

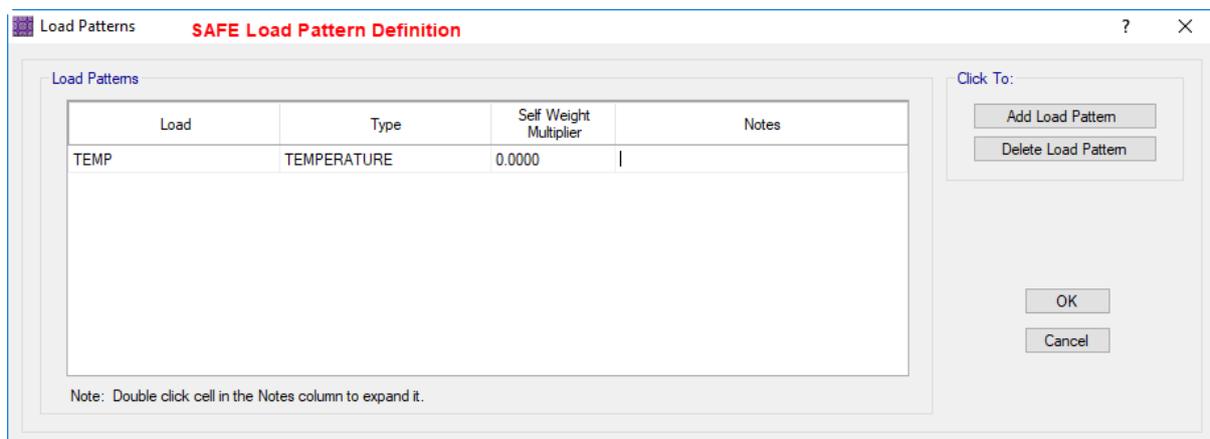
# TEMPERATURE LOADING IN ETABS AND SAFE

## I. Overview

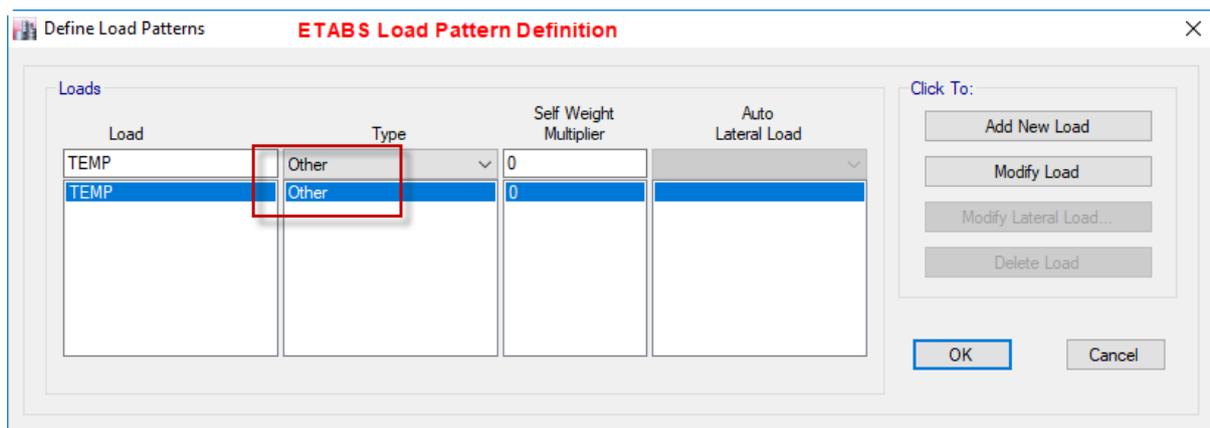
This technical note highlights the difference on temperature loading between ETABS and SAFE.

## II. Defining Load Pattern for Temperature Load

Temperature load in SAFE must be defined with load pattern type “Temperature”.



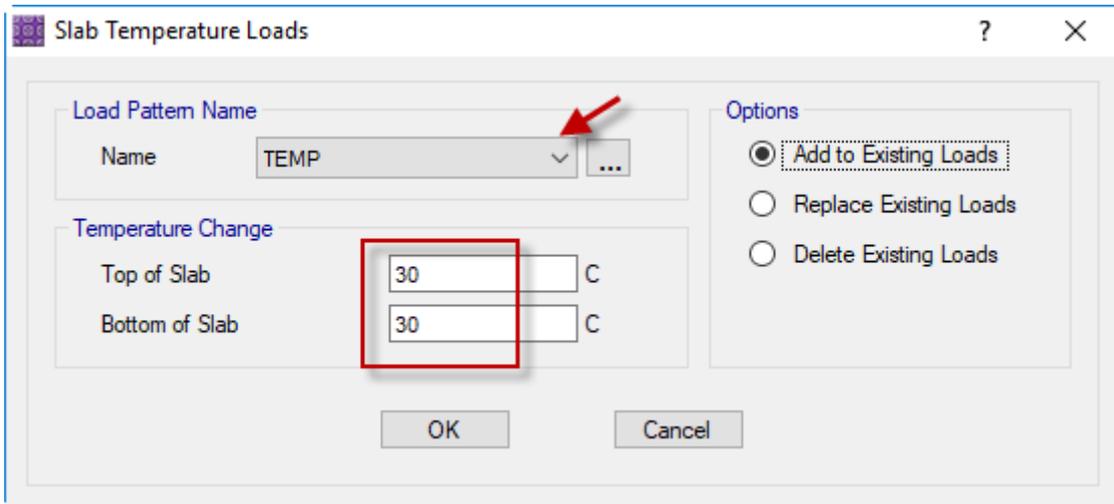
Temperature load in ETABS can be defined with load pattern type “Others”.



