Example 3.4

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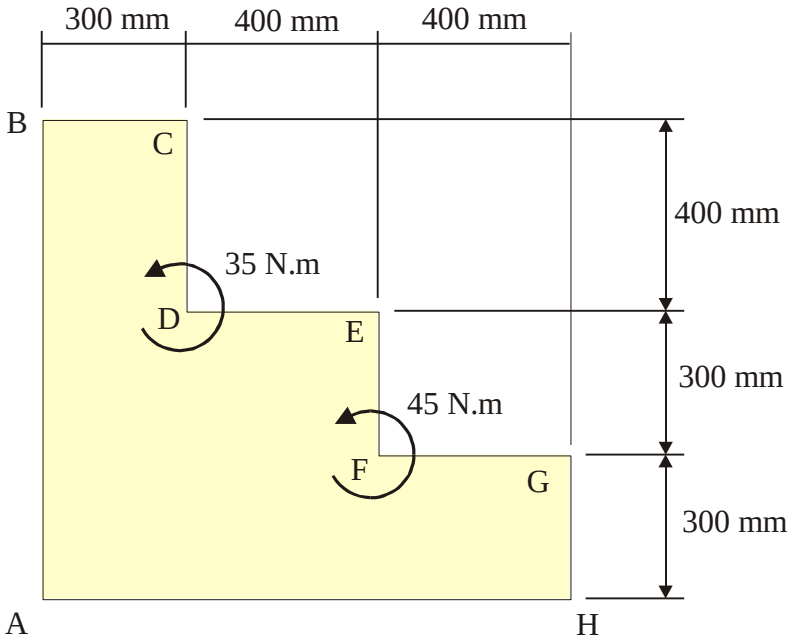
Example 3.4:

A 35 N.m and 45 N.m couple (couple moments) are applied to a piece of plywood. Determine the magnitude of the two smallest forces that can be applied to the plywood that will produce the same moment on the plywood if they are applied:

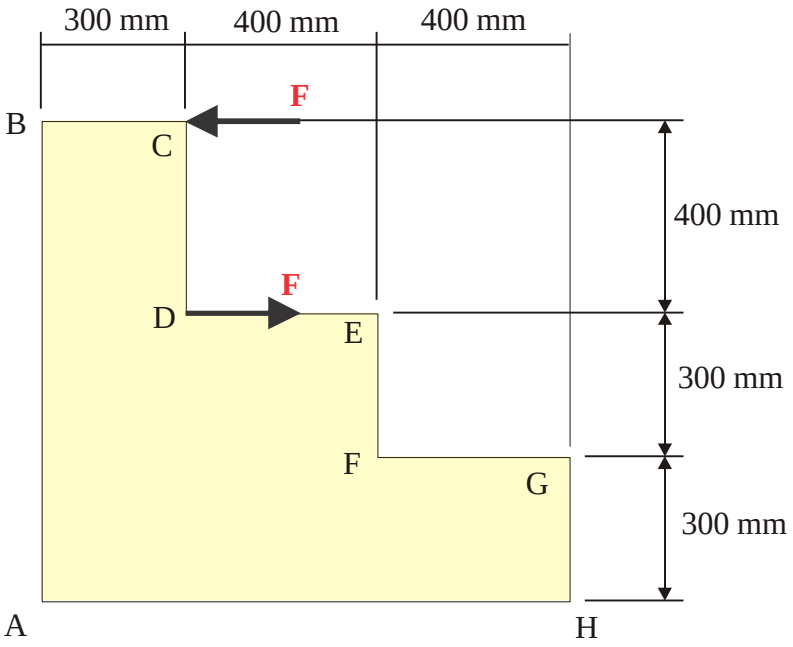
a) horizontally at points C and D,
b) vertically at B and C,
c) at D and E, and
d) anywhere on the plywood.

In this example the forces that constitute the couple moments of 35 N.m and 45 N. m are not shown.

Couple moments are Free Vectors and may be placed anywhere on the rigid body.



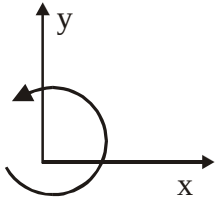
a) Horizontally at points C and D



Resultant Moment:

M_R = +35 N.m + 45 N.m = +80 N.m

M_R = 80 N.m



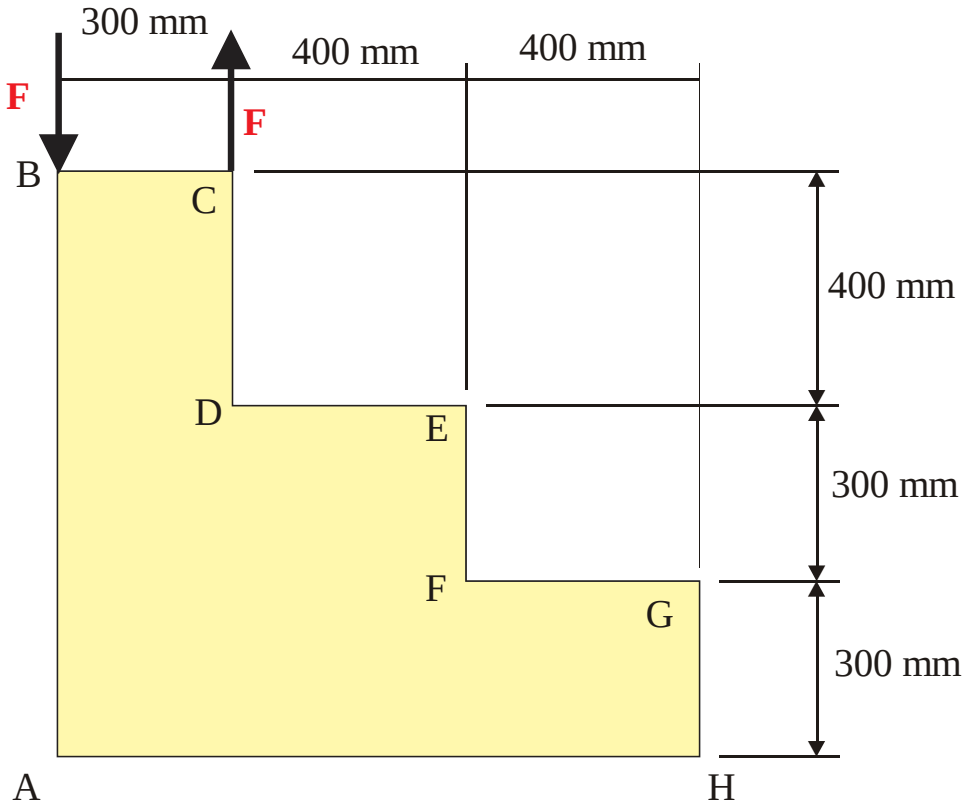
M = Fd

80 = F(0.4)

F = 80/0.4 = 200 N

Couple forces applied with lines of action shown and senses to produce a counter-clockwise (positive) moment

b) Vertically at B and C,



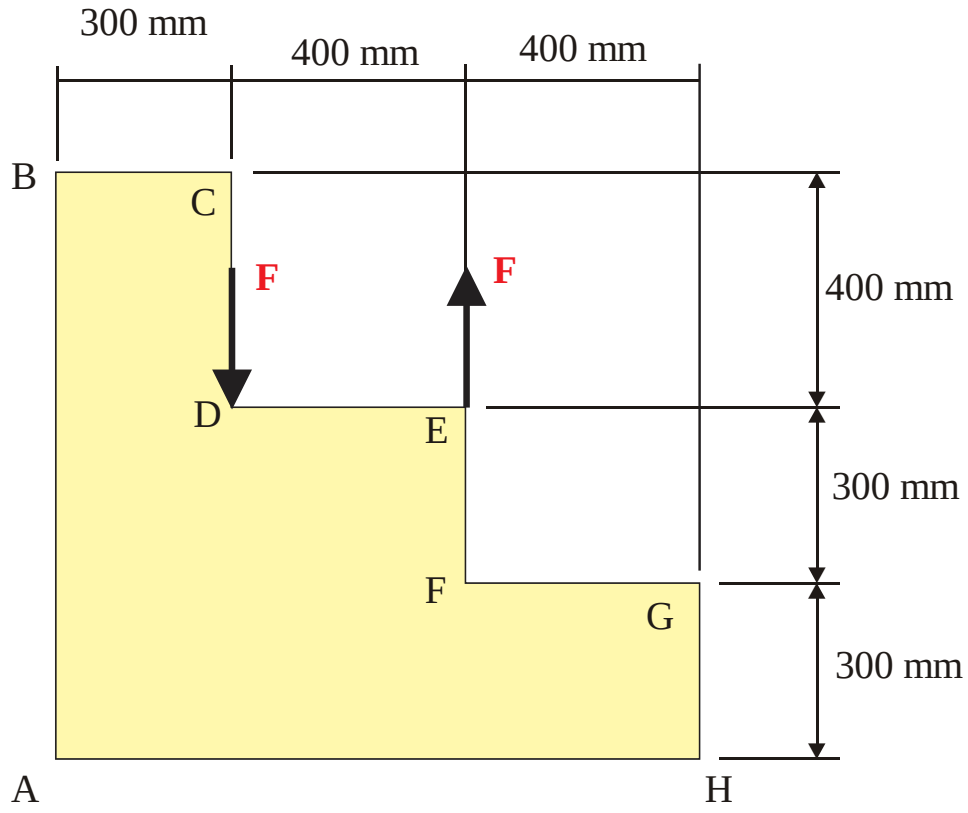
M = Fd

80 = F(0.3)

