

Problem V

Temperature Loading

Steel

$E = 29000$ ksi

Poissons Ratio = 0.3

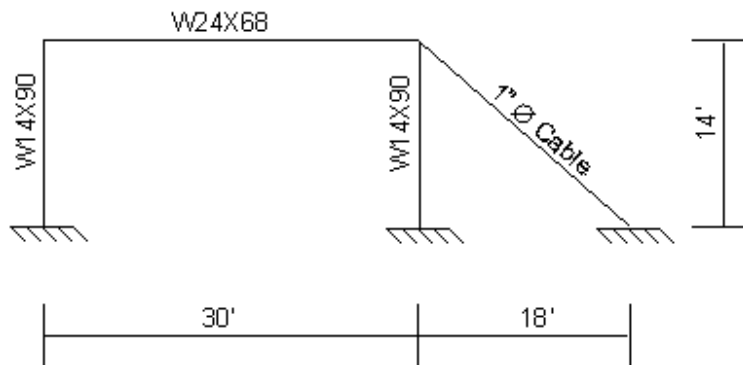
Coefficient of thermal expansion = 0.0000065 (degrees Fahrenheit)

Beam-column connections are rigid

Cable is pinned at each end

To Do

Determine support reactions and frame displacement due to a 100° Fahrenheit temperature drop in the cable only.



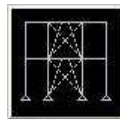
CSI Solution Demonstrates Use of These Features

- Grid Lines
- Temperature Loading

Problem V Solution



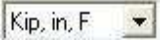
1. Click the **File menu > New Model** command to display the **New Model** form.

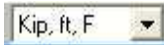





2. Click the drop-down box to set the units to .





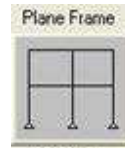
3. Click the **2D Frames** button to display the **2D Frames** form. In that form:



- Select *Portal* in the *2D Frame Type* drop-down list.
- Type 1 in the *Number of Stories* edit box.
- Type 1 in the *Number of Bays* edit box.



- Type **14** in the *Story Height* edit box.
 - Type **30** in the *Bay Width* edit box.
 - Click the **OK** button.
4. Click the “X” in the top right-hand corner of the 3-D View window to close it.
5. Click the **Define menu > Coordinate Systems/Grid** command to display the **Coordinate/Grid Systems** form. In that form:
- Click the **Modify/Show System** button to display the **Define Grid** form. In that form:
 - Verify that the *Ordinates* option is selected in the *Display Grids as* area in the middle right of the form.
 - In the *X Grid Data* portion of the spreadsheet, type **x3** in the *Grid ID* cell of row 3. In that same row, type **33** in the *Ordinate* cell and click in the *Line Type* cell to display *Primary*, the *Visibility* cell to display *Show* and in the *Bubble Loc.* cell to display *Top*.
 - Click the **OK** buttons on the **Define Grid** and **Coordinate/Grid Systems** forms to exit all forms.
6. Click the **XZ View** button  to reset the view.
7. Click the **Set Display Options** button  (or the **View menu > Set Display Options** command) to display the **Display Options for Active Window** form. In that form:
- Check the *Labels* box in the *Joints* area.
 - Check the *Labels* box in the *Frames/Cables/Tendons* area.
 - Click the **OK** button.
8. Click the drop-down box in the status bar to change the units to .
9. Click the **Define menu > Materials** command to display the **Define Materials** form. Highlight the STEEL material and click the **Modify/Show Material** button to display the **Material Property Data** form. In that form:
- Verify that the *Modulus of Elasticity* is 29000, *Poisson's Ratio* is 0.3 and the *Coeff of Thermal Expansion* is 0.0000065.
 - Click the **OK** buttons on the **Material Property Data** and **Define Materials** forms to exit the forms.
10. Click the **Define menu > Frame Sections** command to display the **Frame Properties** form.
- In the *Choose Property Type to Add* area, click the drop-down box that reads *Add I/Wide Flange* and then click on the *Add Circle* item.
 - Click the **Add New Property** button to display the **Circle Section** form. In that form:
 - Type **CABLE** in the *Section Name* edit box.
 - Type **1** in the *Diameter (t3)* edit box.
 - Click the **OK** buttons on the **Circle Section** and **Frame Properties** forms to exit all forms.