### III. Assigning Temperature Load in SAFE

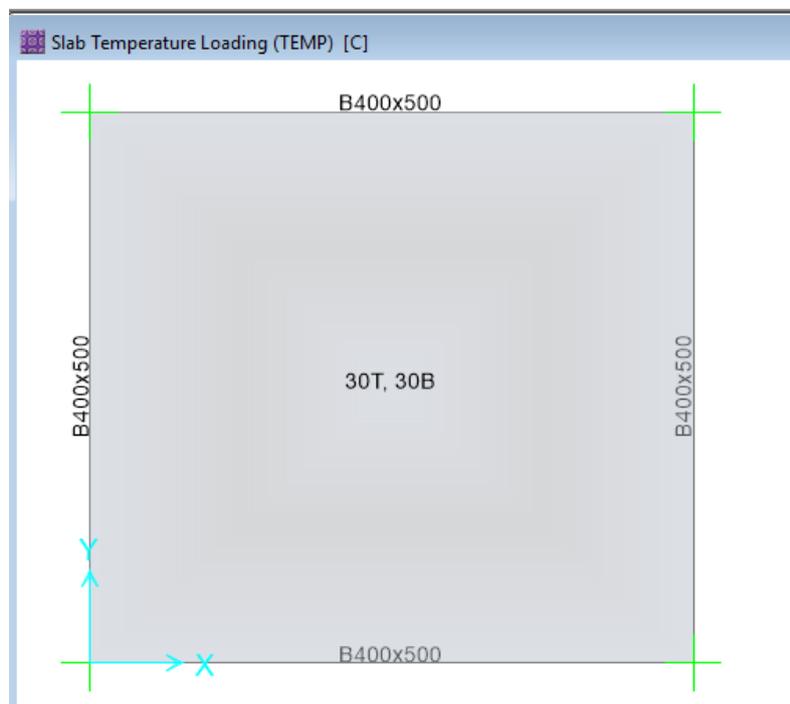
To assign temperature load in SAFE, select the slab/s and click on **Assign>Load Data>Slab Temperature Loads....**

Select the temperature load pattern TEMP and specify the change in top and bottom slab temperatures in the *Temperature Change* edit boxes.



**Note:** If the top and bottom temperature changes are the same, the load will be applied as constant through the slab thickness producing membrane strains. If the top and bottom temperature changes are different, the load is applied as linear in the thickness direction and produces bending strains.

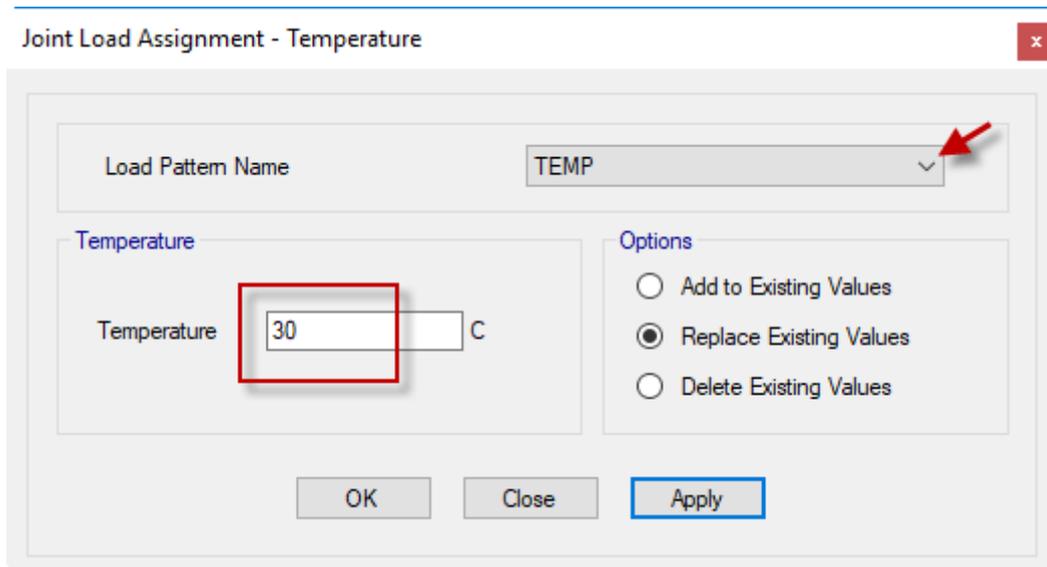
Slab temperature load will be shown as below.



