



Statics Power

*Your 24-7 Tutor
For
Engineering Statics*

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www.actuspotentia.com/Statics.shtml

Bottom Line

- Finish Homework quickly
- Ace your Exams and get good grades
- Be ready for next level of Mechanics courses
- Become an expert in drawing free body diagram

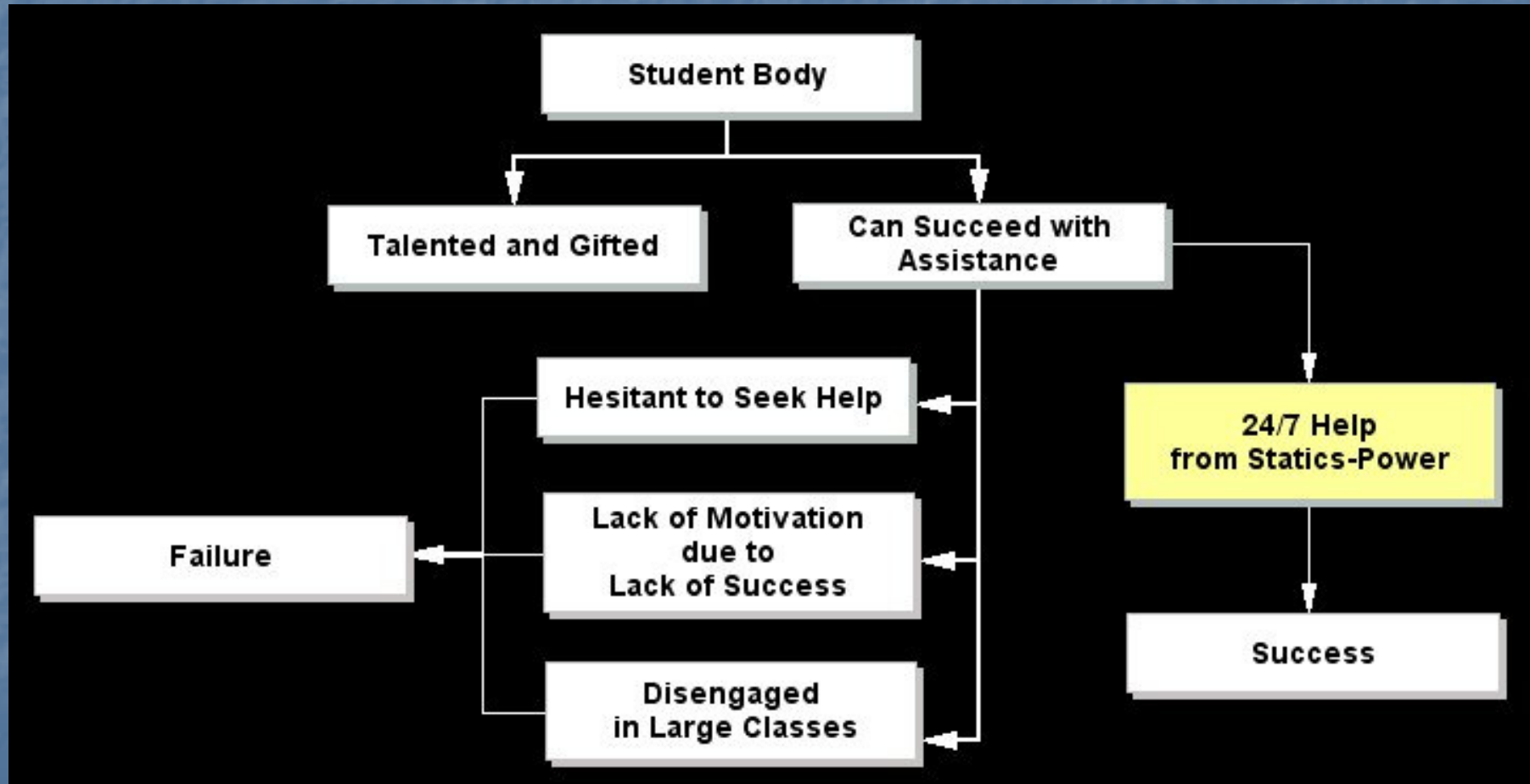
How is Statics^{Power} Different?

- ***Other Software :***
 - ❖ *Operates from a problem bank*
- ***Statics Power :***
 - ❖ *The students can pose and solve an unlimited number of problems of their choice.*
 - ❖ *Easy-to-learn drawing tools enable the students to pose the problems.*
 - ❖ *Six topics wrapped in one package—*
 - ✓ *Force-Moment-Couple*
 - ✓ *Free-body-diagram*
 - ✓ *Shear-Moment Diagrams*
 - ✓ *Area Properties*
 - ✓ *Friction Problems*
 - ✓ *Method of Joints*

What will it do for the students?

- *Will supplement and reinforce classroom activities.*
- *Will give them the control over the pace of the progress in their learning.*
- *Will keep them engaged through interactive lessons.*
- *Will put them in a structured environment for mastering new concepts.*
- *Will develop their ability to formulate and solve problems.*
- *Will enhance their skill through drill and practice.*
- *Will provide 24/7 help/support on the desktop.*
- *Will tell them what went wrong and where in multistep problems.*
- *Will prepare them for higher level courses.*

No Student Left Behind



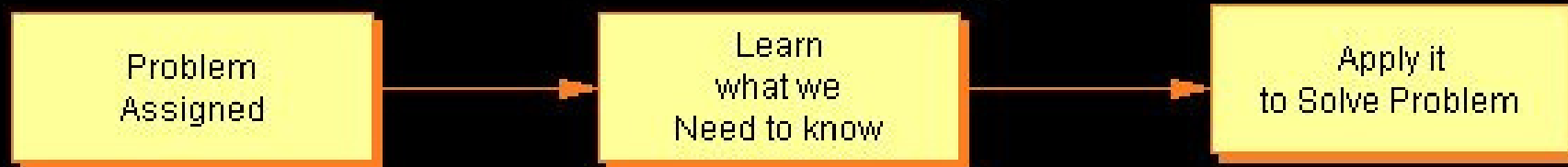
Statics Power

Promotes Problem-Based-Learning

Subject Based Learning



Problem Based Learning



Lecture Contents

Contents

(slide numbers in parenthesis)

