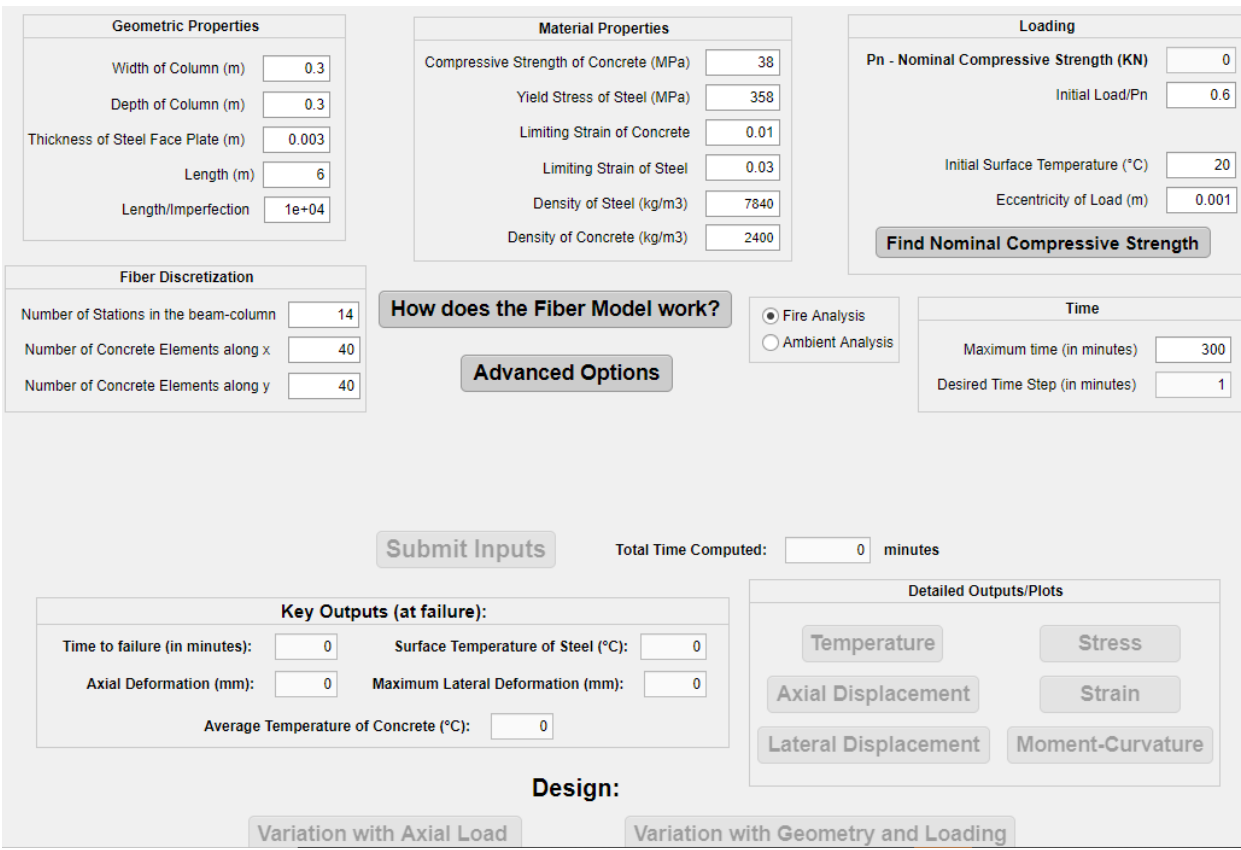
GUI Report:

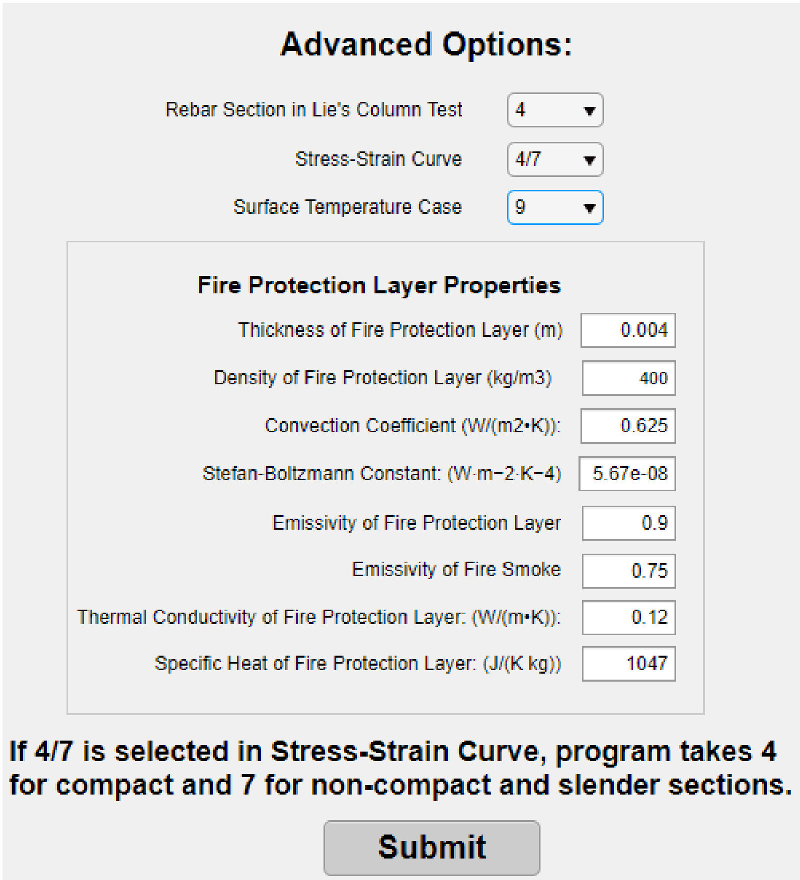
A Graphical User Interface (GUI) was developed for the MATLAB code on MATLAB App Designer, R2018b. It consists of two main components, a pre-processor and a post-processor.