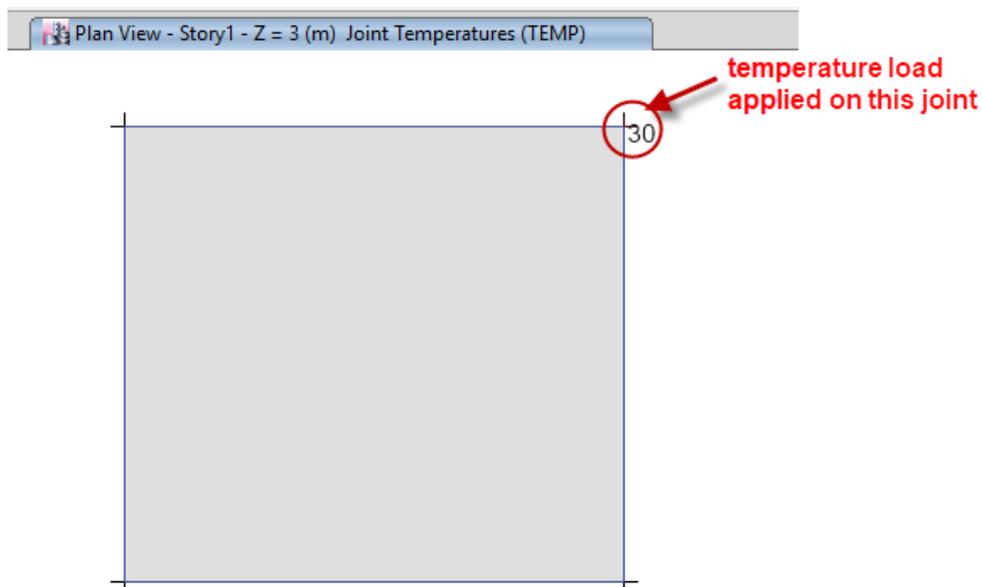
**IV. Assigning Temperature Load in ETABS**

ETABS has options to assign temperature load on joints, frames and shell elements.

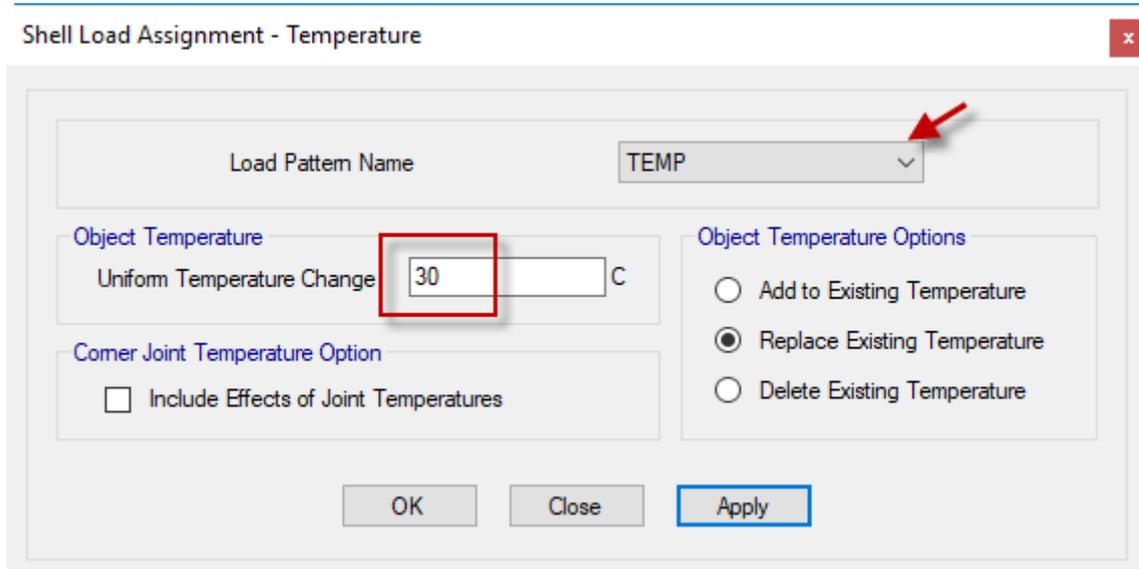
To assign temperature load on joint elements in ETABS, select the joint and click on **Assign>Joint Loads>Temperature....**