- | | |
|--|---|
| 1. <u>Newton</u> (3) | 14. <u>Center of mass, centroid</u> (30,31) |
| 2. <u>First Law</u> (4,5) | 15. <u>Rotational motion</u> (32-34) |
| 3. <u>Force</u> (6-8) | 16. <u>General motion & equilibrium</u> (35-37) |
| 4. <u>Non-rectangular components</u> (9) | 17. <u>Concurrent forces</u> (38) |
| 5. <u>Rectangular components</u> (10-13) | 18. <u>Two-force member</u> (39) |
| 6. <u>Mass</u> (14) | 19. <u>Friction</u> (40) |
| 7. <u>Gravitation and weight</u> (15-17) | 20. <u>Supports</u> (41) |
| 8. <u>Moment</u> (18,19) | 21. <u>Cables</u> (42) |
| 9. <u>Couple</u> (20) | 22. <u>Free-Body-Diagram</u> (43-45) |
| 10. <u>Translational motion</u> (21,22) | 23. <u>Truss</u> (46-50) |
| 11. <u>Second Law</u> (23,24) | 24. <u>Frames</u> (51-54) |
| 12. <u>Third Law</u> (25-27) | 25. <u>Beams</u> (55-57) |
| 13. <u>Equation of motion, translation</u> (28,29) | 26. <u>Moment of Inertia</u> (58,59) |

Screen Shot

Force-Moment-Couple Application

(9 problem situations are included in the application)

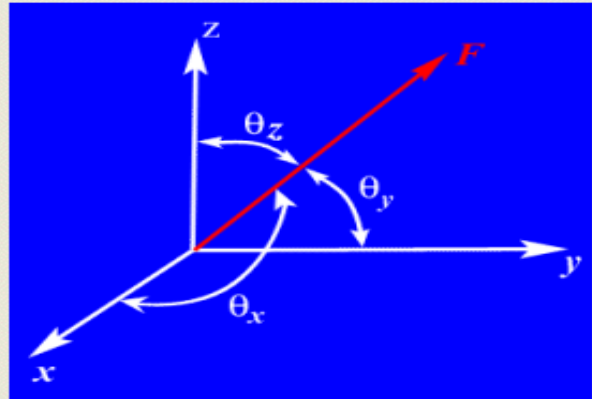
DirectionCosines

Direction Cosines

Check three given quantities

- F(x)
- F(y)
- F(z)
- cos(theta - x)
- cos(theta - y)
- cos(theta - z)
- Magnitude of F

Setup Solve

$$F_x = F \cos \theta_x \quad F_y = F \cos \theta_y$$
$$F_z = F \cos \theta_z$$
$$F_x^2 + F_y^2 + F_z^2 = F^2$$


Next Problem Close Calculator

Screen Shot Free-Body-Diagram Application

Free Body Diagram

File Graph Options View Help

x16 1 m

1 square = 1 m
Zoom: 16X

Draw any truss, frame or machine by using the structural elements

Apply point load, distributed load, and couple by using the load button

Number	Type	# Pins	Name	Length	Width	Radius
0	Beam	3	ABE	18.22569	1	0
1	Beam	3	CBD	18.45232	1	0
2	Beam	2	DE	10.79363	1	0
3	Pin Support	1	A	0	0	0
4	Roller2 Supp	1	C	0	0	0
*						

Name	X	Y
A	22.375	10.125
B	30.75	26.3125
C	39.375	10
D	36.21298	16.04284
E	36.3125	15.9375
*		

Screen Shot

Free-Body-Diagram Application

Free Body Diagram

File Graph Options View Help

Whole FBD | Solution Strategy | Member ABE | Member CBD | Member DE | Pins

3 Equations and 6 Unknown Forces

Software draws free-body-diagrams for the whole structure and each component of the structure.

Analysis view

Screen Shot Free-Body-Diagram Application

The screenshot displays the 'Free Body Diagram' application window. The interface includes a menu bar (File, Graph, Options, View, Help), a toolbar with various icons, and a tabbed workspace. The active tab is 'Solution Strategy'. On the left, the 'Solution Members' panel is empty, with buttons for 'Add', 'Remove', 'Solve', and 'Show Program Solution'. A message indicates 'Step 2 cannot be solved because there are too many unknowns.' The main area shows a table titled 'Possible Solution Strategy' with the following data:

Step	Member Name	Flag
1	Whole FBD	
2	Member FG	Computer
3	Member CDF	Computer
4	Member DE	Computer
5	Pin E	Computer
6	Pin C	Computer
7	Member AB	Computer
7	Member CAH	Computer
7	Pin A	Computer
8	Pin H	Computer
9	Member EBH	Computer
10	Pin B	Computer

A green arrow points from the text below to the table. The status bar at the bottom indicates 'Analysis view'.

