Otte

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".

Load	Туре	Self Weight Multiplier	Notes	Add Load Pattern
TEMP	TEMPERATURE	0.0000		Delete Load Pattern

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

Pefine Load Patterns	ETABS Load Pat	tern Definition		
Loads	Туре	Self Weight Multiplier	Auto Lateral Load	Click To: Add New Load
TEMP TEMP	Other Other		~	Modify Load Modify Lateral Load Delete Load OK Cancel



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.

Slab Temperature Loads		? ×
Name TEMP	~	Add to Existing Loads Replace Existing Loads
Temperature Change Top of Slab Bottom of Slab	30 C 30 C	 Delete Existing Loads
	OK	incel

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 Load Assignment - Temperature	x
Load Pattern Name	ТЕМР
Temperature	Options Add to Existing Values Replace Existing Values Delete Existing Values
OK	Close Apply

Joint temperature load will be shown as below.

👔 Plan 🕻	View - Story1 - Z = 3 (m) Joint Temperatures (TEMP)	
		temperature load applied on this joint
-	(30
-		-



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

Load Pattern Name	TEMP
Object Temperature	Object Temperature Options
Uniform Temperature Change 30	C Add to Existing Temperature
Corner Joint Temperature Option	Replace Existing Temperature
Include Effects of Joint Temperatures	Delete Existing 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.

	30	60
Shell Lo	30 ad Assignment - Temperature	30
	Load Pattern Name	MP
Obj L	ject Temperature Jniform Temperature Change 30 C mer Joint Temperature Option	Object Temperature Options Add to Existing Temperature Replace Existing Temperature
		 Delete Existing Temperature



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...

Cookie Cut Floor Objects at Selected Fr	rame Objects		
Extend Frames to Shell Edges			
O Cookie Cut Floor Objects at Selected Jo	pints at		Degrees
 Divide Quadrilaterals/Triangles into 	19	by 18	Areas
O Divide Quadrilaterals/Triangles at			
Intersections with Visible Grids			
Selected Joint Objects on Edges			
Intersections with Selected Frame (Objects		





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

Load Pattern Name	ТЕМР
Object Temperature Uniform Temperature Change 30 End Joint Temperature Option Include Effects of Joint Temperatures	C Object Temperature Options Add to Existing Temperature Replace Existing Temperature Delete Existing 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.

