ROHININ COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF MECHANICAL ENGINEERING

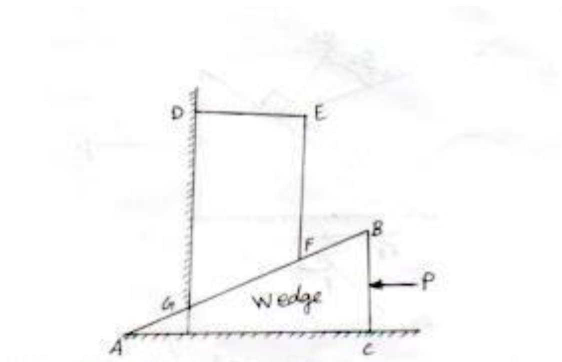
NAME OF THE SUBJECT: ENGINEERING MECHANICS

SUBJECT CODE : ME3351

REGULATION 2021

UNIT V: FRICTION

WEDGE FRICTION

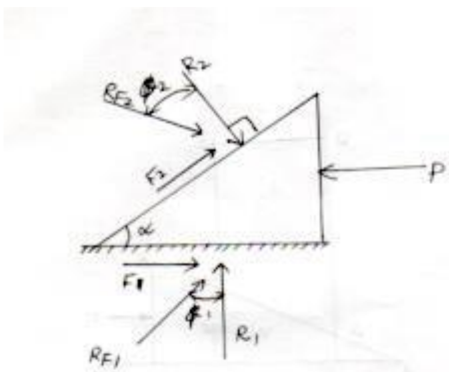


A wedge is a piece of wood or metal, usually of a triangular (or) trapezoidal shape in cross section used for Lifting Loads (or) for slight adjustment like tightening keys for shift

When the force P is applied, sliding take place on the edge AC, DG, and Gf. Hence the reactive force components, normal reactions and the frictional forces are also developed on these sliding surface

Now Let as see the direction of these reactive forces, and draw the free body diagram of wedge and body.

Equilibrium of wedge



Normal force and Frictional force are combined to a single resultant force 'R_F'

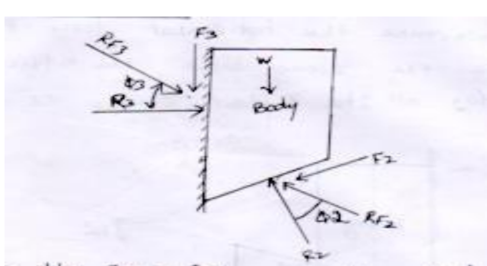
$R_{F1} \& R_{F2}$ *are drawn on wedge*

Where $R_{F1} = \sqrt{F_1{}^2 + R_1{}^2}$

$R_{F2} = \sqrt{F_2{}^2 + R_2{}^2}$

$F_1 \& F_2$ are Limiting friction $\emptyset_1, \emptyset_2$means of angle of friction

It is defined as the in b/w the angle of [Line of action of the normal reaction$N_1 \& N_2$] and Resultant force $R_{F_1} \& R_{F_2}$



Equilibrium of body

When the force ‘P’ push the wedge, the body tends to move upwards, hence the frictional force F_3 on the surface AD is acting download.

Then the normal reaction R_3 and F_3 are replaced by a single resultant R_{F3}, which makes on angle of $\emptyset_3$with line of action of normal reactionR_3

Concurrent forces$R_1 R_2$, self weight(w)

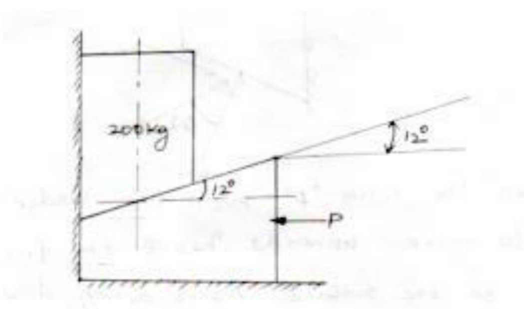
Note (i) always draw the free body diagram of wedge first then draw the force body diagram of the below

(ii) while solving, if the Load is given, solve free body of block first and if the force ‘P’ is given.solve the free body of wedge