11. Click the drop-down box in the status bar to change the units to .
12. Verify that the snap to **Points and Grid Intersections** button  on the side toolbar is depressed.
13. Click the **Draw Frame/Cable/Tendon** button  on the side toolbar, or the **Draw menu > Draw Frame/Cable/Tendon** command to display the **Properties of Object** form. In that form:
 - Select *CABLE* from the *Property* drop-down box.
 - Select *Pinned* from the *Moment Releases* drop-down box
14. Draw the line (cable) object as follows:
 - Place the mouse pointer on point 4. When the text box reading "Point" appears, click the left mouse button once.
 - Move the mouse pointer to the grid intersection at the bottom of the cable (lower right-hand grid intersection). When the text box reading *Grid Point* appears, click the left mouse button once.
 - Press the Enter key on the keyboard.
15. Click the **Set Select Mode** button  to exit the Draw mode and enter the Select mode.
16. Select joints 1, 3 and 5.
17. Click the **Assign menu > Joint > Restraints** command to display the **Joint Restraints** form. In that form:
 - Click the **fixed base fast restraint** button  to set all degrees of freedom (U1, U2, U3, R1, R2 and R3) as restrained.
 - Click the **OK** button.
18. Select the beam (line object 3).
19. Click the **Assign menu > Frame/Cable/Tendon > Frame Sections** command to display the **Frame Properties** form. In that form:
 - Click on *W24X68* in the *Properties* area to highlight it.
 - Click the **OK** button.
20. Select the two columns (line objects 1 and 2).
21. Click the **Assign menu > Frame/Cable/Tendon > Frame Sections** command to display the **Frame Properties** form. In that form:
 - Click on *W14X90* in the *Properties* area to highlight it.
 - Click the **OK** button.
22. Click the **Show Undeformed Shape** button  to remove the displayed frame section assignments.
23. Click the **Define menu > Load Cases** command to display the **Define Loads** form. In that form:

- Type **0** in the *Self Weight Multiplier* edit box.
 - Click the **Modify Load** button.
 - Click the **OK** button.
24. Select the line (cable) object (frame object 4).
25. Click the **Assign menu > Frame/Cable/Tendon Loads > Temperature** command to display the **Frame Temperature Loading** form. In that form:
- Verify that the *Temperature* option is selected in the *Type* area.
 - Verify that the *By Element* option is selected in the *Temperature* area.
 - Type **-100** in the *Temperature* edit box.
 - Click the **OK** button.
26. Click the **Show Undeformed Shape** button  to remove the displayed temperature assignments.
27. Click the **Set Display Options** button  (or the **View menu > Set Display Options** command) to display the **Display Options for Active Window** form. In that form:
- Uncheck the *Labels* box in the *Joints* area.
 - Uncheck the *Labels* box in the *Frames/Cables* area.
 - Click the **OK** button.
28. Click the **Analyze menu > Set Analysis Options** command to display the **Analysis Options** form.



- In that form click the **Plane Frame XZ Plane** button  to set the available degrees of freedom.
 - Click the **OK** button.
29. Click the **Run Analysis** button  to display the **Set Analysis Cases to Run** form. In that form:
- Click on MODAL in the *Case Name* list to highlight it.
 - Click the **Run/Do Not Run Case** button.
 - Click the **Run Now** button.
30. When the analysis is complete, check the messages in the *SAP Analysis Monitor* window (there should be no warnings or errors) and then click the **OK** button to close the window.
31. Click the **Display menu > Show Forces/Stresses > Joints** command to display the **Joint Reaction Forces** form. In that form:
- Verify that the *Reactions* option is selected in the *Type* area.
 - Click the **OK** button.

32. The reactions are displayed on the screen. If the text goes off of the screen, click the **Pan** button  to move the display, or click the **Zoom Out One Step** button  as many times as required to resize the display.