24-261 Statics, Fall 2001
Laboratory #2
Due: 1:30 PM, September 20, 2001

The purpose of this laboratory is to study a series of connections, focusing on the relative motions and on the forces and moments that can be exerted. See Page 5 for the definition of the initial orientation for each connection. Use the axes that are defined in those diagrams.

For each connection, you will carry out the following tasks.

(i) Motions permitted by a connection

For each connection, there is a part clamped to the table and a remote part which you can grasp and move. Attempt to translate (displace) the remote part in each of the coordinate directions from the initial orientation. Attempt to rotate the remote part about each of the coordinate axes. Using the Tables on Page 2, indicate whether the connection permits translation in each of the x, y or z directions. Indicate whether the connection permits rotation about each of the x, y or z-axes. If a connection permits only very minor jiggling in a particular direction, then we say that the connection does not permit such a motion.

(ii) Forces and moments exerted at a connection

You are to consider whether each connection is capable of exerting each possible component of force and moment. For example, is the connection capable of resisting translation (displacement) of the remote part in the x-direction? If so, then a force in the x-direction can be exerted by one part of the connection on the other. Is the connection capable of resisting rotation of the remote part about the z-axis? If so, then a moment about the z-axis can be exerted by one part of the connection on the other. Indicate the potential presence of each component with a YES or NO in the tables.

After completing the above tables, solve the four problems shown on pages 3 and 4. Follow the instructions carefully.

Complete the following tables, one for each connection. You should also include a drawing of each connection, a definition of axes, and the loadings and calculations from which the possible force and moment components are inferred.

Pin Joint

Motion Permitted (YES or NO)	Force or Moment exerted (YES or NO)
Translation x ?	F_x ?
Translation x ?	F_y ?
Translation x ?	F_z ?
Rotation x ?	M_x ?
Rotation y ?	M_y ?
Rotation z ?	M_z ?

Ball Joint

Motion Permitted (YES or NO)	Force or Moment exerted (YES or NO)
Translation x ?	F_x ?
Translation x ?	F_y ?
Translation x ?	F_z ?
Rotation x ?	M_x ?
Rotation y ?	M_y ?
Rotation z ?	M_z ?

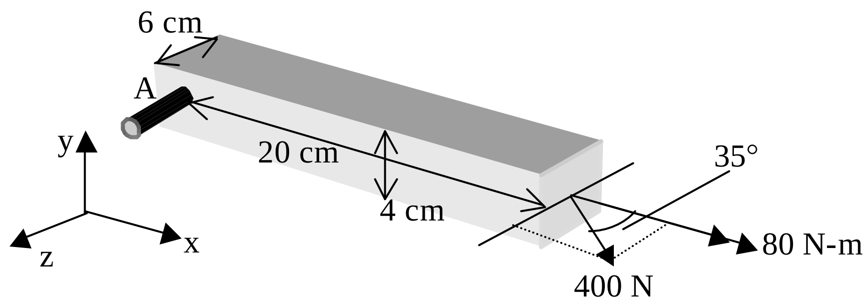
Sliding Joint

Motion Permitted (YES or NO)	Force or Moment exerted (YES or NO)
Translation x ?	F_x ?
Translation x ?	F_y ?
Translation x ?	F_z ?
Rotation x ?	M_x ?
Rotation y ?	M_y ?
Rotation z ?	M_z ?

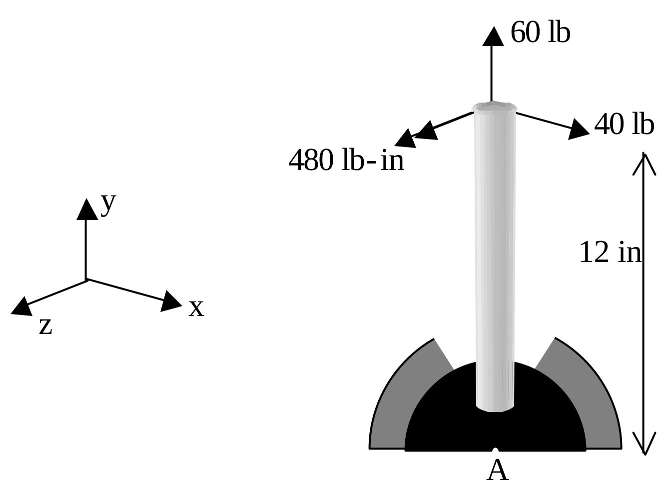
Universal Joint

Motion Permitted (YES or NO)	Force or Moment exerted (YES or NO)
Translation x ?	F_x ?
Translation x ?	F_y ?
Translation x ?	F_z ?
Rotation x ?	M_x ?
Rotation y ?	M_y ?
Rotation z ?	M_z ?