Pre-Processor

The pre-processor takes the inputs (geometric, material, loading and fiber discretization) from the user, and generates interactive visual outputs of Temperature, Axial and Lateral Deformations, Stress, Strain and Moment-Curvature.



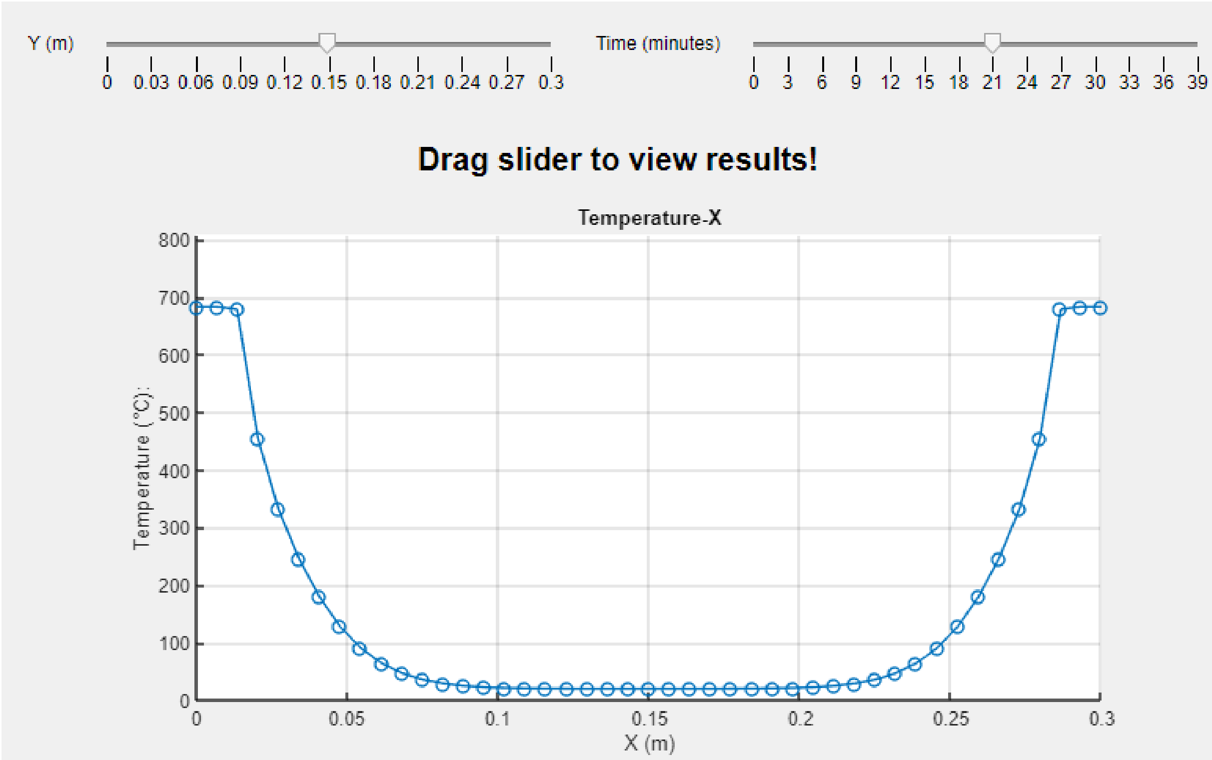
By default, Surface Temperature Case 10 (without fire protection) was used. Rebars were assumed to be absent and Stress-Strain Curves were programmatically chosen to be either 4 or 7 based on whether the cross section was compact, non-compact or slender. The user could change any of these parameters, all of which were present in a separate window named ‘Advanced Options’