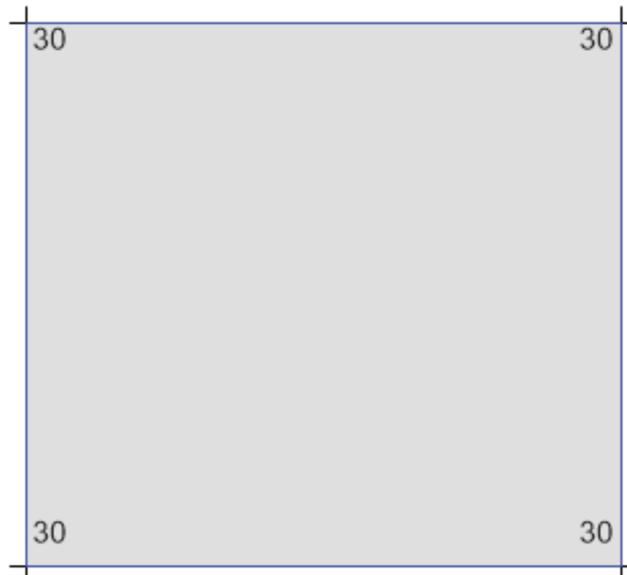
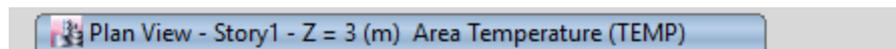
Joint temperature load will be shown as below.



To assign temperature load on slab elements in ETABS, select the slab/s and click on **Assign>Shell Loads>Temperature....**

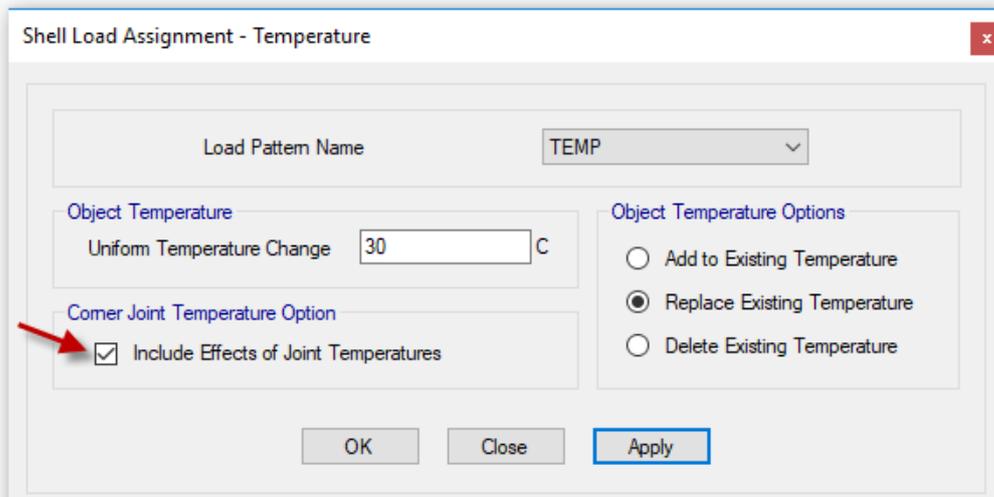
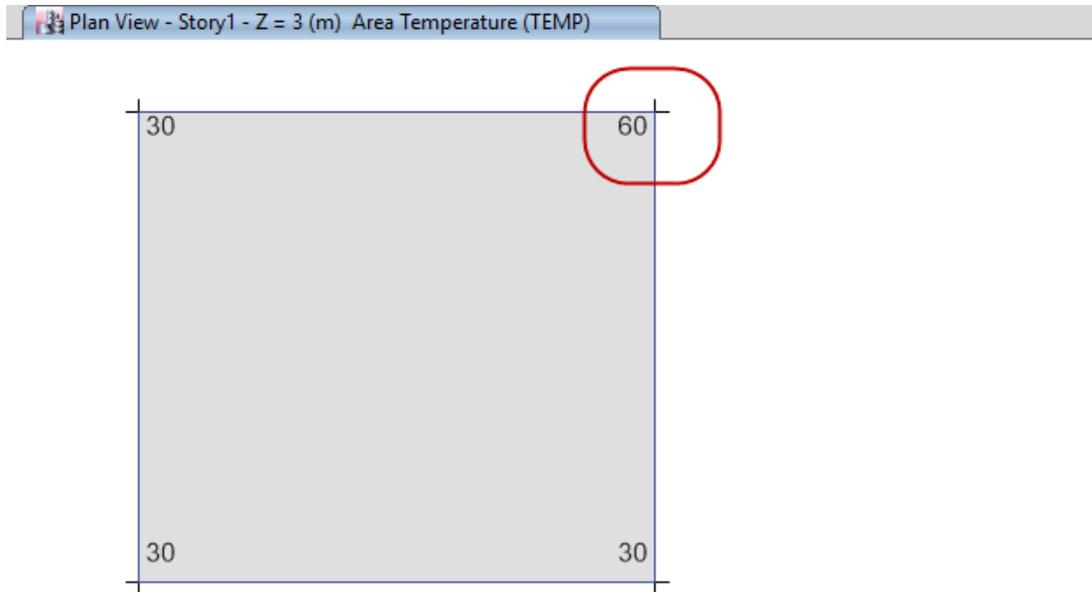


When temperature loads are displayed, numbers are shown at each corner of the shell object. Those numbers correspond to the temperatures at the corners of the object.