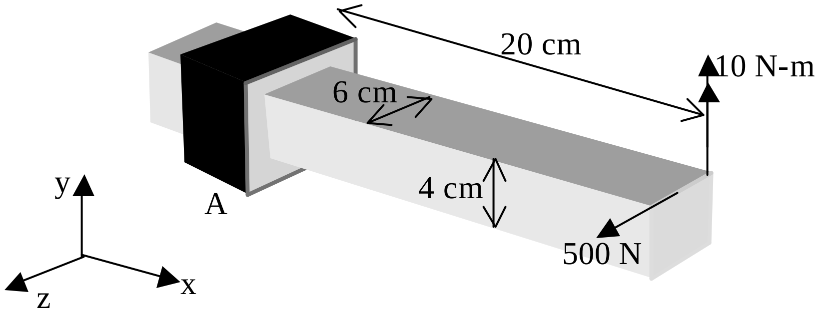
The member is subjected to the loads at the right end. There is a pin joint at the left end A. Draw the free body diagram of the member including the applied loads and all of the loads which could be exerted at the pin joint. The loads at the joint replace the pin which should not be drawn. Take the joint loads to act at the center of the pin. Each of the loads should be given an appropriate symbol and drawn in the positive coordinate direction. Write down the equations of the equilibrium and solve for the unknown loads at the joint. Redraw the member, now with the actual loads at the joint, drawn in their correct sense and labeled with magnitudes.



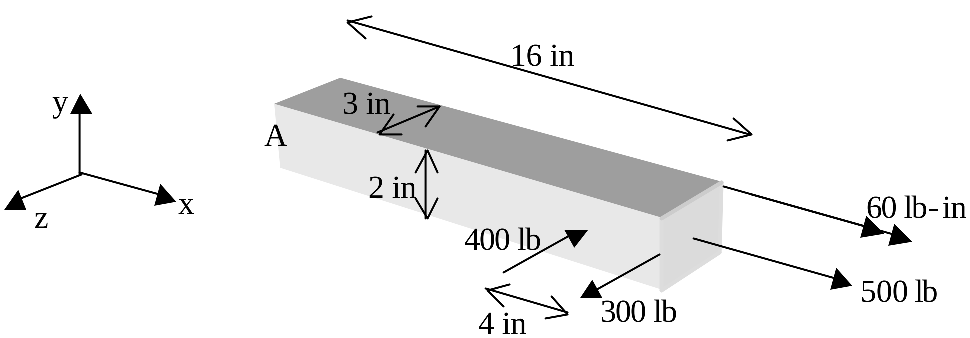
The member is subjected to the loads at the upper end. There is a ball joint at the lower end A. Draw the free body diagram of the member including the applied loads and all of the loads which could be exerted at the ball joint. The loads at the joint replace the joint which should not be drawn. The loads at the joint act at the center A of the joint. Each of the loads should be given an appropriate symbol and drawn in the positive coordinate direction. Write down the equations of the equilibrium and solve for the unknown loads at the joint. Redraw the member, now with the actual loads at the connection, drawn in their correct sense and labeled with magnitudes.



The member is subjected to the loads at the right end. There is a sliding joint at the left end A. Draw the free body diagram of this object including the applied loads and all of the loads which could be exerted at the joint. The loads at the joint replace the rectangular sleeve which should not be drawn. Take the joint loads to act at the center of the member within the rectangular sleeve. Each of the loads should be given an appropriate symbol and drawn in the positive coordinate direction. Write down the equations of the equilibrium and solve for the unknown loads at the joint. Redraw the member, now with the actual loads at the joint, drawn in their correct sense and labeled with magnitudes.



The member is subjected to the loads at the right end. There is a universal joint at the left end A (not drawn). (The web site http://www.beldenuniversal.com/universal_joints/single_universal_joints/spec is a reference to a manufacturer of universal joints – you can see some pictures and drawings there.) Draw the free body diagram of this member including the applied loads and all of the loads which could be exerted at the joint. Take the joint loads to be at the center of the member at the left end. (All applied forces at in the center plane of the member.) Each of the loads should be given an appropriate symbol and drawn in the positive coordinate direction. Write down the equations of the equilibrium and solve for the unknown loads at the joint. Redraw the member, now with the actual loads at the joint, drawn in their correct sense and labeled with magnitudes.



Pin Joint

Sliding Joint

Ball Joint

Universal Joint