*Software shows solution strategy
for frame, machines, truss problems.*

Free-Body-Diagram Drawing Tools

Free Body Diagram

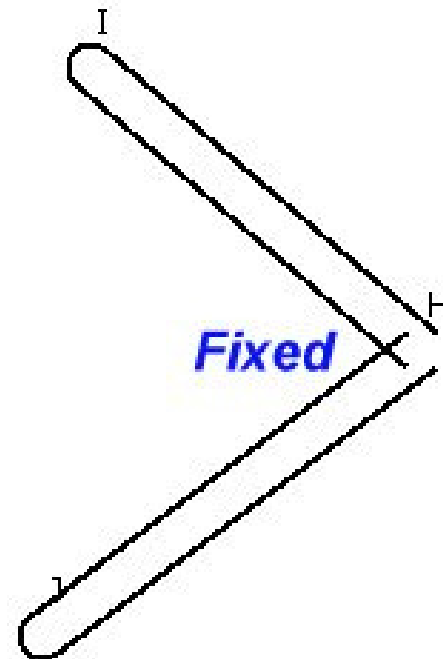
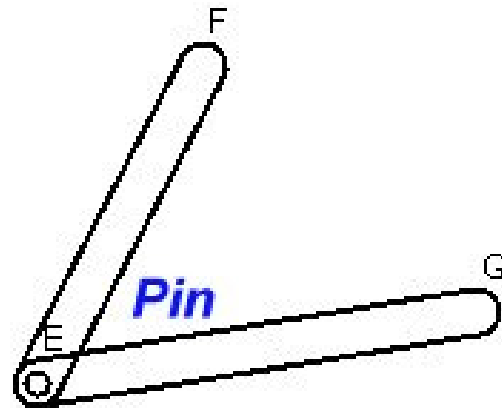
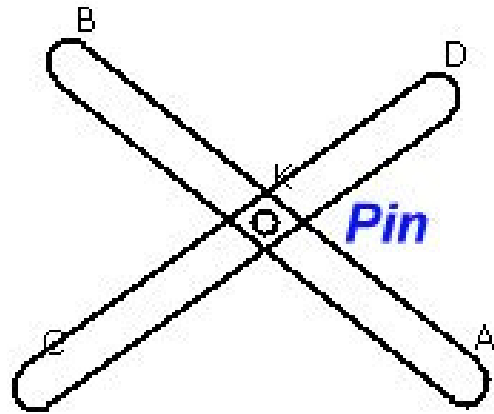
File Graph Options View Help

1 square = 1 m
Zoom: 16X

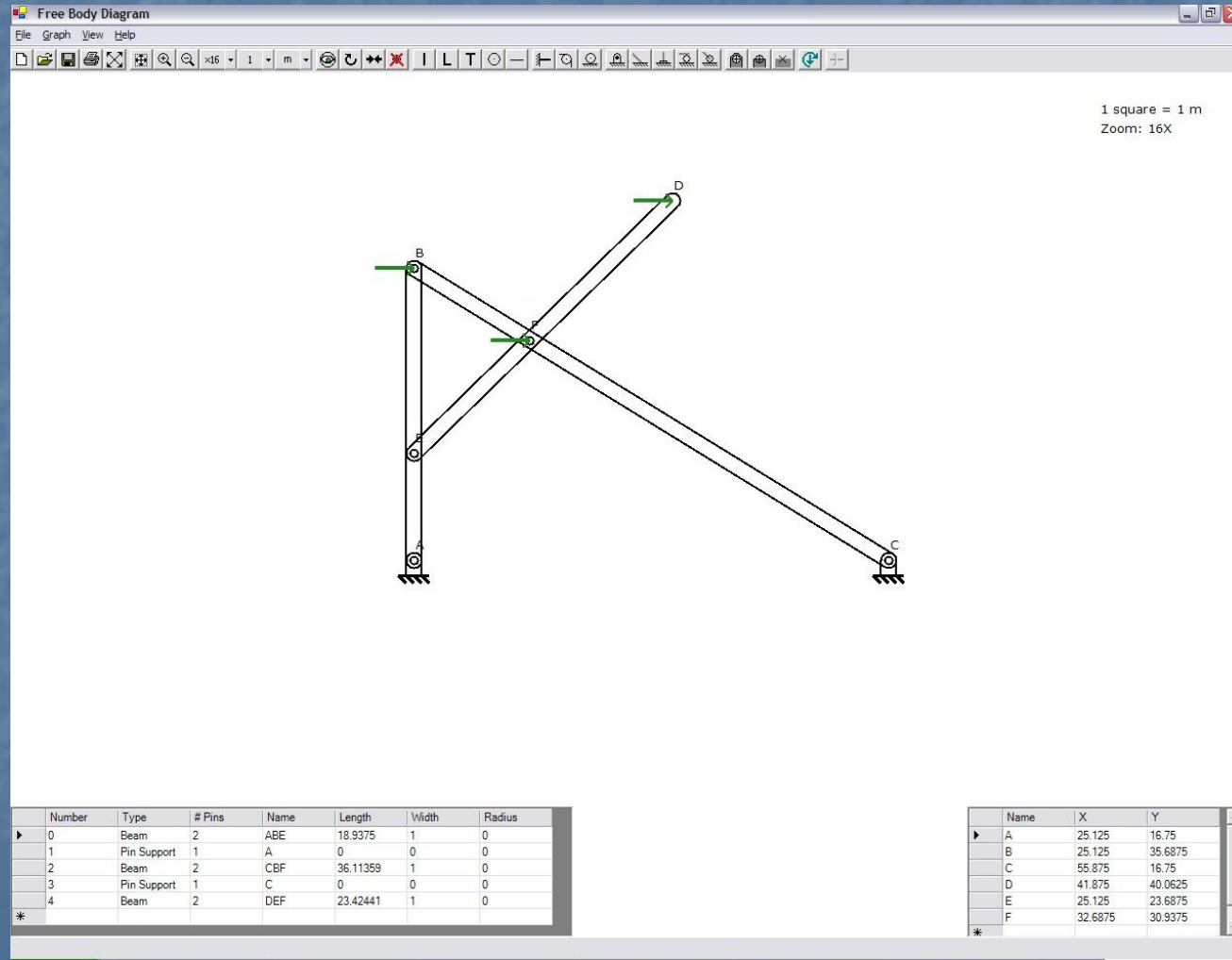
Number	Type	# Pins	Name	Length	Width	Radius
0	Beam	2	AB	10.29904	1	0
1	Beam	2	CD	8.889073	1	0
2	Beam	2	DE	8.676702	1	0
3	Beam	3	FGH	11.99039	1	0
4	Beam	2	HI	15.55274	1	0

