Course Code: ESC106A
Course Title: Construction Materials and Engineering Mechanics

Lecture No. 23:
Problems on Equilibrium of Coplanar Concurrent Force systems – Multiple bodies

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Lecture Intended Learning Outcomes

At the end of this lecture, students will be able to:

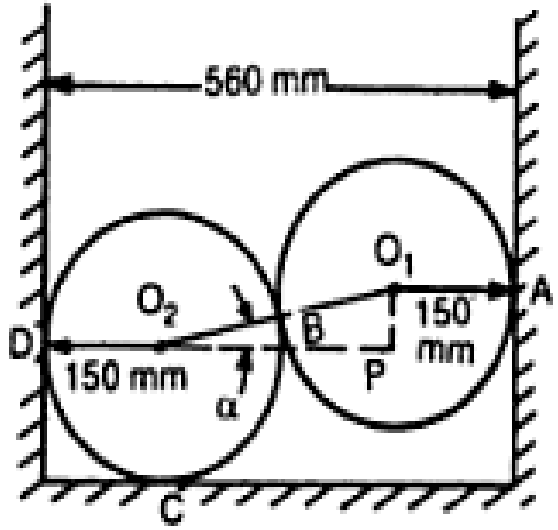
- Apply the Lami's theorem to solve equilibrium related problems (for 3 force system)
- Apply the conditions of equilibrium to solve problems (for more than 3 force system)
- Calculate the unknown forces or reactions for equilibrium of coplanar concurrent force system involving single bodies

Contents

Lami's theorem to solve equilibrium related problems, problems applying the conditions of equilibrium

Problems

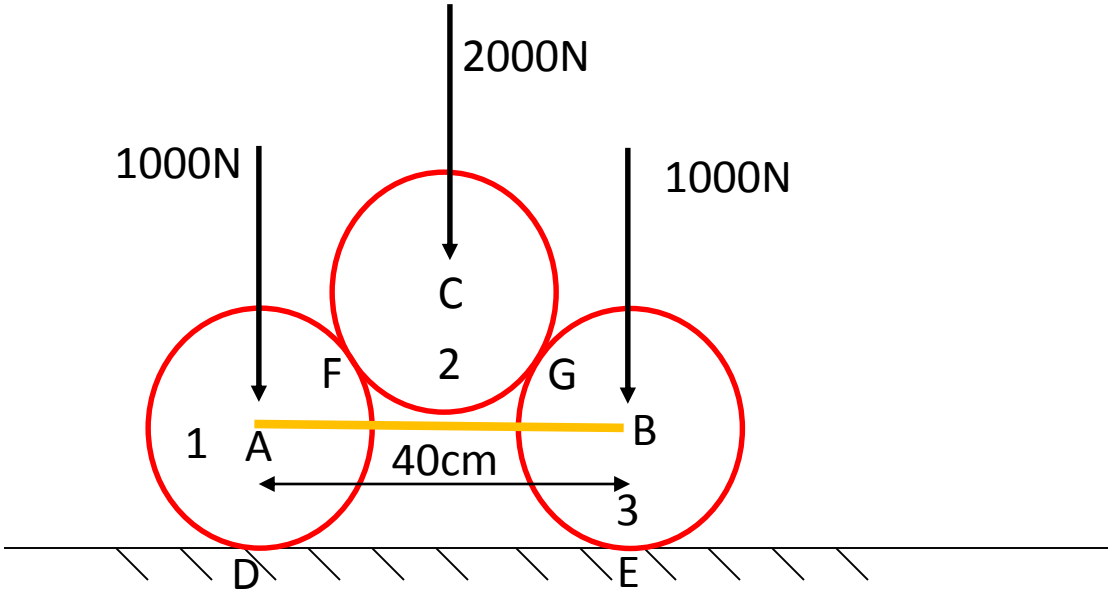
1.Two smooth spheres, each of radius 150mm and weighing 250N rest in a horizontal channel having vertical walls, the distance between the walls being 560mm.Find the reactions at the points of contacts A,B,C and D as shown in the figure.