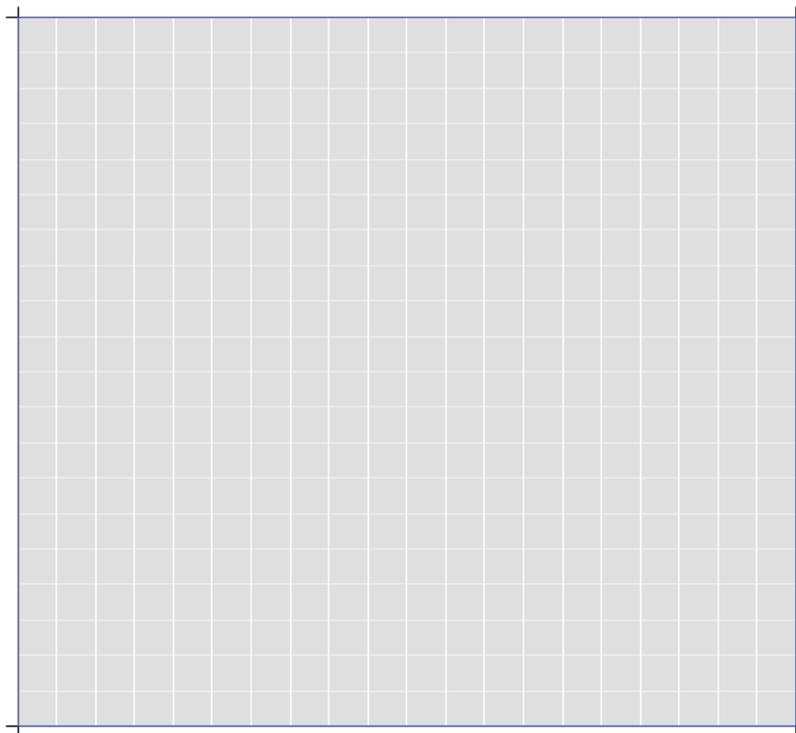
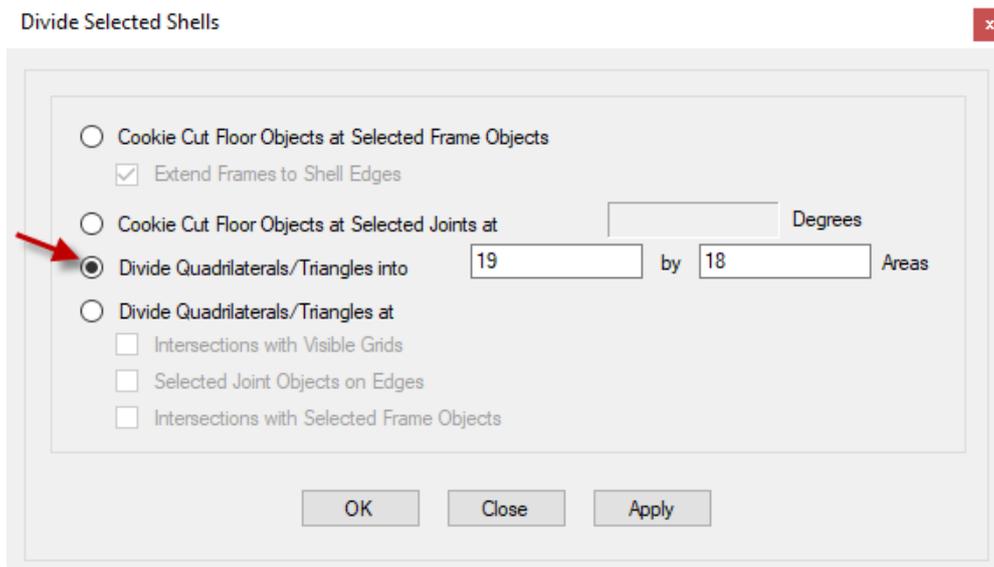


**Important Note:** If the effects of joint temperature were specified to not be included when the temperature load was assigned (“*Include Effects of Joint Temperatures*” check box unchecked), the displayed temperatures for the shell object are the same and are equal to the temperature assigned to the object. This is true regardless of any joint object temperatures that may be assigned to the joint objects at the corners of the shell object.

