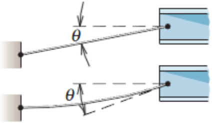
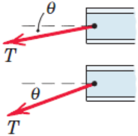
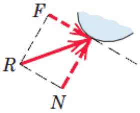
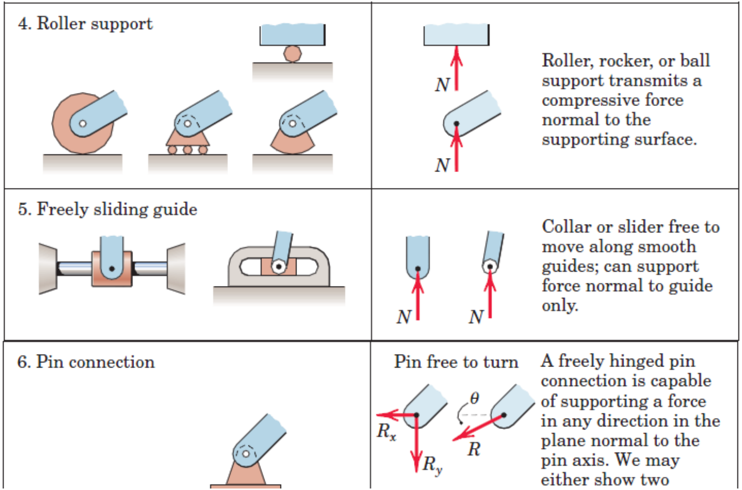
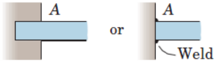
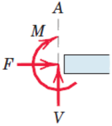
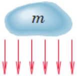
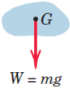
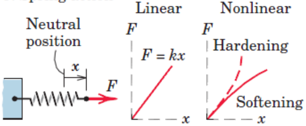
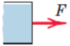
Theoretical Mechanics, Lab 6: STATICS 1

Statics: one body

Innopolis University

MODELING THE ACTION OF FORCES IN TWO-DIMENSIONAL ANALYSIS	
Type of Contact and Force Origin	**Action on Body to Be Isolated**
1. Flexible cable, belt, chain, or rope Weight of cable negligible Weight of cable not negligible 	 Force exerted by a flexible cable is always a tension away from the body in the direction of the cable.
2. Smooth surfaces 	 Contact force is compressive and is normal to the surface.
3. Rough surfaces 	 Rough surfaces are capable of supporting a tangential compo-nent F (frictional force) as well as a normal component N of the resultant

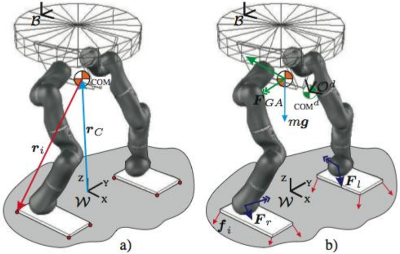

4. Roller support
N
N
Roller, rocker, or ball support transmits a compressive force normal to the supporting surface.
5. Freely sliding guide
N
N
Collar or slider free to move along smooth guides; can support force normal to guide only.
6. Pin connection
Pin free to turn
R_x
R_y
θ
R
A freely hinged pin connection is capable of supporting a force in any direction in the plane normal to the pin axis. We may either show two

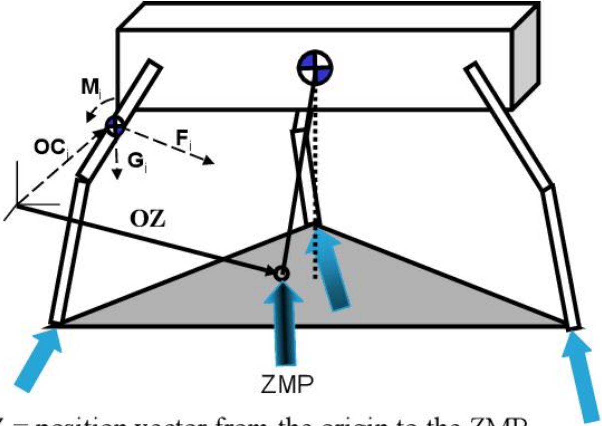
7. Built-in or fixed support 		A built-in or fixed support is capable of supporting an axial force F, a transverse force V (shear force), and a couple M (bending moment) to prevent rotation.
8. Gravitational attraction 		The resultant of gravitational attraction on all elements of a body of mass m is the weight $W = mg$ and acts toward the center of the earth through the center mass G.
9. Spring action 		Spring force is tensile if spring is stretched and compressive if compressed. For a linearly elastic spring the stiffness k is the force required to deform the spring a unit distance.

