Statics2() Statics (2 dimensional) 4-3-08

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This program solves two dimensional statics (equilibrium) problems, that is, ones in which all forces lie in the same plane and all torques, or moments, are perpendicular to that plane. This update allows the solution of more complex structures, such as trusses, by enabling its application to components of a structure as well as to the structure as a whole. Most commonly, the program would be used for the whole structure first to determine any external forces, then to find forces in members or forces acting at a joint. A maximum of 3 unknowns can be found if forces are applied at more than one point, or 2 if all forces are applied at one point. If there are too many unknowns, you will be prompted to choose a component, which could be a single member, a section, or a joint, involving some of the same unknowns so more equations are generated, perhaps allowing solution. Up to 9 equations in 9 unknowns can be solved.

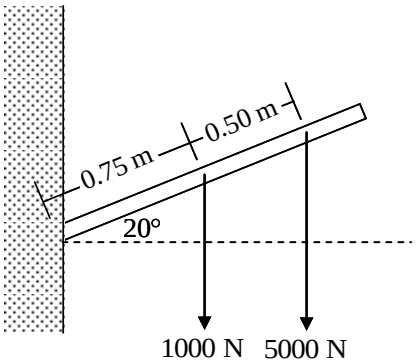
After an origin is chosen, each force and the position vector of its point of application (relative to the origin), as well as any couples, are entered. Vectors can be entered in either polar or rectangular form, or with a given magnitude along a line between two specified points. To save keystrokes, no ( ) or [ ] are needed, and so you don't have to hunt for the angle symbol ($\angle$), vectors are entered as either $r,,\theta$ or x,y. Notice the two commas used instead of $,\angle$ for polar form.

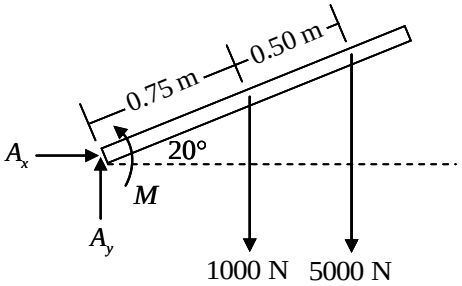
When the unknowns are all vector magnitudes or vector components, results are found quickly, but if angles are among the unknowns, there can be a delay of a minute or so, and solutions typically involve one or more arbitrary integers. Angular unknowns can usually be avoided by using components or the direction along a line. Then angles can be found by rectangular to polar conversion. Solutions are copied to the home screen for use in further calculations. Results are saved so they can be used if two or more passes through the program are required for a complete solution.

Copyto_h(), by Samuel Stearley, Pieces(), Piec_dsp(), and Cmpctlst() are used in the main program. Place all programs in the same folder, then run Statics2().

For 3 dimensional cases, see Statics3(). You may also run Statics2() and Statics3() as options in Statics(). Place Statics(), Statics2(), Statics3(), Copyto_h(), Pieces(), Piec_dsp(), Cmpctlst(), Partsand(), and Partsall() in the same folder, then run Statics().

Example: A uniform beam, 1.5 m long, and weighing 1000N, is embedded in a wall at an angle as shown. It supports a 5000 N load applied as shown. The wall exerts a force A, shown in component form, and a moment or couple M. Solve for A_x, A_y, and M.





When beginning a new problem, choose the option to delete all 1 & 2 letter variables to prevent retention of values from a previous problem.

3 forces, 1 couple

	Force #1	Force #2	Force #3		Couple #1
x,y or r,,θ	0,0	0.75,,20	1.25,,20	M1	m
Fx,Fy or F,,θ	ax,ay	1000,,-90	5000,,-90		

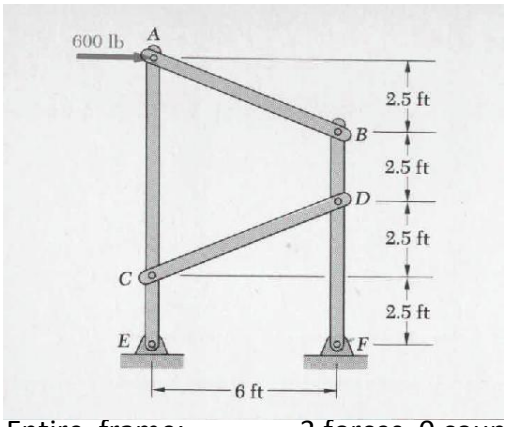
Notice that the force 1000,, -90 could have been entered in component form as 0,-1000

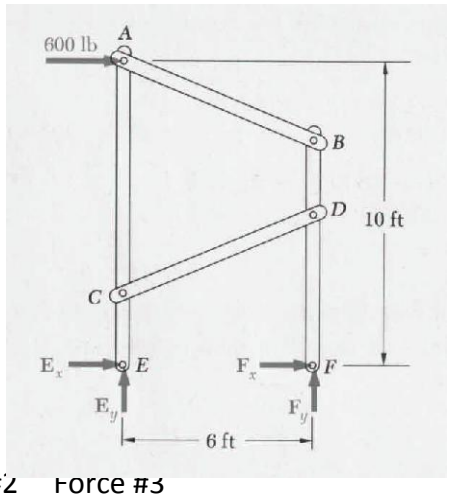
m = 6577.85 The results are copied to the home screen

ax = 0.00 and are stored as m, ax, and ay.

ay = 6000.00

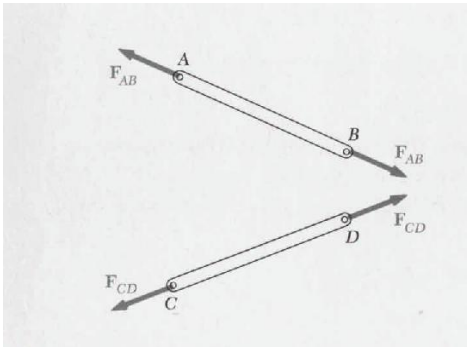
Ex. 2: A 600 lb horizontal force is applied to pin A of the frame shown. Determine the forces acting on the two vertical members of the frame.