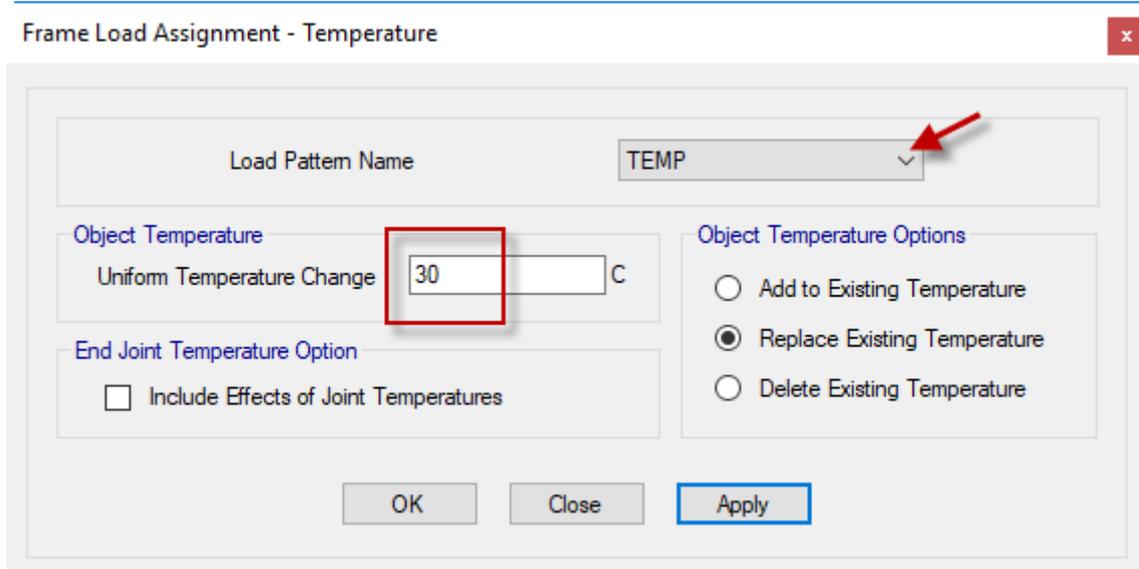
If the effects of joint temperature were specified to be included when the temperature load was assigned, the displayed temperatures for the shell object are equal to the temperature assigned to the object plus the temperature assigned to the joint object at the considered corner of the shell object. In that case the displayed temperatures for a shell object may be different at each corner.



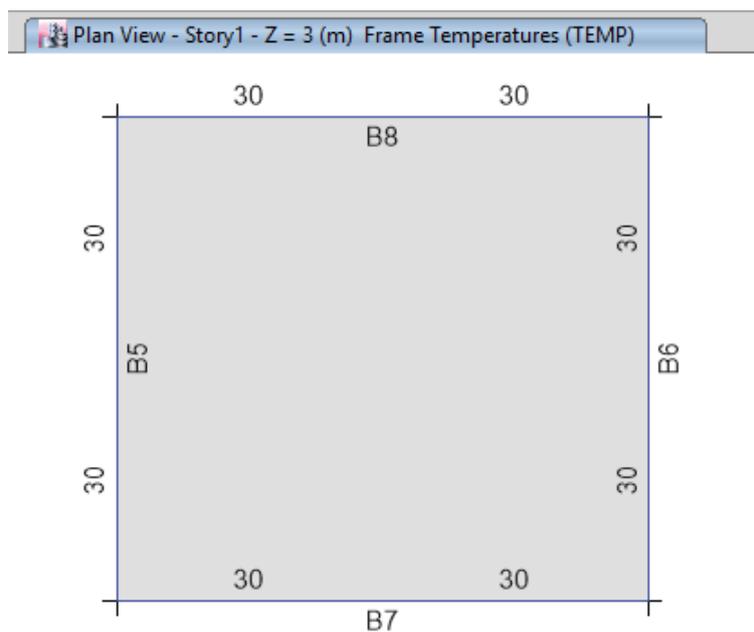
**Important Note:** The slabs have to be manually meshed (subdivided) in ETABS when applying temperature load. Select the slab/s and click on Edit>Shell>Divide Shells...



To assign temperature load on frame elements in ETABS, select the frame and click on **Assign>Frame Loads>Temperature....**