Center of gravity VS Center of mass

For classical mechanics - it’s the same. More info here

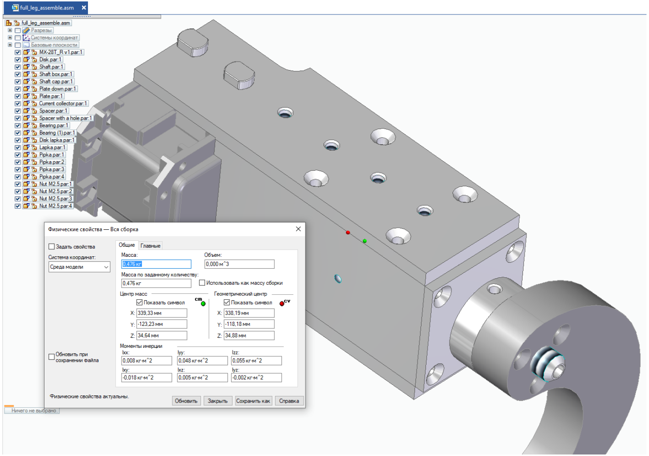
Where a center of mass can be used?





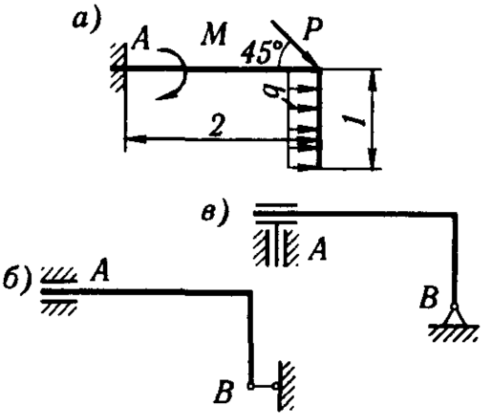
OZ = position vector from the origin to the ZMP

How to find the center of mass in real life



Task 1 (mine)

Find reaction forces in supports of the construction systems. The size of all objects and the loads are given.

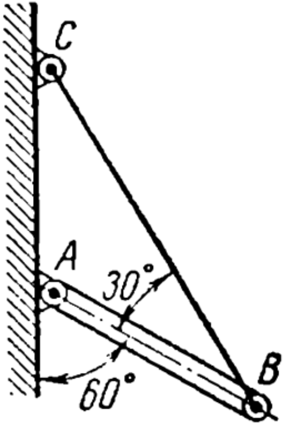


Task 2 (yours): M (rus) 2.26

A uniform rod *AB* is hinged at *A* to a vertical wall and is held at an angle of 60° to the vertical by a string *BC*? forming and angle of 30° with the rod.

Determine the magnitude and direction of the reaction *R* of the hinge, if the weight of the rod is 2 kgf.

Answer: $R = 1\,kgf$, $\angle(R, AC) = 60°$



New devices morph and transform - like Iron Man's suit

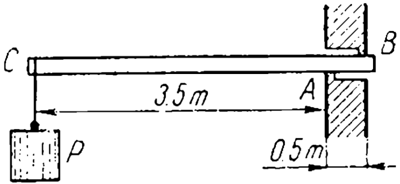
Video

Task 3 (yours): M (rus) 3.12

A uniform horizontal beam 4 m long and weighing 500 kgf is placed with one end in a wall of 0.5 m thick so that it rests against points A and B (Fig. 35).

Calculate the reactions of the supports at the points A and B, if a load $P = 4000$ kgf is attached to the free end of the beam.

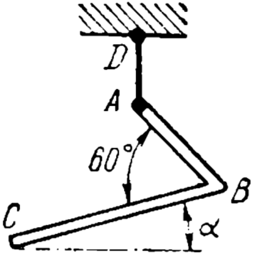
Ans. $R_A = 34{,}000$ kgf upwards; $R_B = 29{,}500$ kgf downwards.



Task 4 (yours): M (rus) 3.28

56. Two uniform rods AB and BC with equal cross-sections are connected with their ends at an angle of 60° thus forming a cranking lever ABC, as shown in Fig. 42. AB is one half BC. The lever is suspended by a thread AD from the end A. Determine the angle α of inclination formed by the rod BC and the horizontal when in equilibrium. The sizes of the cross-sections may be neglected.

Ans. $\tan\alpha = \frac{\sqrt{3}}{5}$; $\alpha = 19°05'$.



Deserve “A” grade!

– Oleg Bulichev

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Room 105 (Underground robotics lab)