Name	X	Y
A	17.6875	16.375
B	11.125	24.3125
C	26.9375	25.5
D	23.0625	17.5
E	31.3125	14.8125
F	30.125	22.5625
G	41.75	25.5

Free-Body-Diagram Connect Members

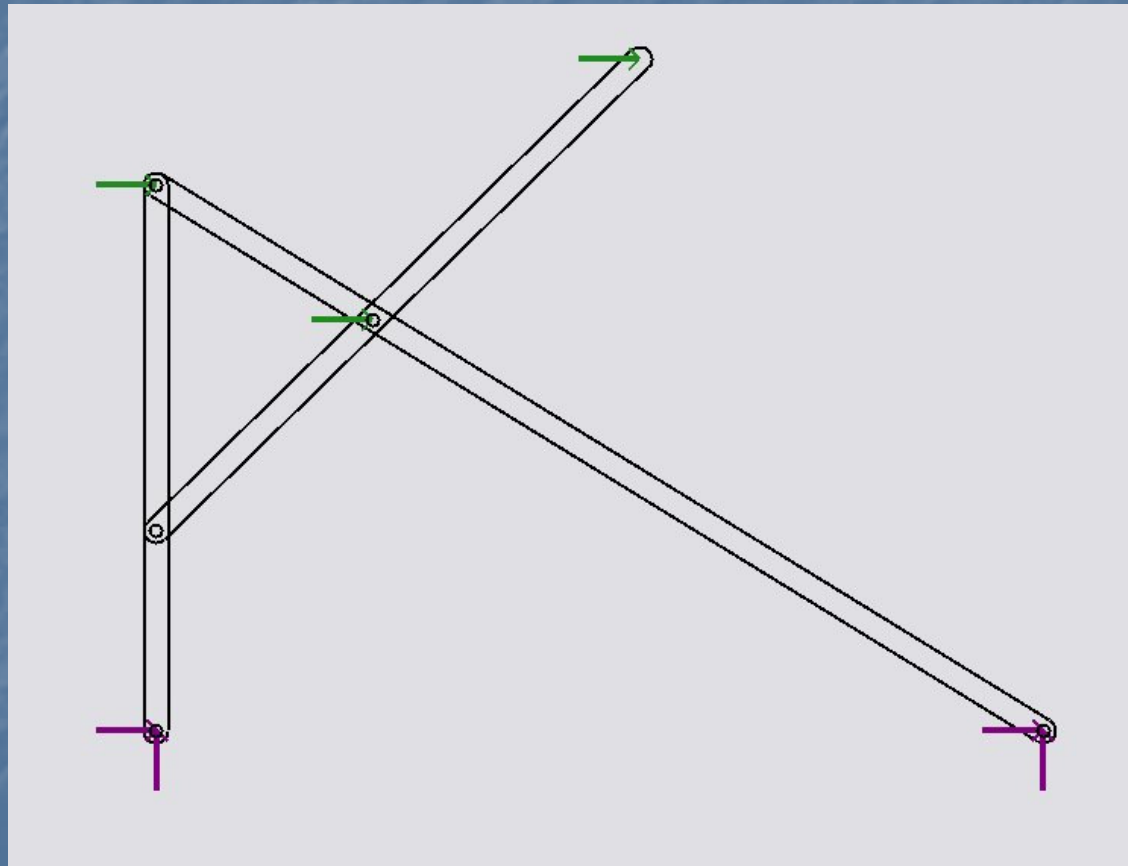


Frame-1

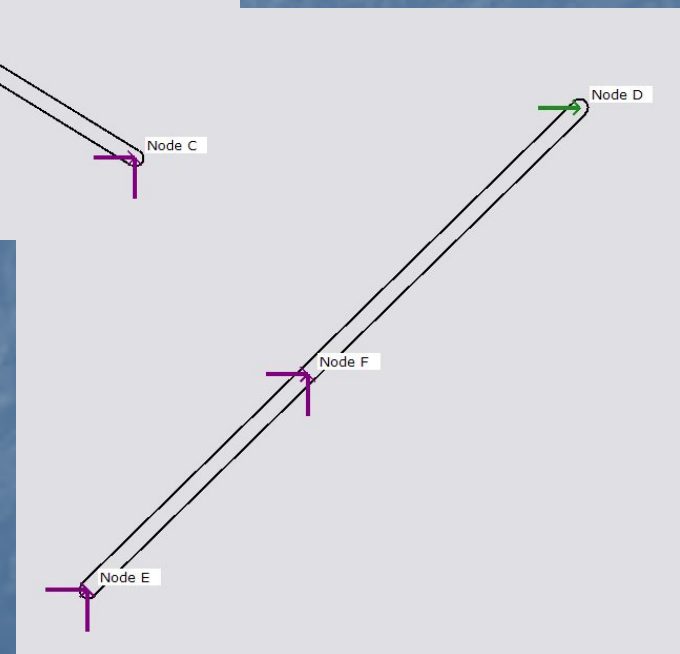
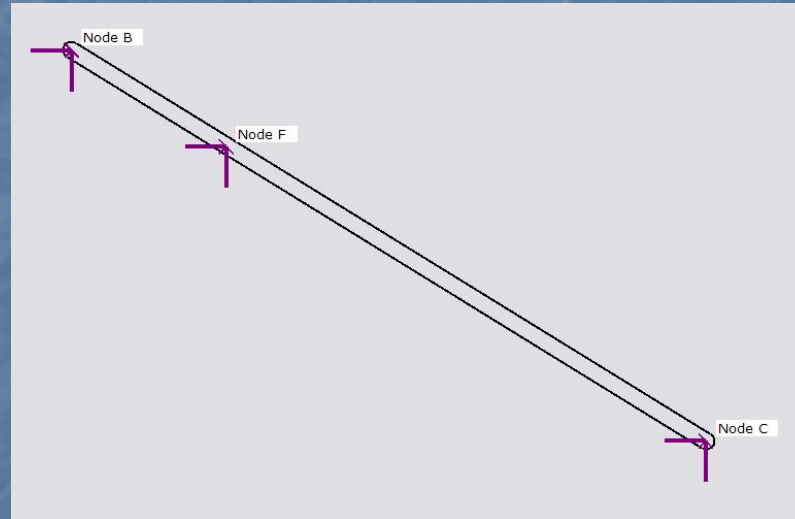
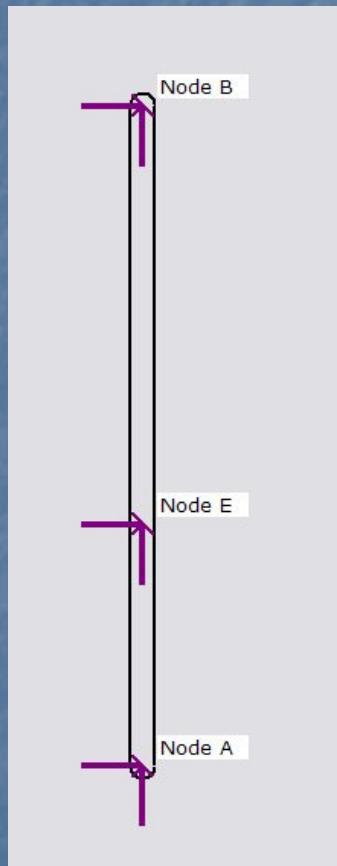