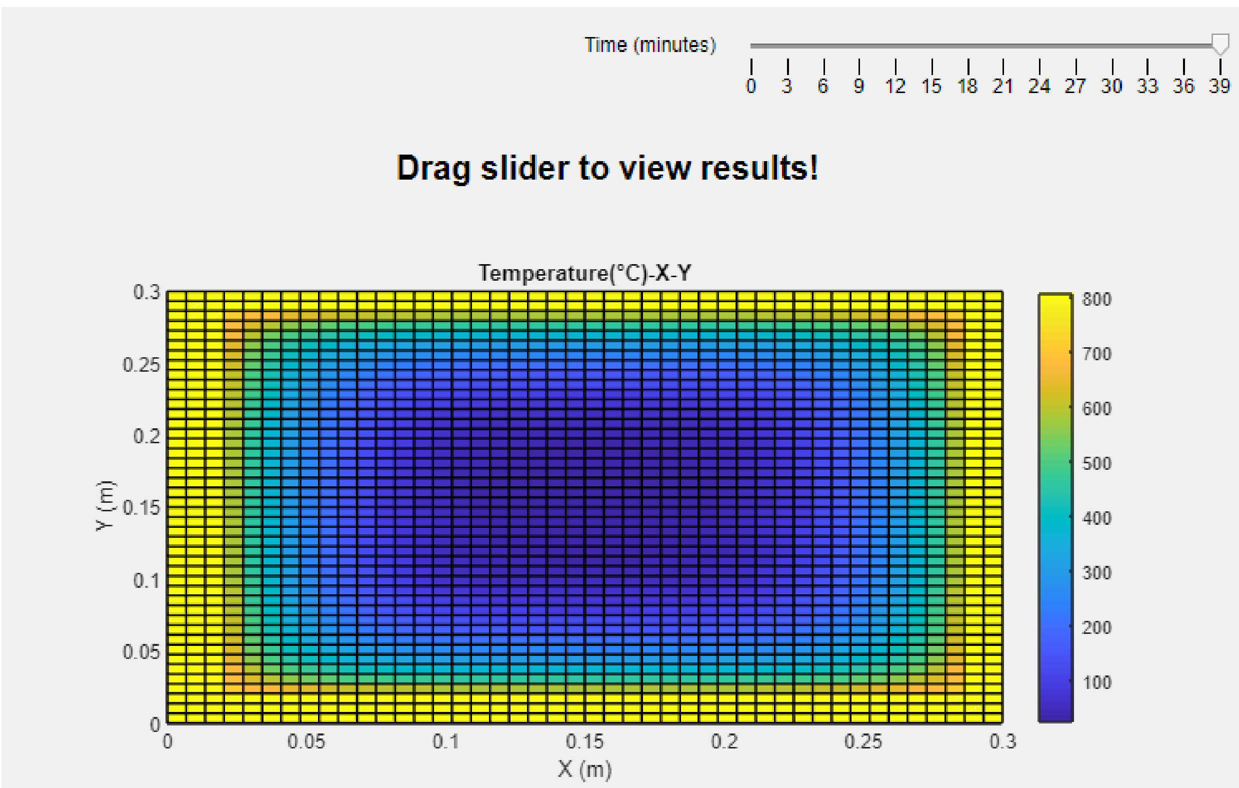


1.**Temperature, Stress, Strain:**

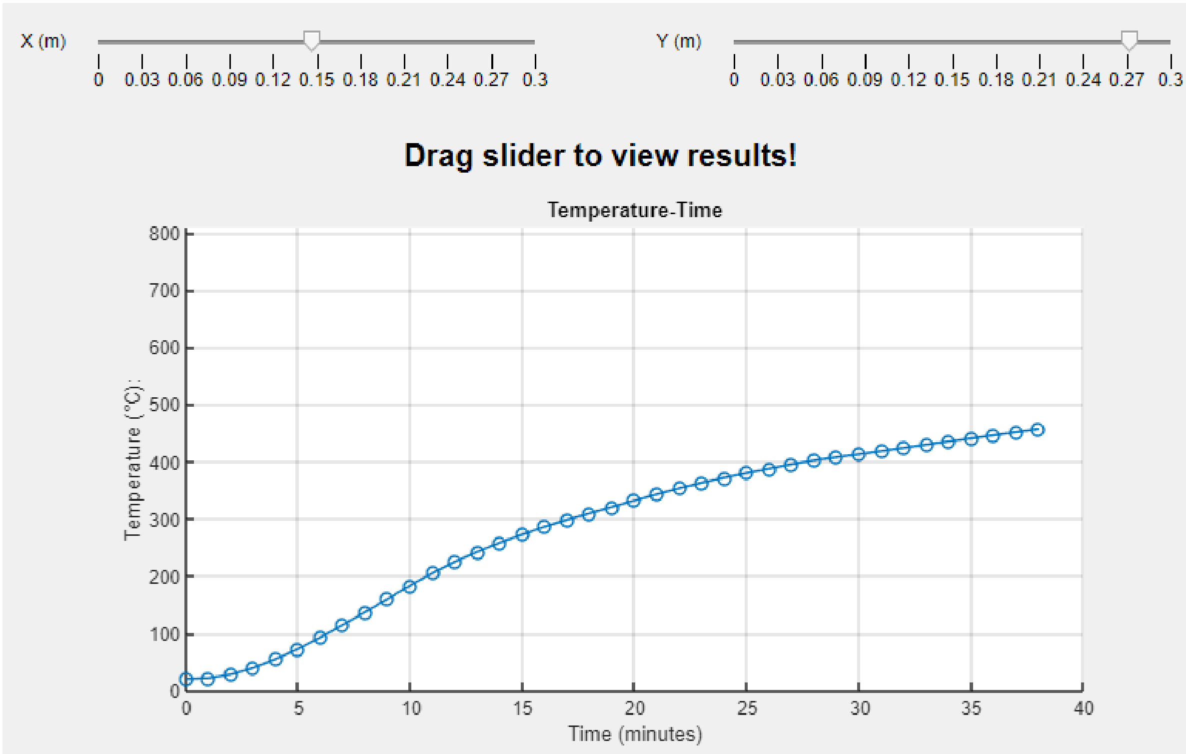
Temperature is plotted in the following manner:

- Space (X, Y, or both) for a given time instant

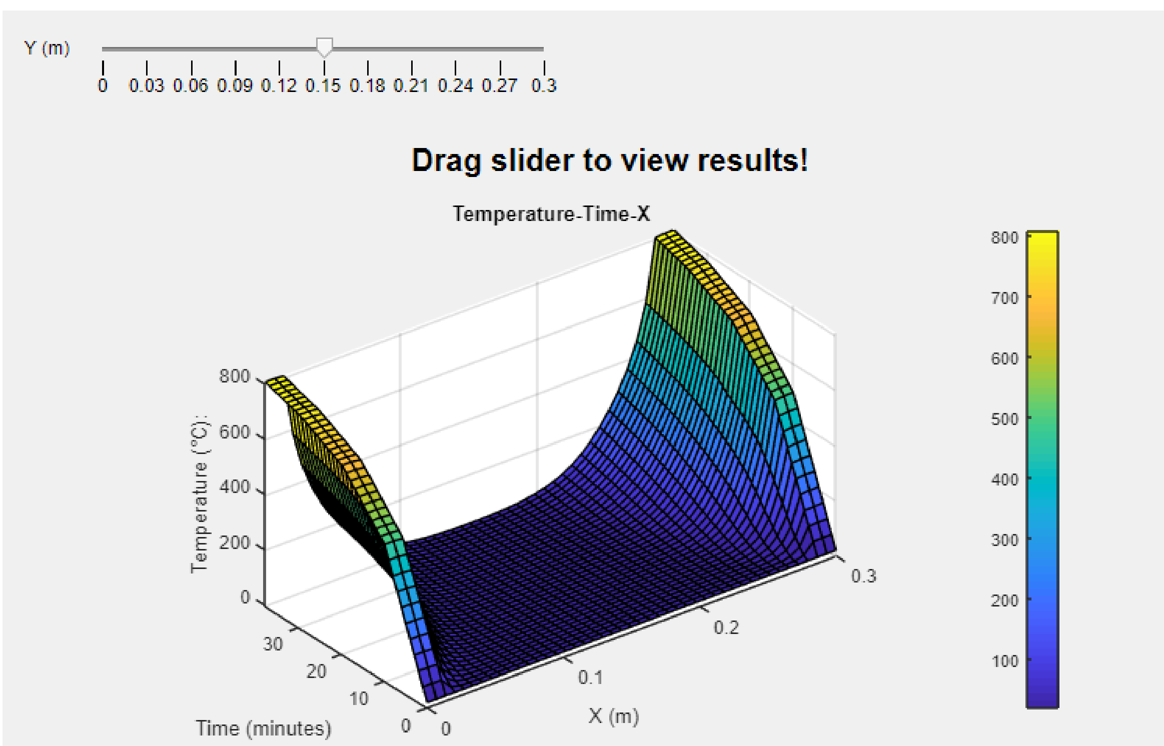




- Time (For a given X,Y) - 2D plot

