## Answer on Question \#45367-Physics-Mechanics-Kinematics-Dynamics

A uniform rectangular beam of length $L=5 \mathrm{~m}$ and mass $M=40 \mathrm{~kg}$ is supported but not attached to the two posts which are length $D=3 \mathrm{~m}$ apart. A child of mass $W=20 \mathrm{~kg}$ starts walking along the beam.

How close can he get to the right end of the beam without it falling over?

## Solution

We assume infinitely rigid posts.


The upward force exerted by the left on the beam cannot be negative - this is the limiting condition on how far the child can be to the right. Let's set up the static equilibrium condition with the pivot about the left end of the beam.

Take the pivot about left end.
Force:

$$
M g+W g=F_{1}+F_{2}
$$

Torque:

$$
F_{1} D=M g \frac{L}{2}+W g(L-x)
$$

Since $F_{2} \geq 0$,

$$
\begin{gathered}
F_{1} D \leq(M g+W g) D \\
M g \frac{L}{2}+W g(L-x) \leq(M g+W g) D \\
-\frac{M}{W}\left(D-\frac{L}{2}\right)+L-D \leq x \\
x \geq-\frac{40}{20}\left(3-\frac{5}{2}\right)+5-3=1 m .
\end{gathered}
$$

Answer: 1m.

