i>Clicker

If $w_0 = 100$ lbs/ft and L=10 ft, and $s = x/L$; which of the following has dimensions of force?

A) $w_o \cdot e^{-(x/L - 1/2)^2}$

B) $\int_0^L w_o \left[4\left(\frac{x}{L}\right) - 3\right] \cdot x \cdot dx$

C) $w_o \int_0^L \left[4\left(\frac{x}{L}\right)^2 - 3\right] \cdot dx$

D) $w_o L^2 \int_0^1 [4s - 3] \cdot ds$

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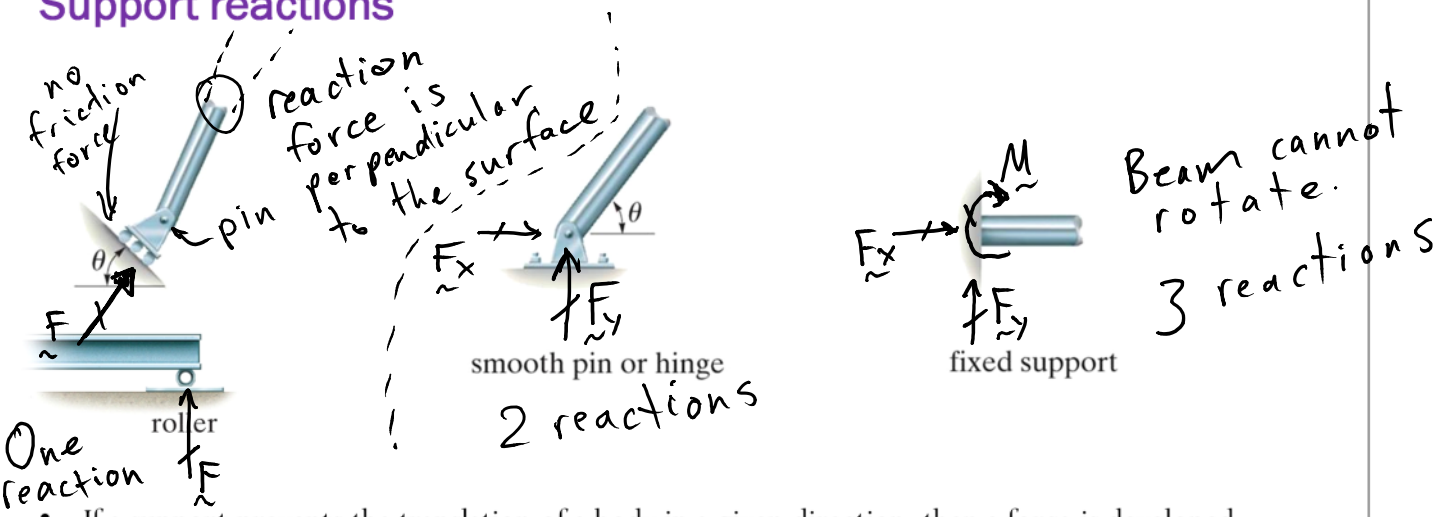
Equilibrium in two-dimensional bodies

Support reactions



- If a support prevents the translation of a body in a given direction, then a force is developed on the body on that direction
- If a rotation is prevented, a couple moment is exerted on the body

Reactions tell the ways in which the structure cannot move.