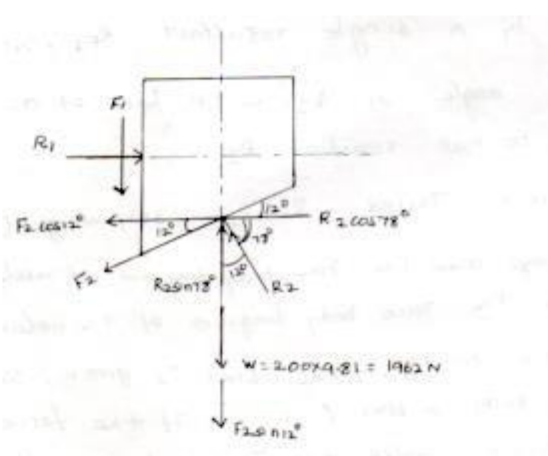
(iii) self-weight of the wedge is neglected

Problem: 1

Determine the horizontal force P required to raise the 200 kg block the efficient of friction for all the contact surface is 0.25



Free body Diagram of block



Sum of all X direction force

$\sum F_X = 0$ + $\longrightarrow$ $\longleftarrow$ -

$R_1 - R_2 \cos 78 - F_2\ cos 12° = 0$

$R_1 - 0.207R_2 - \mu R_2 cos 12° = 0$

$R_1 - 0.207R_2 - 0.25 \times R_2 \times cos 12° = 0$

$R_1 - 0.207R_2 - 0.24R_2 = 0$

$R_1 = 0.207R_2 + 0.24R_2$

$R_1 = 0.45R_2$

Sum of all Y direction force

$\sum F_Y = 0$ $\downarrow$ - $\uparrow$ +

$-1962 - F_1 - F_2 sin 12 + R_2 sin 78 = 0$

$-1962 - 0.25R_1 - 0.25R_2 sin 12° + R_2 sin 78° = 0$

$-1962 - 0.25R_1 - 0.051R_2 + 0.97R_2 = 0$

$-1962 - 0.25 \times [0.45R_2] - 0.051R_2 + 0.97R_2 = 0$

$-1962 - 0.112R_2 - 0.051R_2 + 0.97R_2 = 0$

$-1962 + 0.807R_2 = 0$

$0.807R_2 = 1962$

$R_2 = \frac{1962}{0.867}$

$R_2 = 2431.22\ N$

R_2 Value sub in eqn (1)

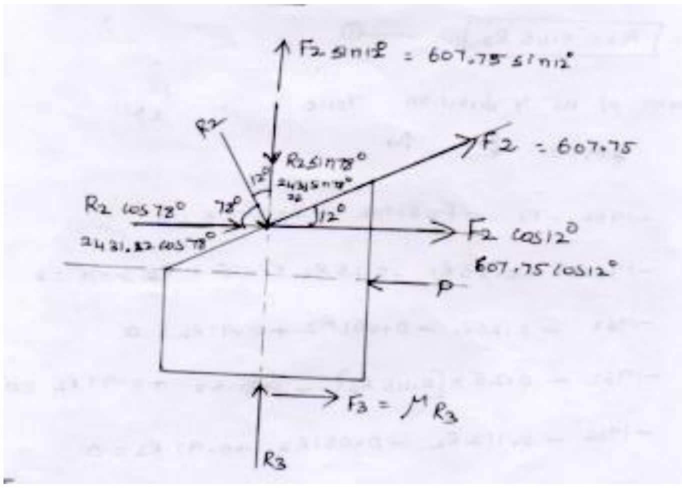
$R_1 = 0.45\ R_2$ ---→0.45×2431.22

$R_1 = 1094\ N$

$F_1 = \mu R_1 = 0.25 \times 1094 = 273.51\ N$

$F_2 = \mu R_2 = 0.25 \times 2431 = 607.75\ N$

Free body diagram of wedge



$\sum F_X = 0$

$-P + F_3 + 2431.22\ cos78° + 607.75\ cos12° = 0$

$-P + \mu R_3 + 278 + 594.46 = 0$

$-P = -\mu R_3 - 2378 - 594.46$

$-P = -[\mu R_3 + 2378 + 594.46]$

$P = 0.25 \times R_3 + 2378 + 594.46$-------------- (2)

$\sum F_Y = 0$

$R_3 - R_2 sin78° + 607.75\ sin12° = 0$

$R_3 - 2431.51 sin78° + 607.75\ sin12° = 0$

$R_3 - 505.47 + 126.35 = 0$

$R_3 = 505.47 - 126.35$

$R_3 = 379.11\ N$

R_3 vlaue sub in Eqn (2)

$P = 0.25 \times R_3 + 2378 + 594.46$

$P = 0.25 \times 379.11 + 2378 + 594.46$

$P = 3067.23\ N$