\text{ in}) = 0 \Rightarrow T = 62.5\text{ lb}$$



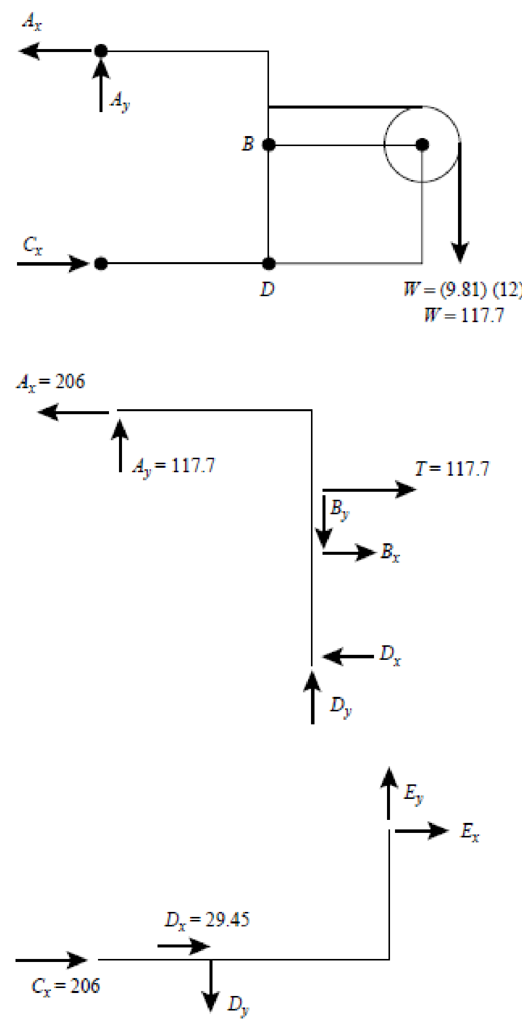

Summary

| |
|---|
| Tension in Spring = 62.5 lb |
| $F_x = 25$ lb, $F_y = -75$ lb |

*Resuelva*

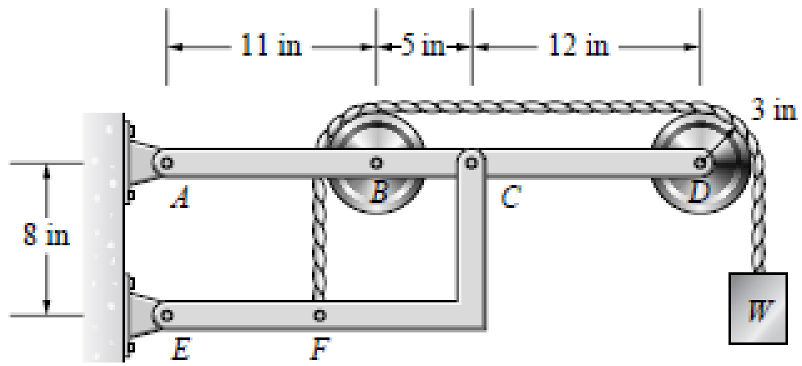


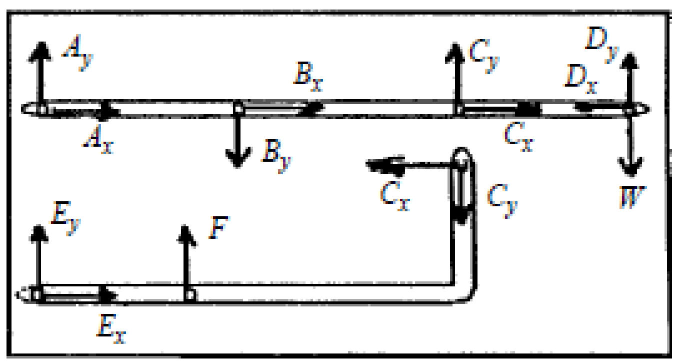
A
200 mm
B
E
100 m
200 mm
C
D
m
200 mm
400 mm