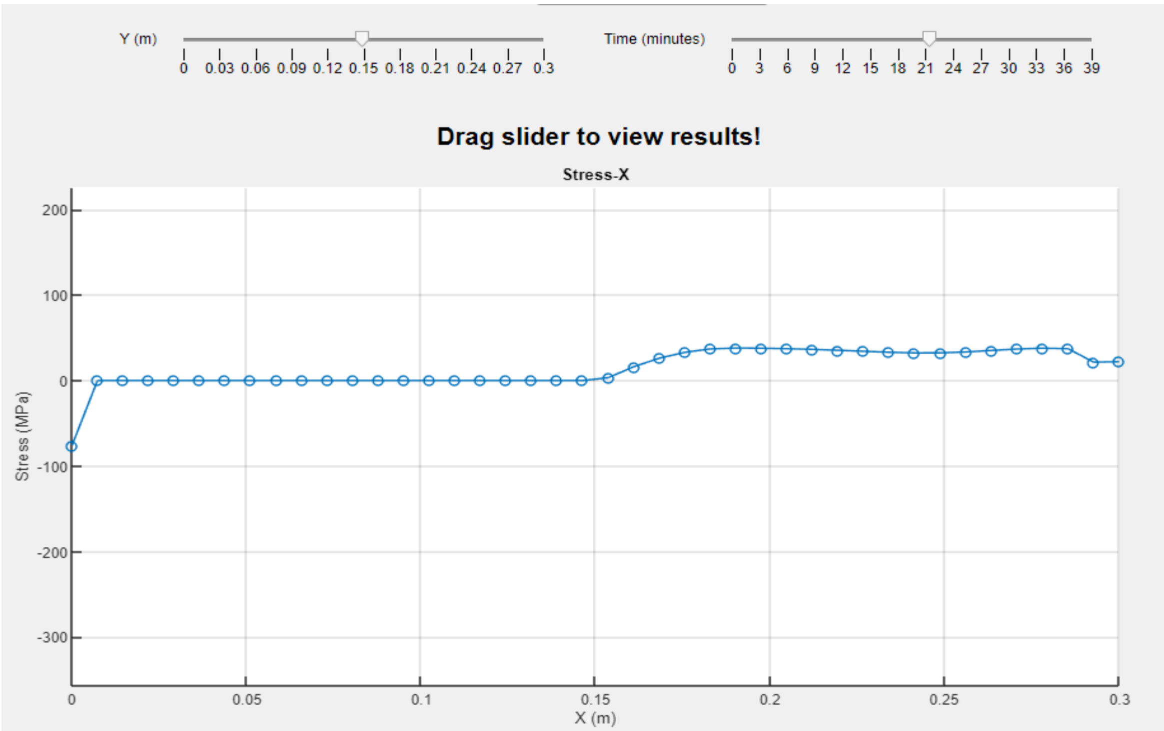


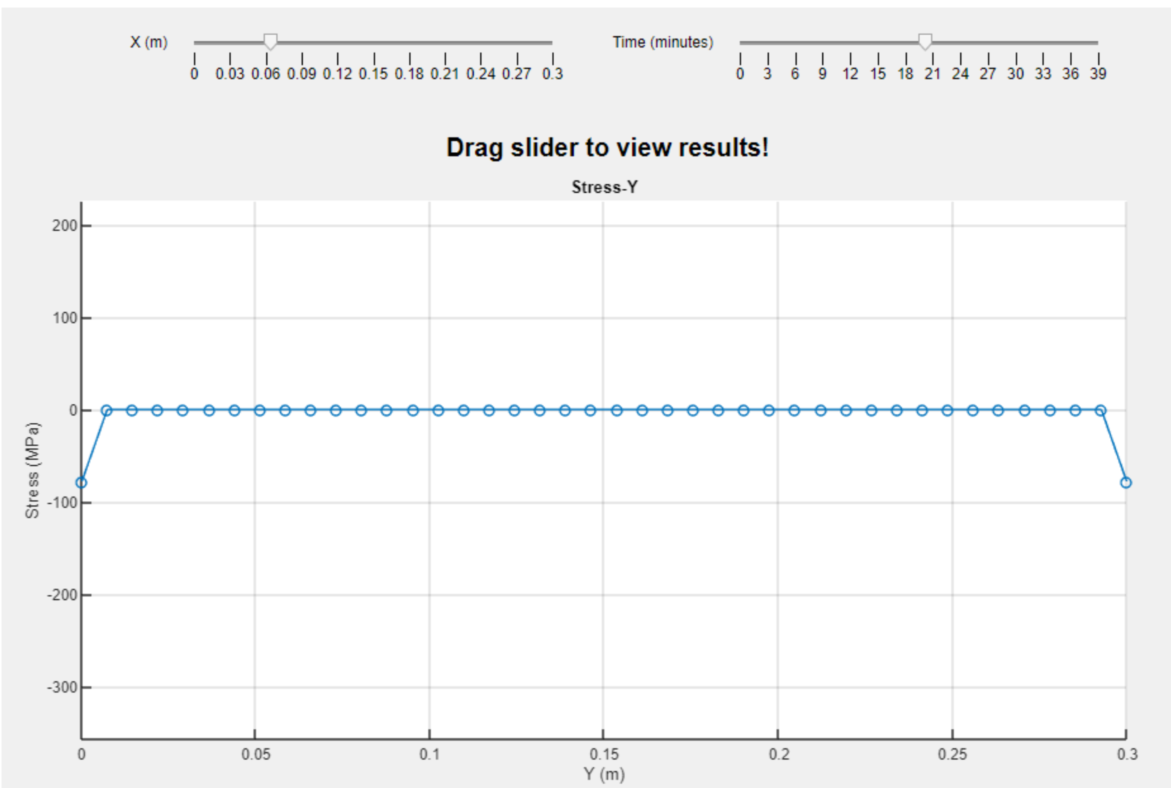
- Space-Time (For a given X/Y) - 3D Surface Plot