Software Draws FBDs

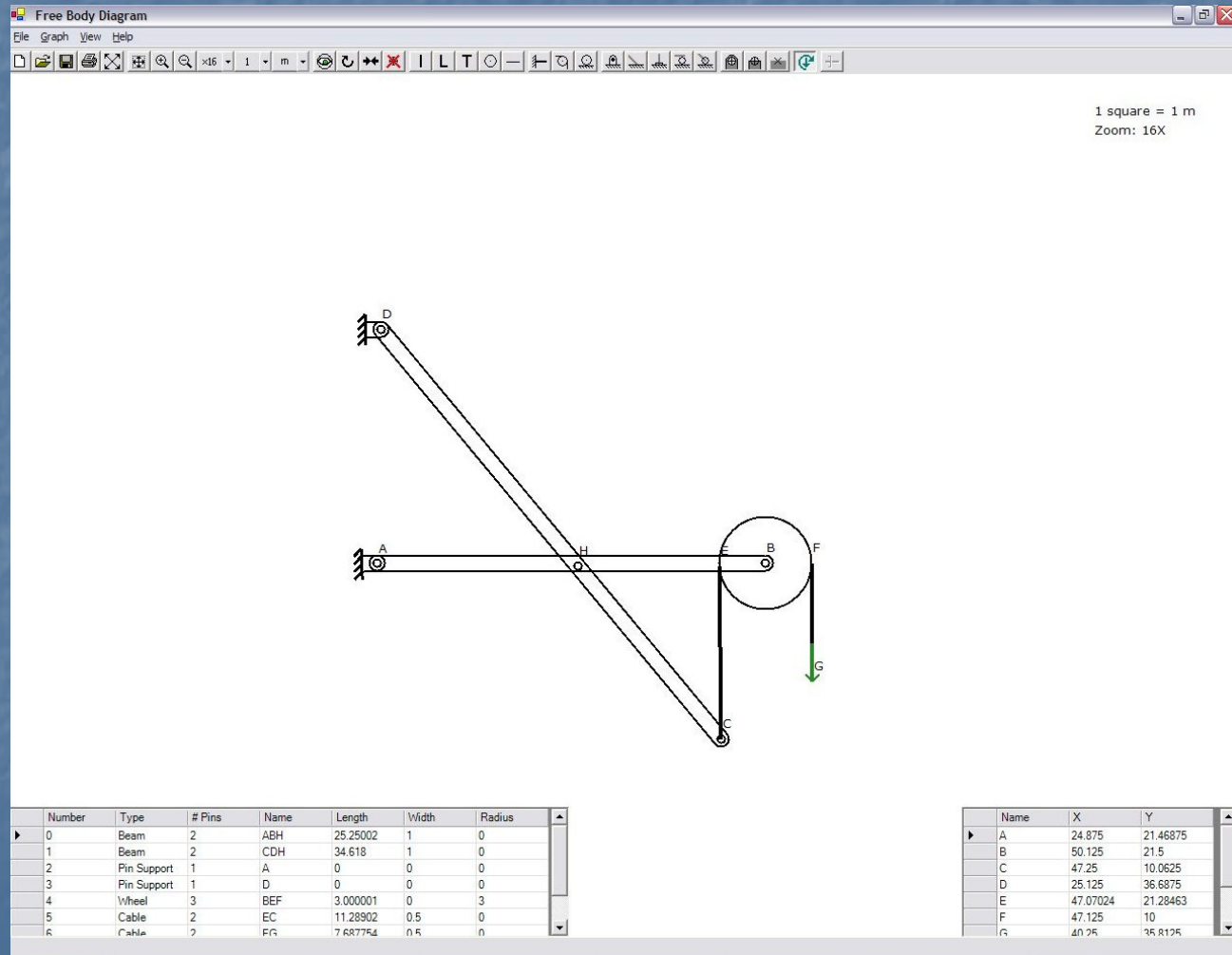
Frame-1



FBDs for Frame-1

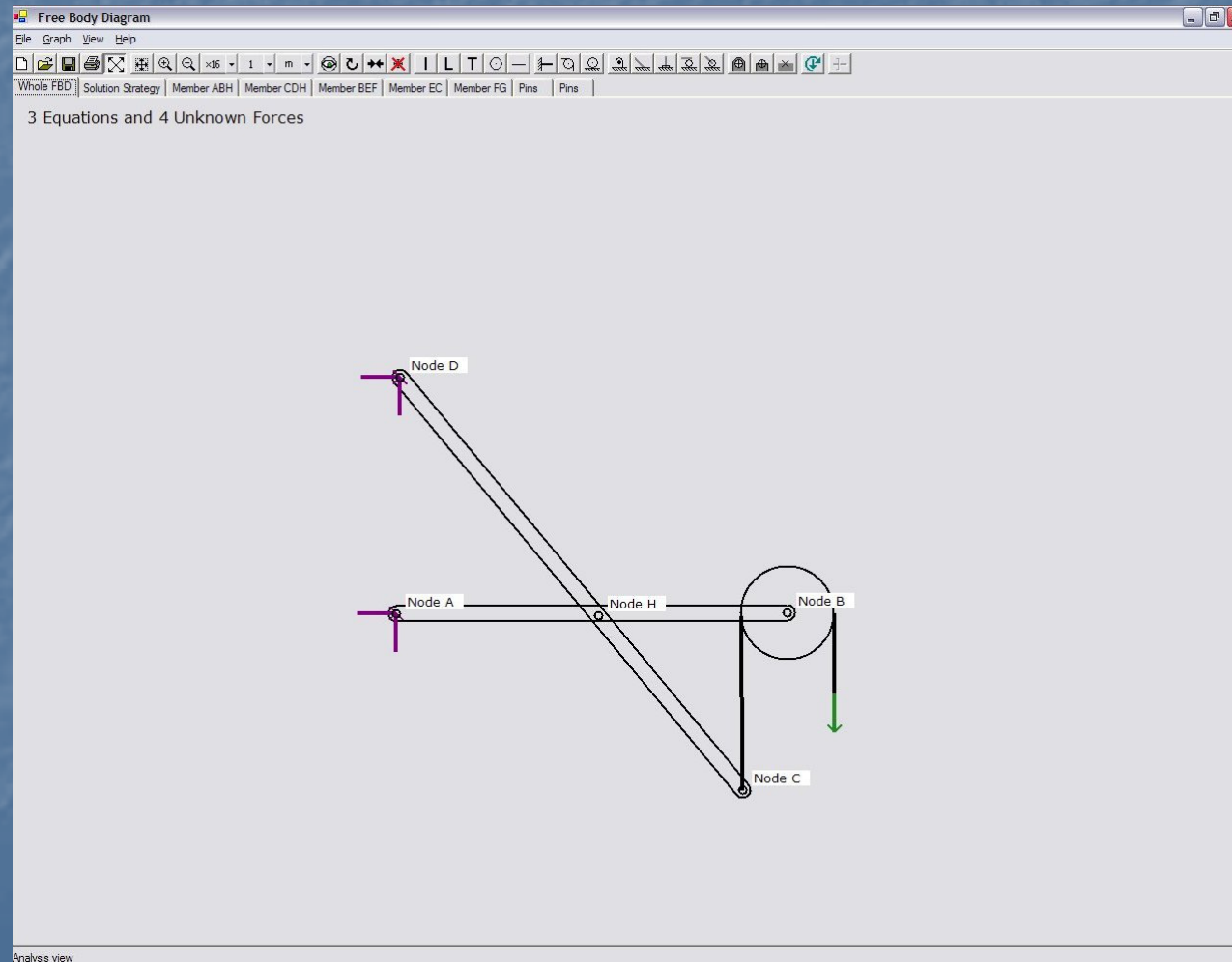


Frame-2



Software Draws FBDs

Frame-2



FBDs Frame-2

The image displays two screenshots of a software interface for creating Free Body Diagrams (FBDs). The top screenshot shows a horizontal beam with nodes A, H, and B, and the text "3 Equations and 6 Unknown Forces". The bottom screenshot shows a diagonal beam with nodes D, H, and C, and the text "3 Equations and 5 Unknown Forces". Both screenshots include a menu bar (File, Graph, View, Help) and a toolbar with various drawing tools.