$A_x$
$A_y$
B
$C_x$
D
W = (9.81) (12)
W = 117.7
$A_x = 206$
$A_y = 117.7$
T = 117.7
$B_y$
$B_x$
$D_x$
$D_y$
$E_y$
$E_x$
$D_x = 29.45$
$C_x = 206$
$D_y$

*Resolver*


11 in
5 in
12 in
3 in
8 in
A
B
C
D
E
F
W


$A_y$
$B_x$
$C_y$
$D_y$
$D_x$
$A_x$
$B_y$
$C_x$
$C_x$
$C_y$
$W$
$E_y$
$F$
$E_x$


CHAPA


TAS CHAPA

# Tren de la Costa

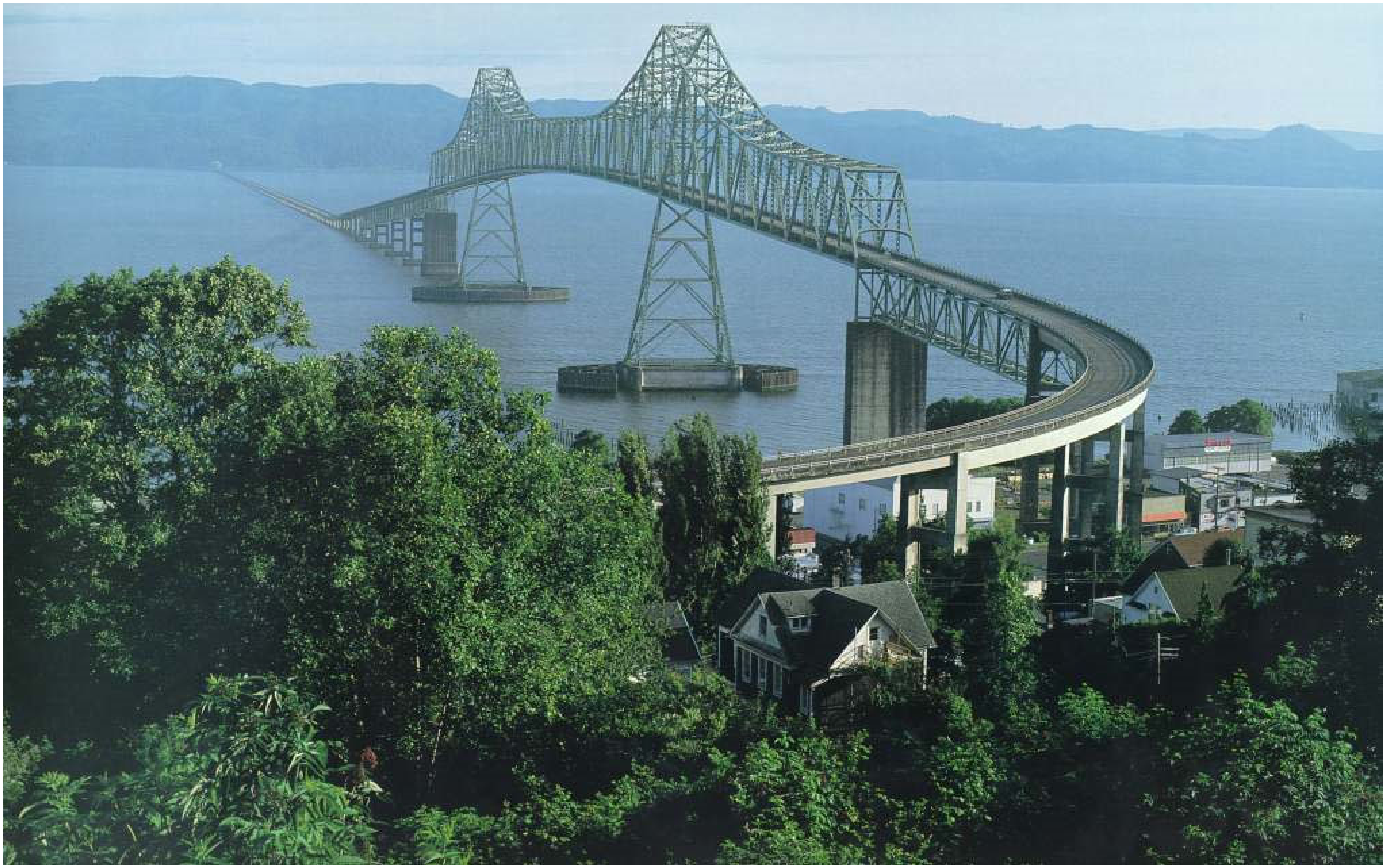

Ferrocarril Belgrano
Quebrada de Humahuaca

**Tren a las Nubes**

**Salta**


**Pte. Dreirosen - Suiza Basilea**

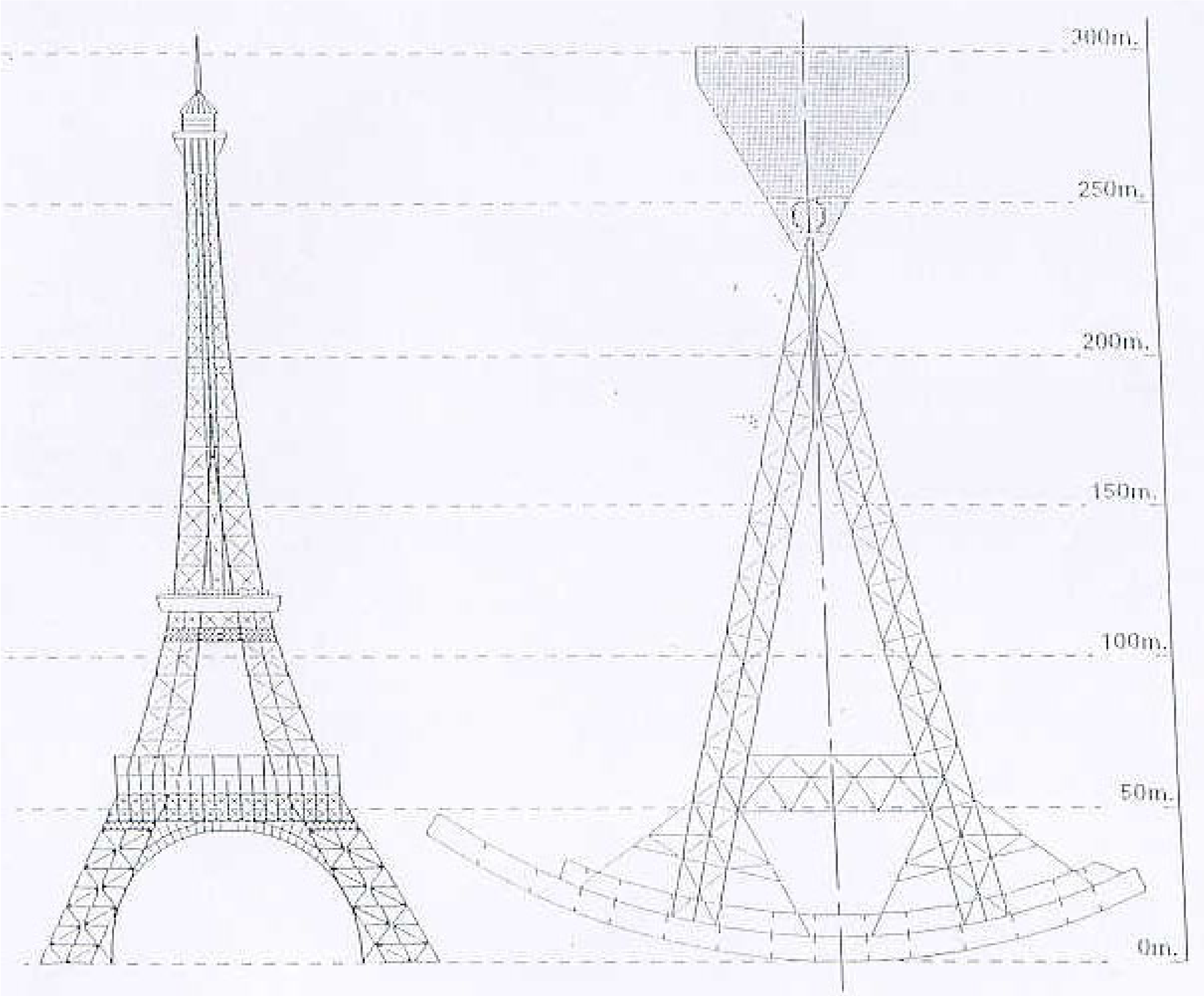