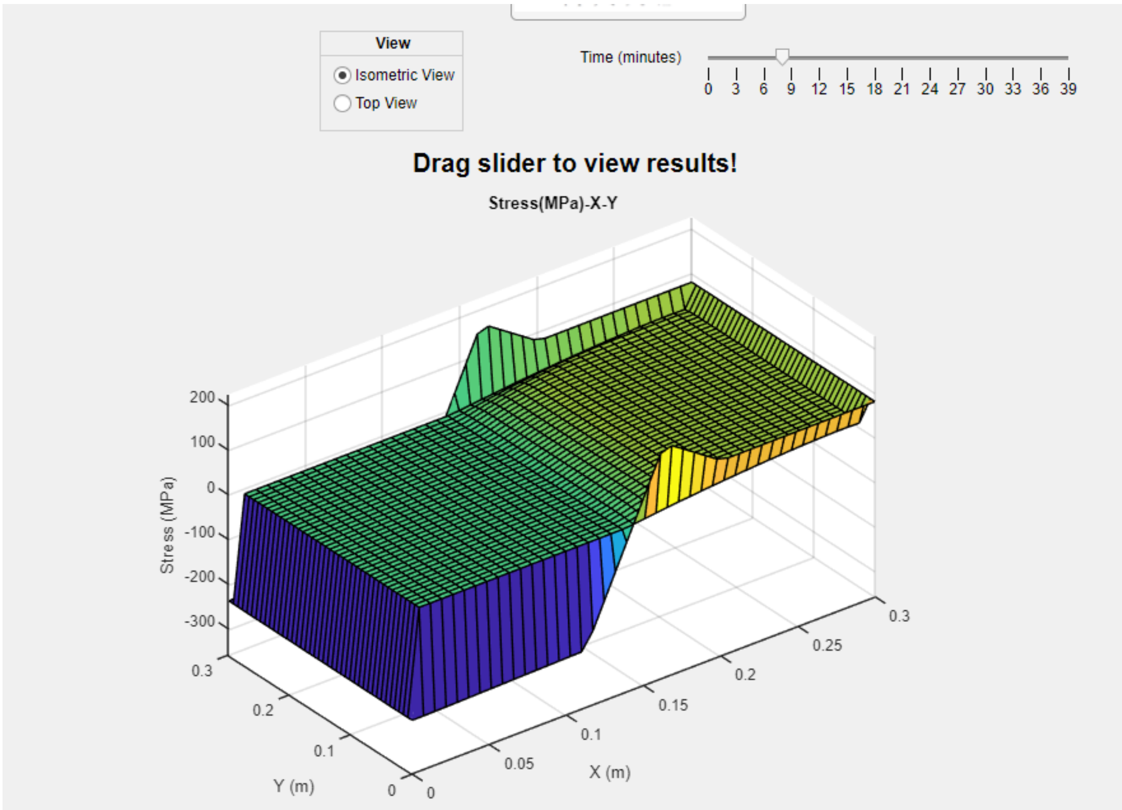


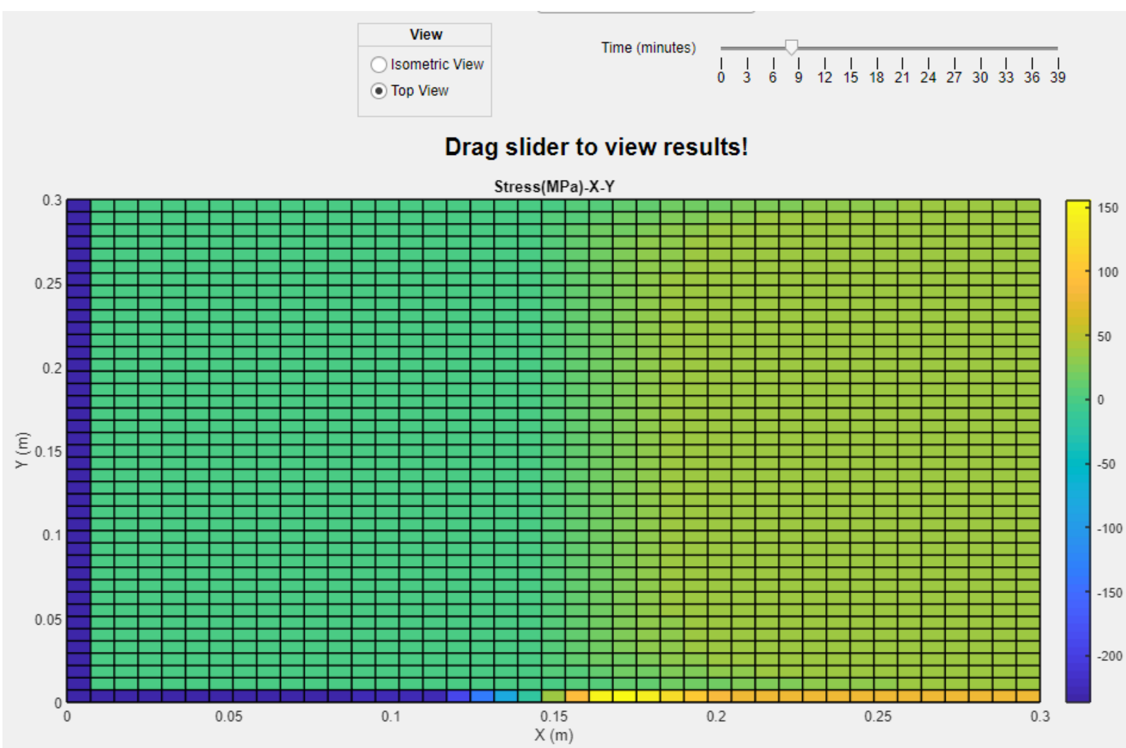
Stress is plotted in the following manner:

- Space (X, Y, or both) for a given time instant - 3D Surface Plot

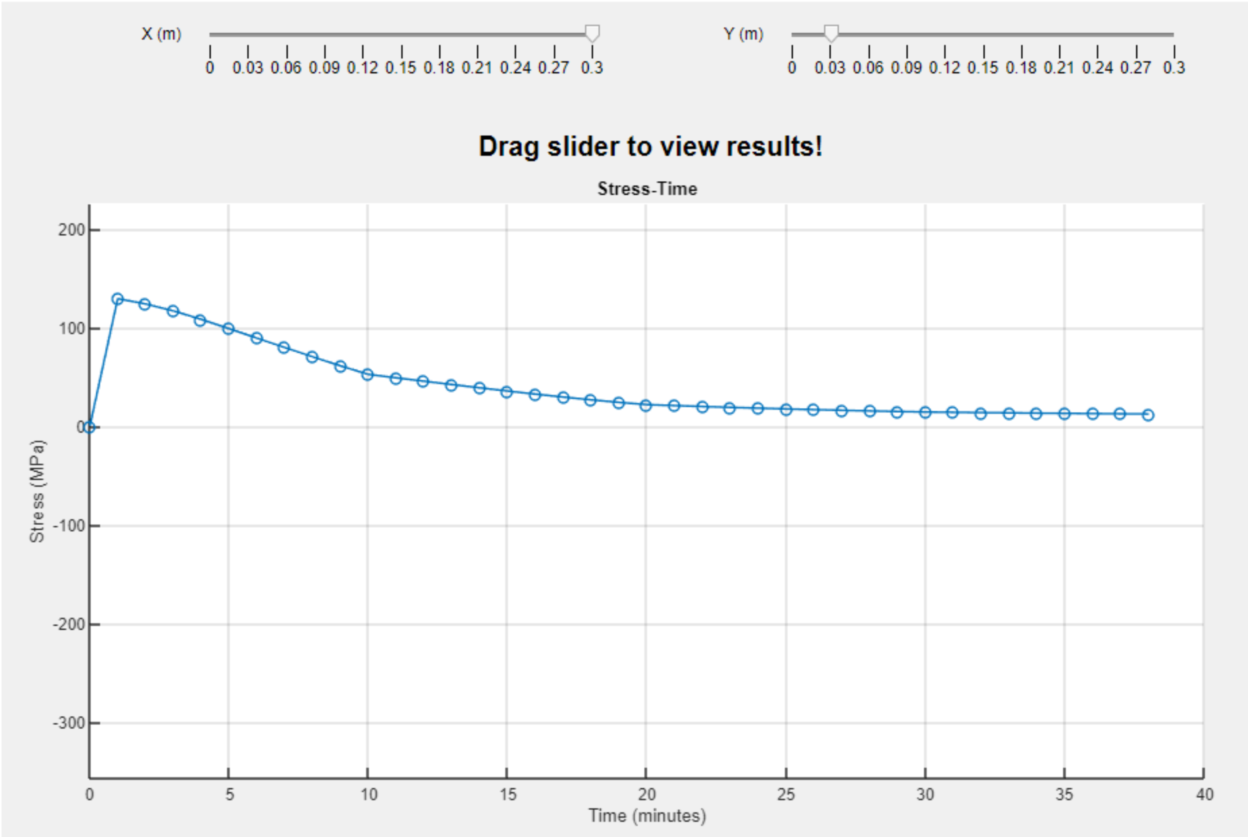




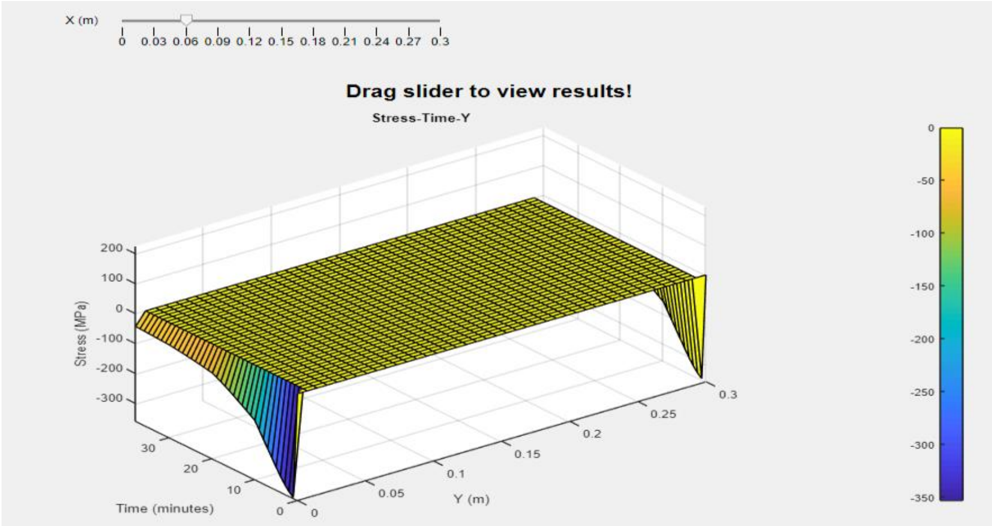

View
Isometric View
Top View
Time (minutes)
0 3 6 9 12 15 18 21 24 27 30 33 36 39
Drag slider to view results!
Stress(MPa)-X-Y
Stress (MPa)
Y (m)
X (m)