Machine

Free Body Diagram

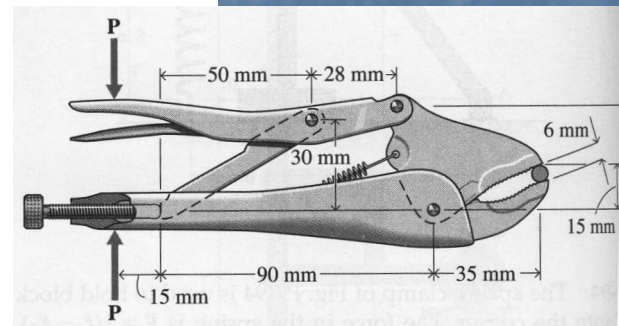
File Graph View Help

1 square = 1 m
Zoom: 16X

draw FBD

Number	Type	# Pins	Name	Length	Width	Radius
0	Beam	2	AB	8.306859	1	0
1	Beam	2	AC	10.19057	1	0
2	Beam	2	ADH	23	1	0
3	Beam	2	EA	3.380204	1	0
4	Beam	2	EF	11.41151	1	0
5	Beam	2	BGI	17.75	1	0
6	Beam	2	HI	8.087654	1	0

Name	X	Y
A	35.5625	20.6875
B	30.3125	27.125
C	35.5	20.6875
D	12.5625	20.6875
E	12.5625	20.84375
F	36.6875	17.5
G	30.375	27.0625



Screen Shot - Truss Problem

Truss Solver - Method of Joints

How is the truss supported?