F = 80/0.3 = 266.67 N

Couple forces applied with lines of action shown and senses to produce a counter-clockwise (positive) moment

c) At D and E



M = Fd

80 = F(0.4)

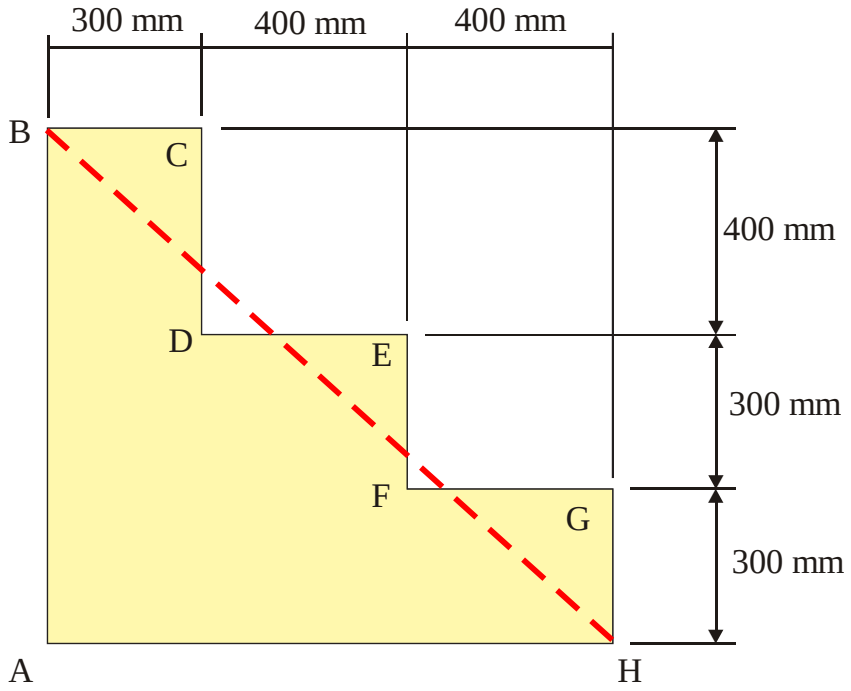
F = 80/0.4 = 200 N

Couple forces applied with lines of action shown and senses to produce a counter-clockwise (positive) moment .

d) Anywhere on the plywood.

Step 1 – M = Fd
OR
M/d = F
F is smallest or minimum when d is largest or maximum.

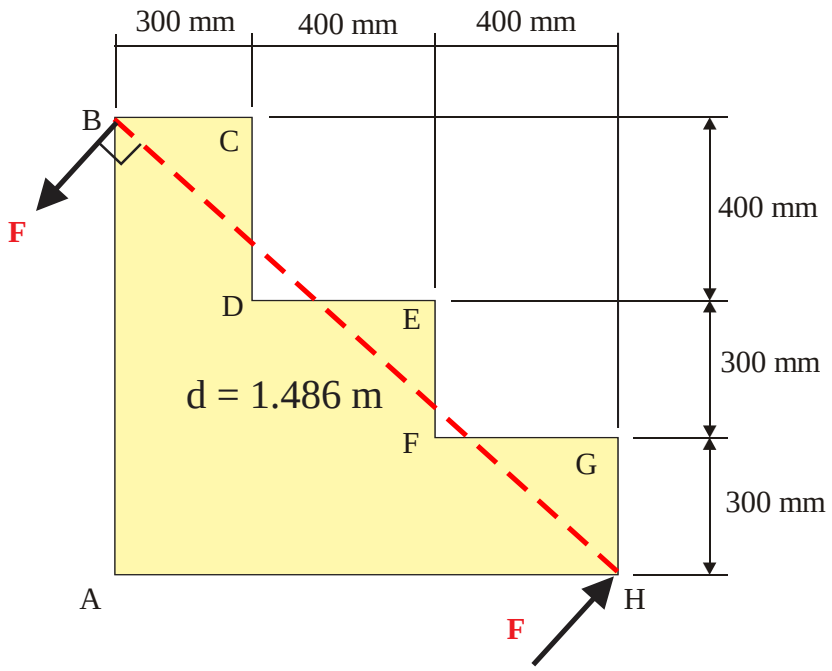
Therefore, the two points on the plywood that are furthest apart are B and H. Connect them by a line and calculate d.



$$d = \sqrt{1.1^2 + 1.0^2} = \sqrt{2.21} = 1.486\text{m}$$

Step 2 – Apply couple forces PERPENDICULAR to this line so as to produce an 80 N.m counter- clockwise couple moment.

d) Anywhere on the plywood. (continued)



M = Fd

80 = F(0.4)

F = 80/1.486 = 53.84 N

Couple forces applied with lines of action shown and senses to produce a counter-clockwise (positive) moment .