R_A=432.3N
R_B=501.1N
R_C=500N
R_D=434.29N

Problems

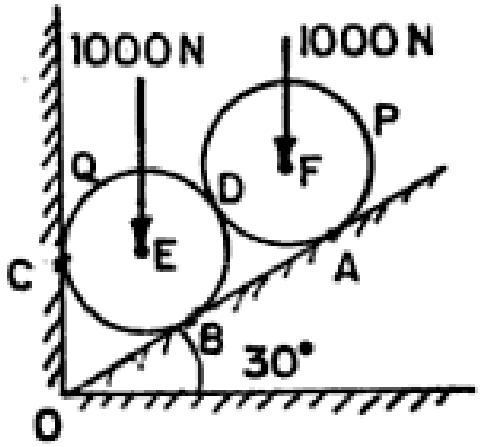
2.Two smooth circular cylinders, each of radius 15cm and weighing 1000N are connected at their centres by a string AB of length=40cm and rest upon a horizontal plane, supporting above them a third cylinder of weight=2000N and radius 15cm as shown. Find the force in string AB and the pressure produced on the floor at the point of contacts D and E.



R_F=1342.18N
R_G=1342.18N
F_{AB}=895.2N
R_D=2000N
R_E=2000N

Problems

3.Two identical rollers , each of weight W=1000N, are supported by an inclined plane and a vertical wall as shown in the figure. Find the reactions at the points of supports A,B and C. Assume all the surfaces to be smooth.



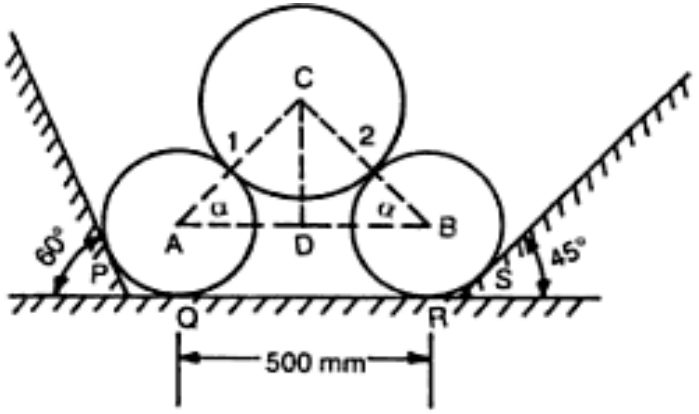
R_A=866.17N

R_D=499.78N

Problems

4.Three spheres are piled in a trench as shown in fig. Self weight and radii of the cylinders are as shown below. Treating all the contact surfaces as smooth, determine the reactions developed at the contact surfaces P, Q, R and S. Given centre to centre distance between sphere A and B is 500mm

Spheres	*Weight*	*Radius*
A	2 kN	400 mm
B	2 kN	400 mm
C	4 kN	600 mm

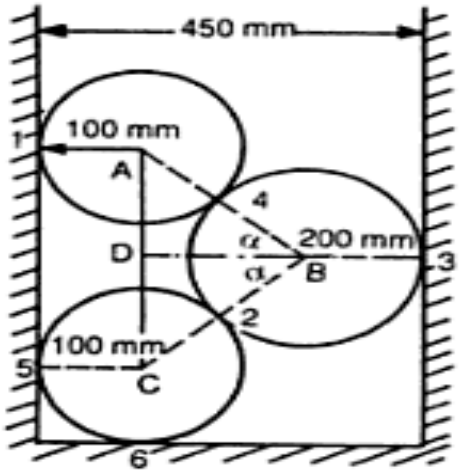


R_P=0.596kN
R_Q=4.298kN
R_R=1.484kN
R_S=0.730kN

Problems

5.The weights and radii of the three cylinders piled in a rectangular ditch as shown in the fig. Assuming all the surfaces to be smooth, determine the reactions acting on cylinder C

Cylinder	*Weight*	*Radius*
A	80 N	100 mm
B	160 N	200 mm
C	80 N	100 mm



R_2=92.4kN
R_4=277.1kN
R_5=138.6kN
R_6=320kN

Summary

- Lami's Theorem states that if a body is in equilibrium under the action of three forces, each force is proportional to the sine of angle between the other forces
- Lami's theorem is applied to solve problems on equilibrium of Coplanar Concurrent Force systems