Pin - Roller Pin - Pin

Choose a Joint: Joint Label: A,B,C,...
Joint Coordinate: Joint Load:

Is there a pin or roller at this joint? Pin/Roller None

How many members meet at this joint? (Max. 5)
For how many members the force is UNKNOWN?

One end of each member is at the joint. Enter label and coordinate of the other end.

Label	Coordinate	F(ED)	Unknown	Known	OK/EDIT
<input type="text" value="D"/>	<input type="text" value="6"/> <input type="text" value="6"/>	<input type="text" value="F(ED)"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="button" value="OK/EDIT"/>
<input type="text" value="F"/>	<input type="text" value="6"/> <input type="text" value="4"/>	<input type="text" value="F(EF)"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="button" value="OK/EDIT"/>

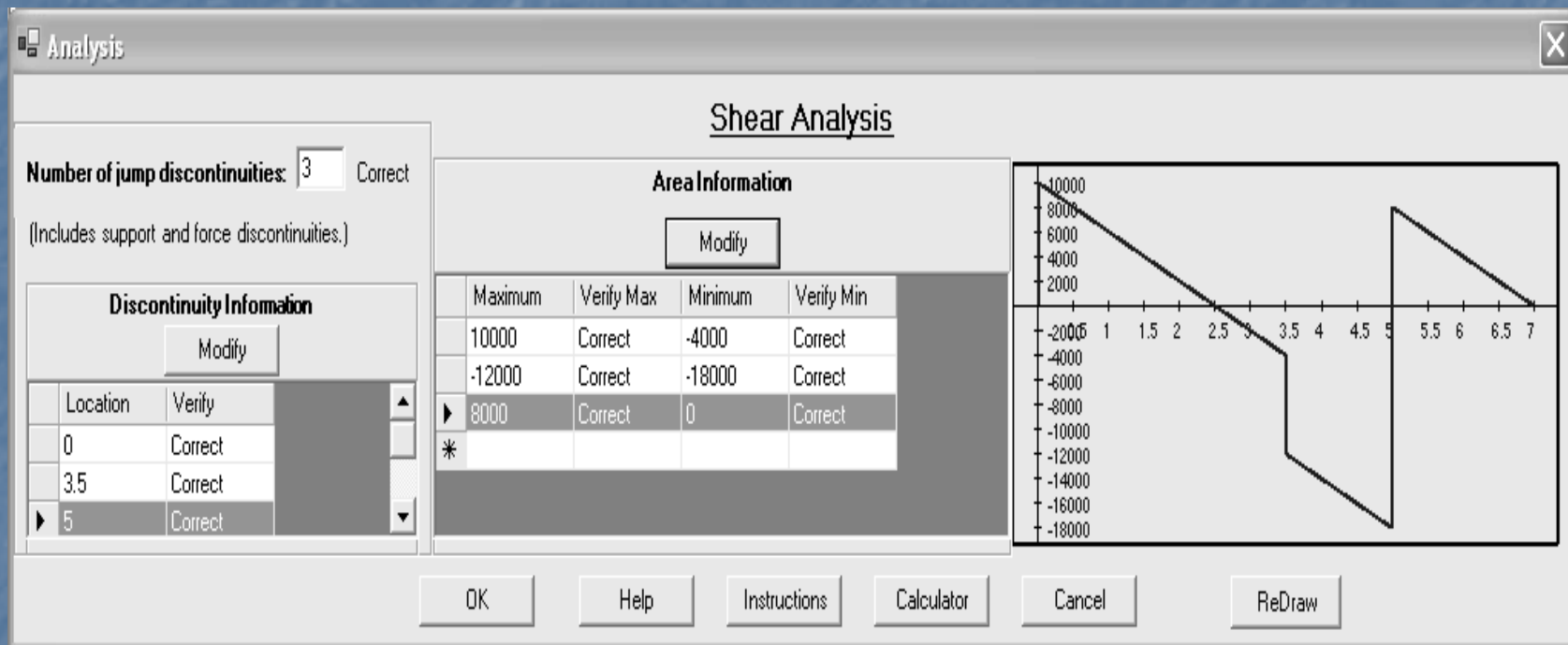
Joint Equations

X - Equilibrium Equation
 F(ED) + F(EF) =

Y - Equilibrium Equation
 F(ED) + F(EF) =

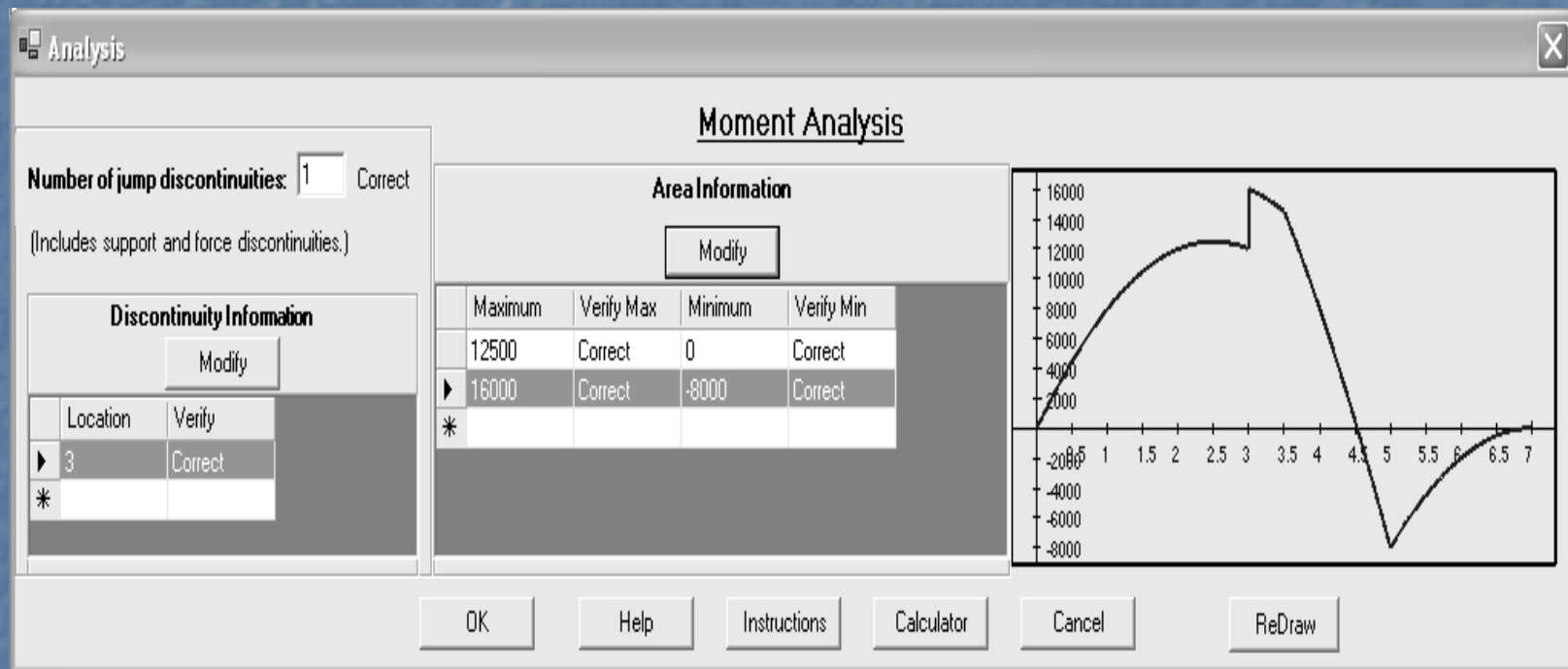
Screen Shot

Shear-Bending Moment Application



Software prompts the user for responses and guides the user through the shear-force-analysis

Screen Shot Shear-Bending Moment Application



Software prompts the user for responses and guides the user through the bending-moment-analysis

Screen Shot - Friction Application

Friction Problem Strategy

How many bodies? (Max of 4)

The bodies are named as: A B C

How many rough surfaces? (Max of 4)

Surface-1

Between (check 2) A B C D Floor Wall

Friction Coefficient Known Unknown

Surface-2

Between (check 2) A B C D Floor Wall

Friction Coefficient Known Unknown

Surface-3

Between (check 2) A B C D Floor Wall

Friction Coefficient Known Unknown

Solution Strategy

Equilibrium Equations

For body A For body B For body C

Unknown forces: N(AB) F(AB) N(AFloor) F(AFloor) N(CFloor) F(CFloor) P(A1) P(A2) P(B1) P(C1)

Change out of INEQUALITIES into EQUALITIES

$F(AB) = < \mu(A B) N(AB)$ $F(AFloor) = < \mu(AFloor) N(AFloor)$

$F(CFloor) = < \mu(CFloor) N(CFloor)$

Body A

Weight of A Known Unknown

How many UNKNOWN applied forces on A?

Impending motion of A Tip/Moment Balance Slip

Body B

Weight of B Known Unknown

How many UNKNOWN applied forces on B?

Impending motion of B Tip/Moment Balance Slip