**Río Rhin – 128 m**

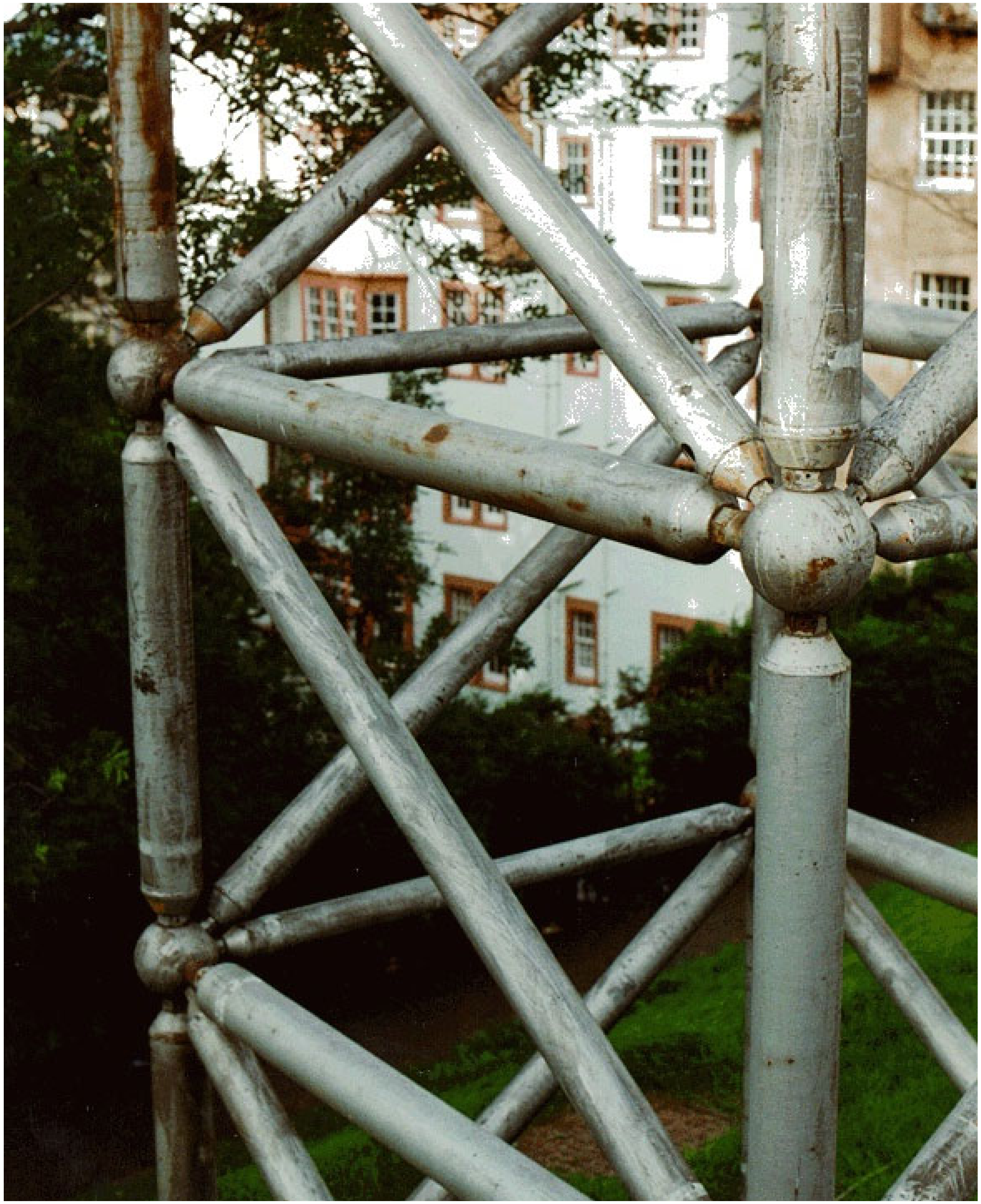


**Puentes Nicolás Avellaneda – Riachuelo – Buenos Aires**

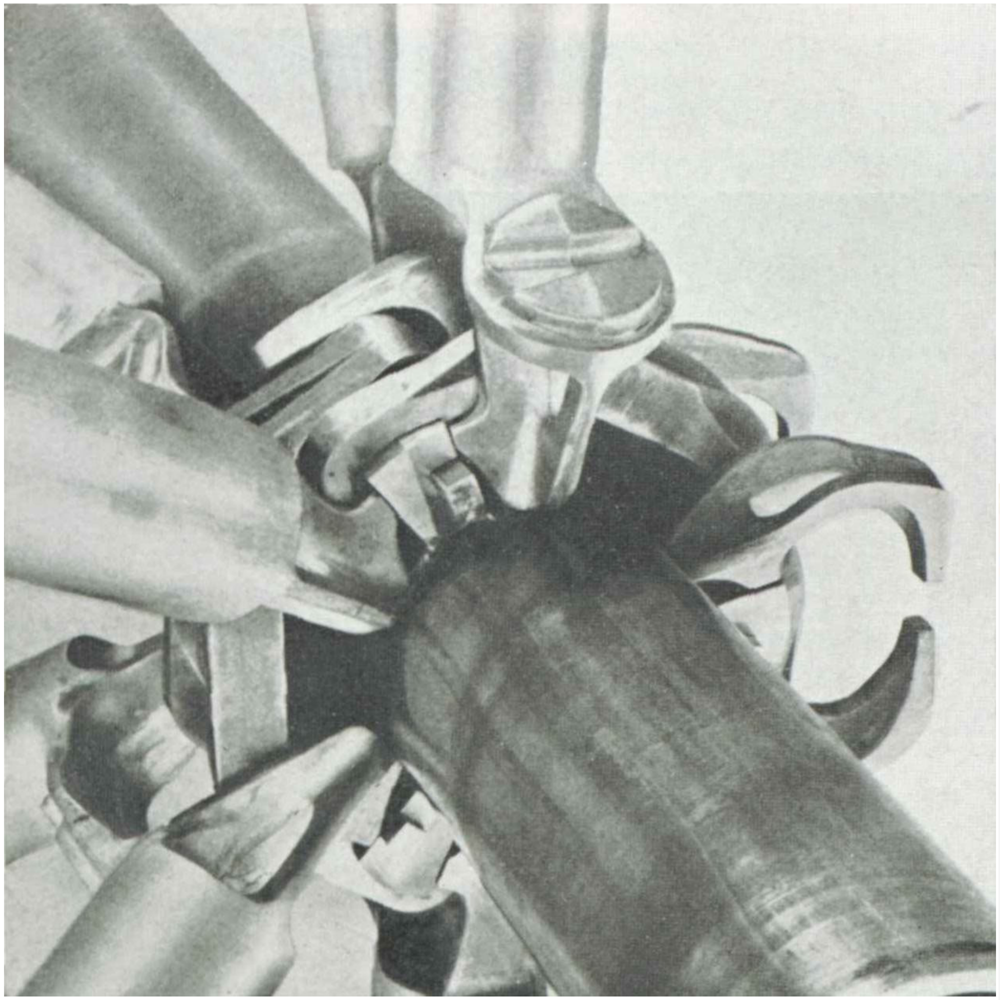
Puente levadizo basculante BARRACA PEÑA - 1913
Riachuelo – Buenos Aires

ENTRADA AL PUERTO DE ROTTERDAM


300m.
250m.
200m.
150m.
100m.
50m.
0m.




AENOR
ER
Empresa Registrada
ER-041/1/93
ISO 9001
CERTIFIED
IQNet
QUALITY SYSTEM



**Sistema**

**K. WACHSMANN**

**Sistema**

**TRIODETIC**