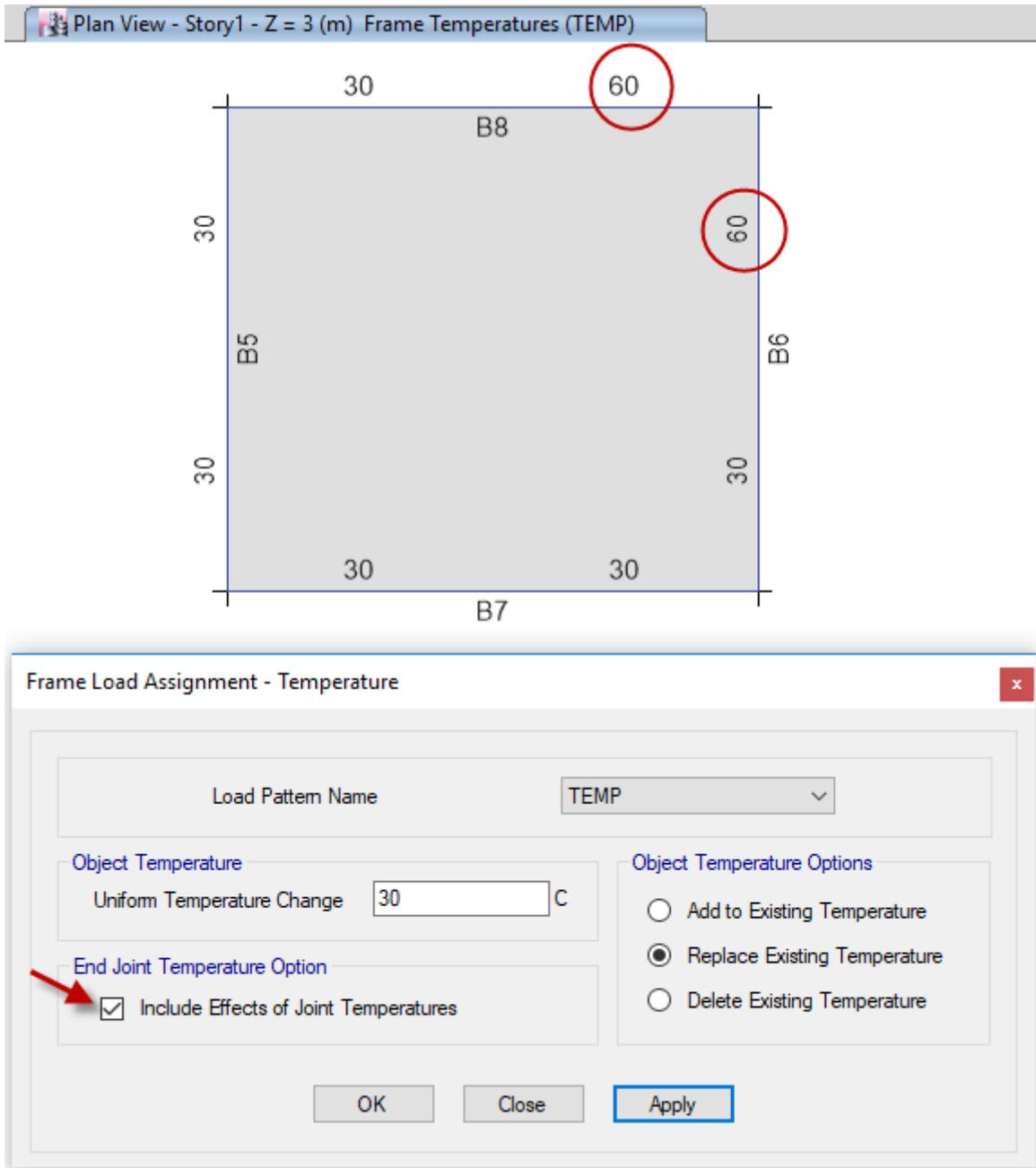


When temperature loads are displayed, two numbers are shown for each frame object. Those two numbers correspond to the temperatures at the ends of the object.



**Important Note:** If the effects of joint temperature were specified to not be included when the temperature load was assigned (*"Include Effects of Joint Temperatures"* check box unchecked), the two displayed temperatures for the frame object are the same and are equal to the temperature assigned to the object. This is true regardless of any joint object temperatures that may be assigned to the joint objects at the end of the frame object.

If the effects of point temperature were specified to be included when the temperature load was assigned (“Include Effects of Joint Temperatures” check box checked), the two displayed temperatures for the frame object are equal to the temperature assigned to the object plus the temperature assigned to the joint object at the considered end of the frame object. In that case, the two displayed temperatures for a frame object may be different.