Body C

Weight of C Known Unknown

How many UNKNOWN applied forces on C?

Impending motion of C Tip/Moment Balance Slip

Equations that relate unknown forces; in addition to equilibrium equations

In addition to equilibrium equations, how many equations can you write (BY USING NEWTON'S 3RD LAW, CONTINUOUS CABLE CONDITION etc.) that relate these unknown forces?

Software prompts the user for responses and guides the user through the friction problem

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Screen Shot Area Properties Application

Area Properties

Define 2D region
 Xmin: 0 Xmax: 2 Ymin: 0 Ymax: 2

Plot type:
 Add f(x)
 Add f(y)
 Add ellipse
 Add polygon
 Plot
 Reset

Functions
 f(x)=x^2
 f(y)=2-y^2

Enable analysis using a shifted/rotated coordinate system
 Yes
 No

Solve

Coordinate System
 Enter new origin
 Shift origin? Yes No X_o: 1 Y_o: 1
 Enter rotation angle (deg ccw):
 Rotate coordinate system? Yes No 30
 Solve

Moments/Product of Intertia
 I_x'= 0.08024101
 I_y'= 0.4778503
 I_{xy}'= -0.02727762

Solution properties

Area	Moments/Product of Intertia	Moments/Product of Intertia in centroidal coordinate system
A= 0.8782825	I _x = 0.5678717	I _x (c)= 0.09409314
Centroid location	I _y = 0.1696452	I _y (c)= 0.05091037
X _c = 0.3676816	I _{xy} = 0.2482439	I _{xy} (c)= 0.01106459
Y _c = 0.7344641		

User enters functions to define the boundaries of the area

Area properties

Use of parallel axis and rotated axis theorems

Screen Shot Area Properties Application

Area Properties

Define 2D region

Xmin: 0 Xmax: 200 Ymin: 0 Ymax: 200

Plot type:

Add f(x)

Add f(y)

Add ellipse

Add polygon

Plot

Reset

Enable analysis using a shifted/rotated coordinate system Yes No

Solve

Functions

- poly(4,{0,120,200,200})
- ell(60,60,60,0,0,0)
- ell(40,40,60,0,0,0)

200

y

Yc

Xc

0

0 x 200

** Click on desired area

Deselect Area

User builds composite areas by drawing ellipses and polygons

Solution properties

Area	Moments/Product of Inertia	Moments/Product of Inertia in centroidal coordinate system
A= 12217.22	Ix= 7.563629E+07	Ix(c)= 2.560547E+07
Centroid location	Iy= 6.062277E+07	Iy(c)= 1.672101E+07
Xc= 59.94524	Ixy= 4.687926E+07	Ixy(c)= 13059.88
Yc= 63.99301		