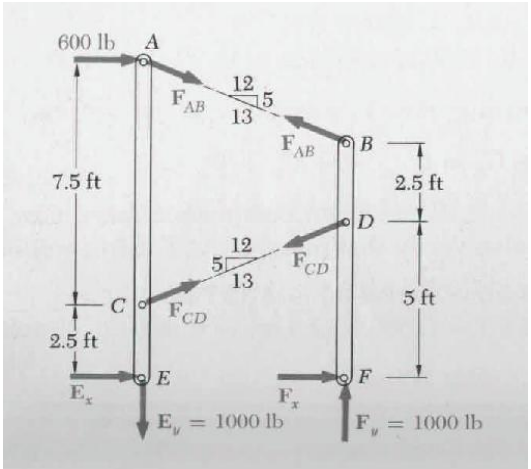




Entire frame: 3 forces, 0 couples

	Force #1	Force #2	Force #3	
x,y or r,,θ	0,0	6,0	0,10	More unknowns than equations.
Fx,Fy or F,,θ	ex,ey	fx,fy	600,0	Apply to a component of structure.



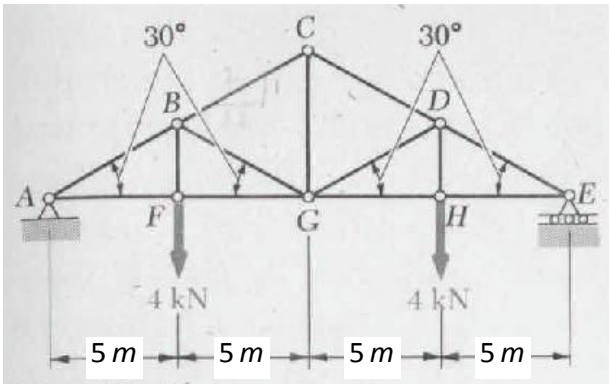


Member AE:

	Force #1	Force #2	Force #3	Force #4
x,y or r,,θ	0,0	0,2.5	0,10	0,10
Fx,Fy or F,,θ	ex,ey	cd,,$\tan^{-1}$(2.5/6)	600,0	ab,,-$\tan^{-1}$(2.5/6)

ab=-1040
cd=1560
ex=-1080
ey=-1000
fx=480
fy=1000

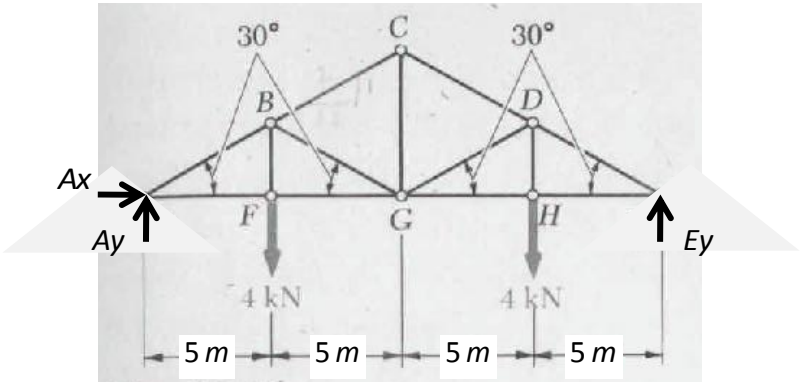
The directions chosen for forces in members of the structure yield a + value for tension, - for compression.



Ex. 3: For the truss shown, determine the reactions at A and E and the forces in members BC, BG and FG.

Entire truss: 4 forces, 0 couples

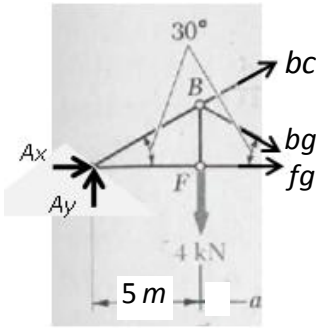
Force #1	Force #2	Force #3	Force #4
0,0	5,0	15,0	20,0
ax,ay	0,-4	0,-4	0,ey



ax = 0.00
ay = 4.00
ay = 4.00

Run program again for section ABF.
Do not delete variables.
Section ABF: 5 forces, 0 couples

Force #1	Force #2	Force #3	Force #4	Force #5
0,0	5,0	5,0	5,5tan(30)	5,5tan(30)
ax,ay	0,-4	fg,,0	bc,,30	bg,,-30



bc = -4.00 (compression)
bg = -4.00 (compression)
fg = 6.93 (tension)