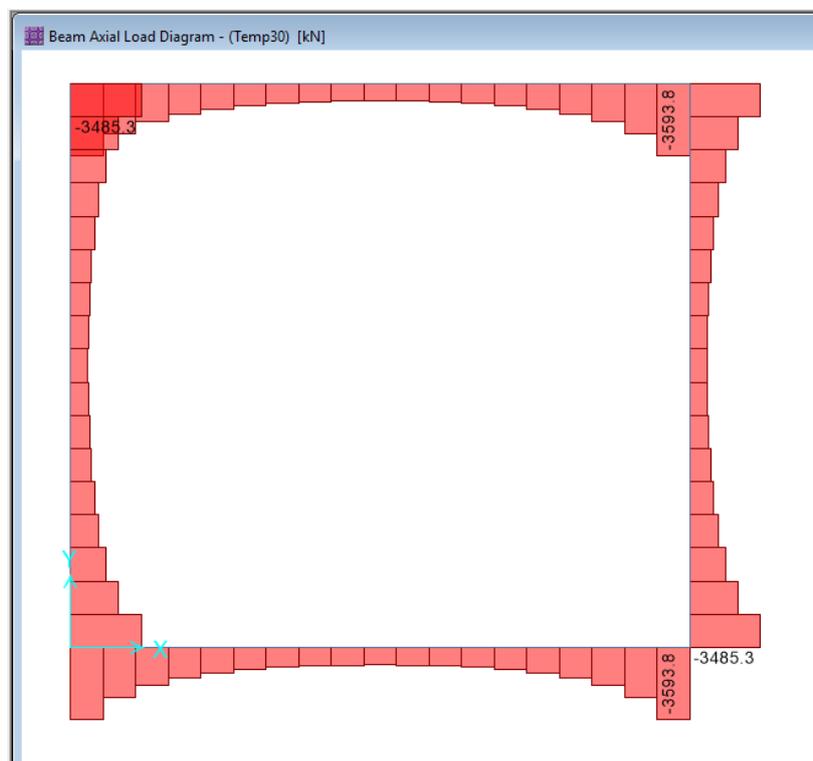
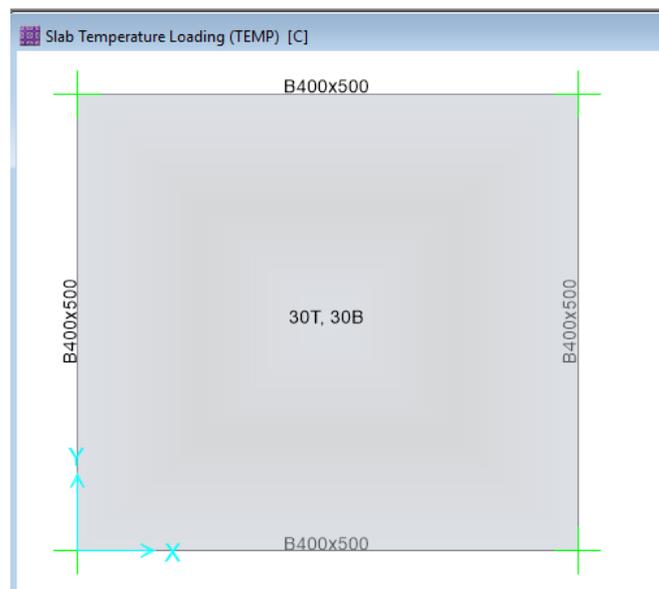


V. Why does perfectly identical ETABS and SAFE models have different temperature load results?

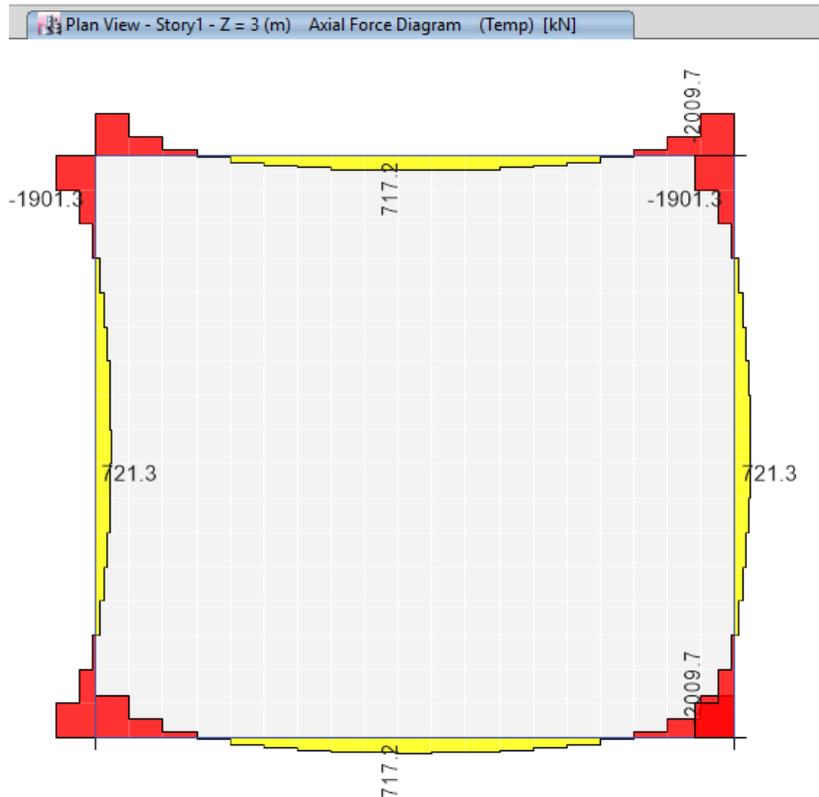
Perfectly identical ETABS and SAFE models could have different temperature load results if temperature loading was defined comparable manner.

Note that in SAFE, there are no option to explicitly assign temperature load for frames or joints. The beams in SAFE automatically takes temperature load from slab.

For an example SAFE model with temperature load of 30 degrees at top and bottom of the slab, the beam axial force is as below:



Comparing with ETABS model with uniform temperature load of 30 degrees applied to slab only, the beam axial force shown below is very different from SAFE results.



Comparing with ETABS model with uniform temperature load of 30 degrees applied to both slab and beams, the beam axial force shown below is similar from SAFE results.