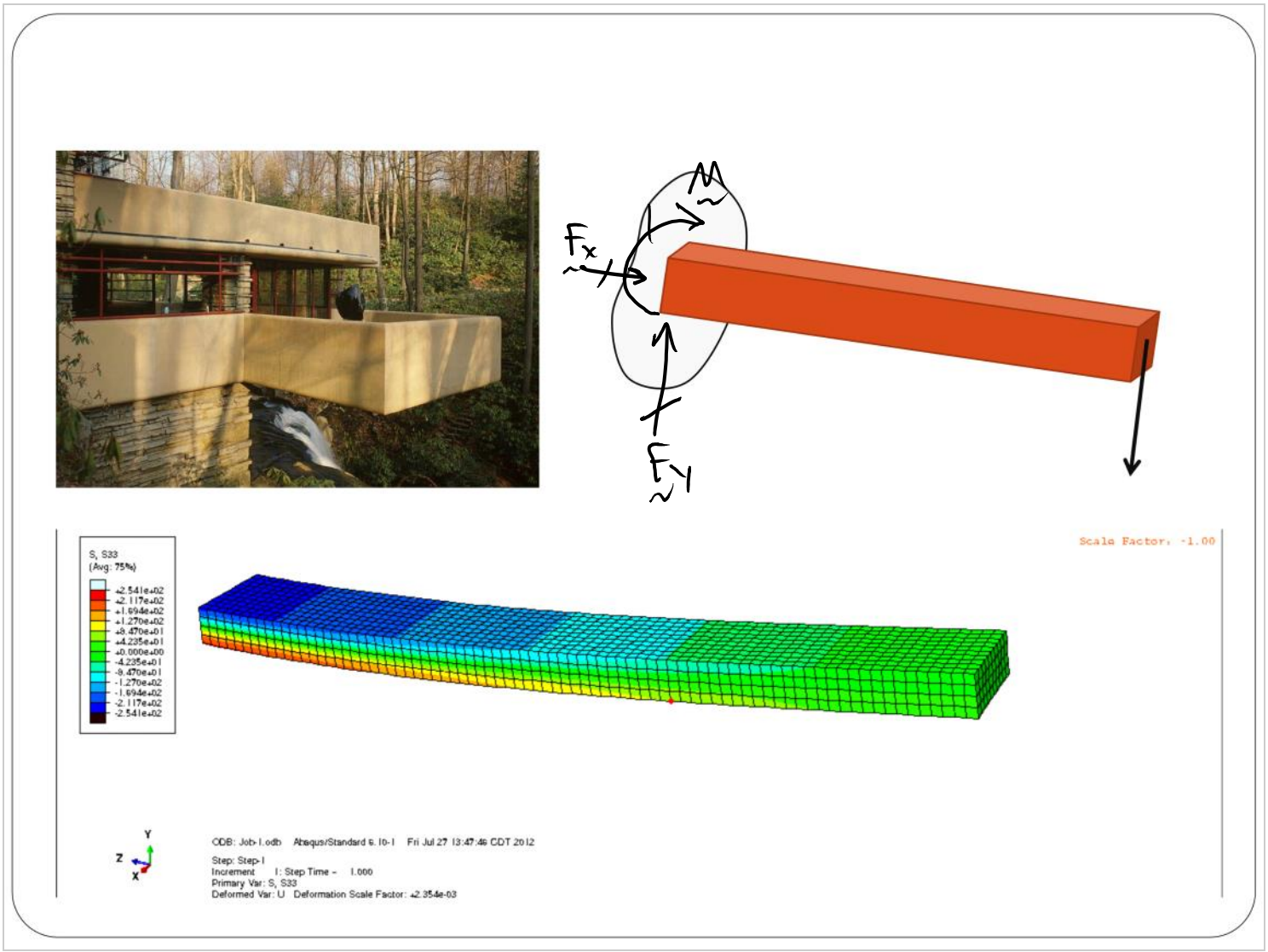

M
Fx
Fy
S, S33
(Avg: 75%)
+2.541e+02
+2.117e+02
+1.694e+02
+1.270e+02
+8.470e+01
+4.235e+01
+0.000e+00
-4.235e+01
-8.470e+01
-1.270e+02
-1.694e+02
-2.117e+02
-2.541e+02
Scale Factor: -1.00
Y
Z
X
ODB: Job-1.odb Abaqus/Standard 6.10-1 Fri Jul 27 13:47:46 CDT 2012
Step: Step-1
Increment 1: Step Time = 1.000
Primary Var: S, S33
Deformed Var: U Deformation Scale Factor: +2.354e-03

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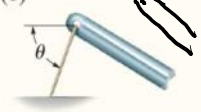
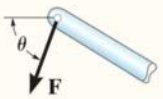
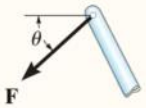
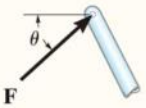
TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

Types of Connection	Reaction	Number of Unknowns
(1)  cable		One unknown. The reaction is a tension force which acts away from the member in the direction of the cable.
(2)  weightless link	 or 	One unknown. The reaction is a force which acts along the axis of the link.
(3)  roller		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.

never compression in a cable

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TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

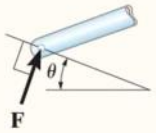
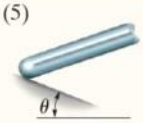
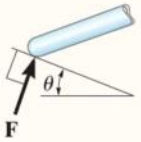
Types of Connection	Reaction	Number of Unknowns
(4)  rocker		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.
(5)  smooth contacting surface		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.

TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

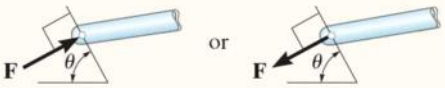
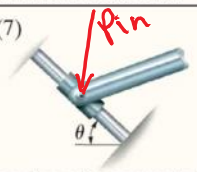
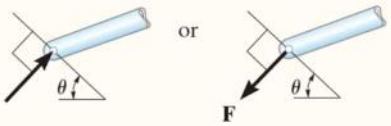
Types of Connection	Reaction	Number of Unknowns
(6)  roller or pin in confined smooth slot		One unknown. The reaction is a force which acts perpendicular to the slot.
(7)  member pin connected to collar on smooth rod		One unknown. The reaction is a force which acts perpendicular to the rod.

TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

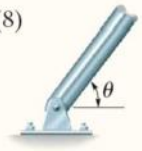
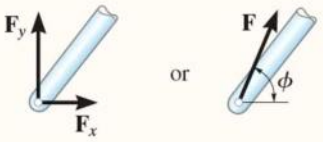
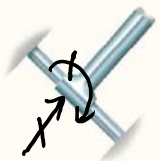
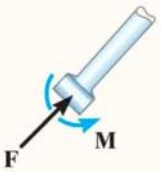
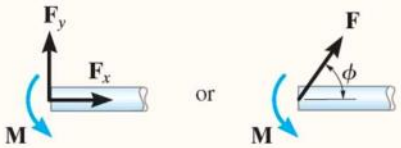
Types of Connection	Reaction	Number of Unknowns
(8)  smooth pin or hinge		Two unknowns. The reactions are two components of force, or the magnitude and direction ϕ of the resultant force. Note that ϕ and θ are not necessarily equal [usually not, unless the rod shown is a link as in (2)].
(9)  member fixed connected to collar on smooth rod		Two unknowns. The reactions are the couple moment and the force which acts perpendicular to the rod.
(10)  fixed support		Three unknowns. The reactions are the couple moment and the two force components, or the couple moment and the magnitude and direction ϕ of the resultant force.

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Figure: 05_PH002
The rocker support for this bridge girder allows horizontal movement so the bridge is free to expand and contract due to a change in temperature. (4)

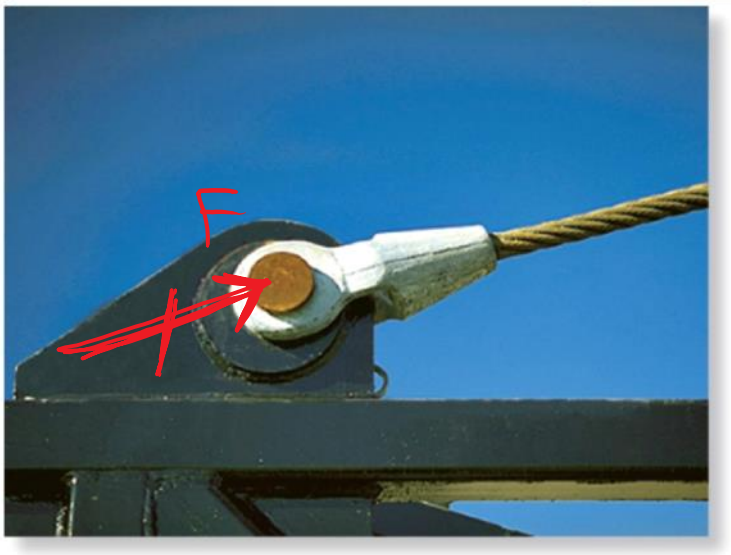
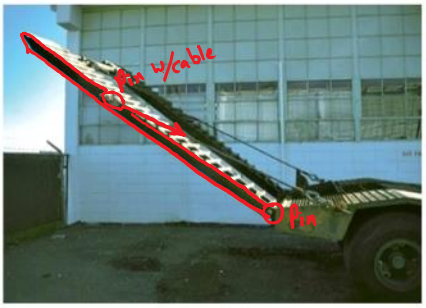
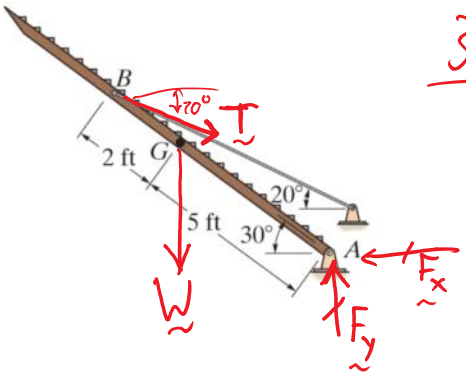


Figure: 05_PH001
The cable exerts a force on the bracket in the direction of the cable. (1)

Figure: 05_PH004
This utility building is pin supported at the top of the column. (8)

The uniform truck ramp has weight 400 lb and is pinned to the body of the truck at each side and held in the position shown by the two side cables. Determine the reaction forces at the pins and the tension in the cables.





3 unknowns
T, F_x, F_y

One other force
W (weight of ramp)

Sum forces:

In x-direction

$$\Sigma F_x = 0 \Rightarrow T\cdot\cos(20^\circ) - F_x = 0$$
$$\Rightarrow F_x = T\cdot\cos(20^\circ)$$

In y-direction

$$\Sigma F_y = -W - T\cdot\sin(20^\circ) + F_y = 0$$

Sum moments about A: $\Sigma M_A = 0$

Zero moment created by F_x and F_y

$$W\cdot(5')\cdot\cos(30^\circ) + (T\cdot\sin(20^\circ))(7'\cdot\cos 30^\circ) - (T\cdot\cos(20^\circ))(7'\cdot\sin(30^\circ)) = 0$$

1 eqn. 1 unknown

algebra

$$= W\cdot 5\cdot\cos 30^\circ$$

$$\therefore T = \frac{W \cdot 5 \cdot \cos 30^\circ}{7 \cdot (\cos 20^\circ \cdot \sin 30^\circ - \sin 20^\circ \cdot \cos 30^\circ)}$$

$$T = 1425 \text{ lbs}$$

Solve $F_x = T \cdot \cos(20^\circ) = 1339 \text{ lbs}$

$$F_y = W + T \cdot \sin 20^\circ = 887 \text{ lbs}$$