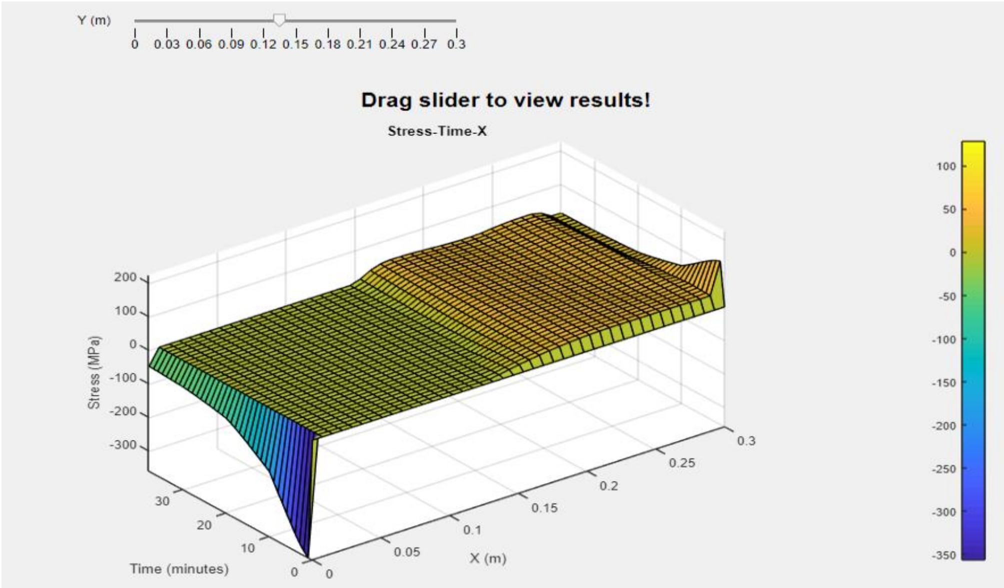

View
Isometric View
Top View
Time (minutes)
0 3 6 9 12 15 18 21 24 27 30 33 36 39
Drag slider to view results!
Stress(MPa)-X-Y
Y (m)
X (m)

- Time (For a given X,Y) - 2D plot



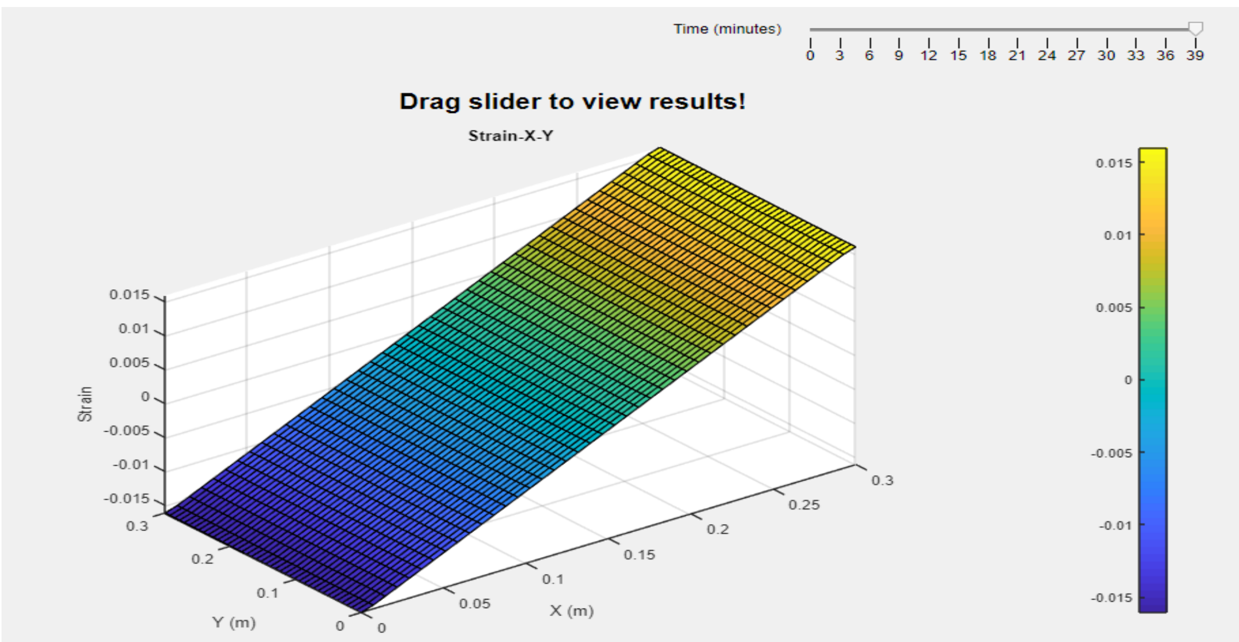
- Space-Time (For a given X/Y) - 3D Surface Plot



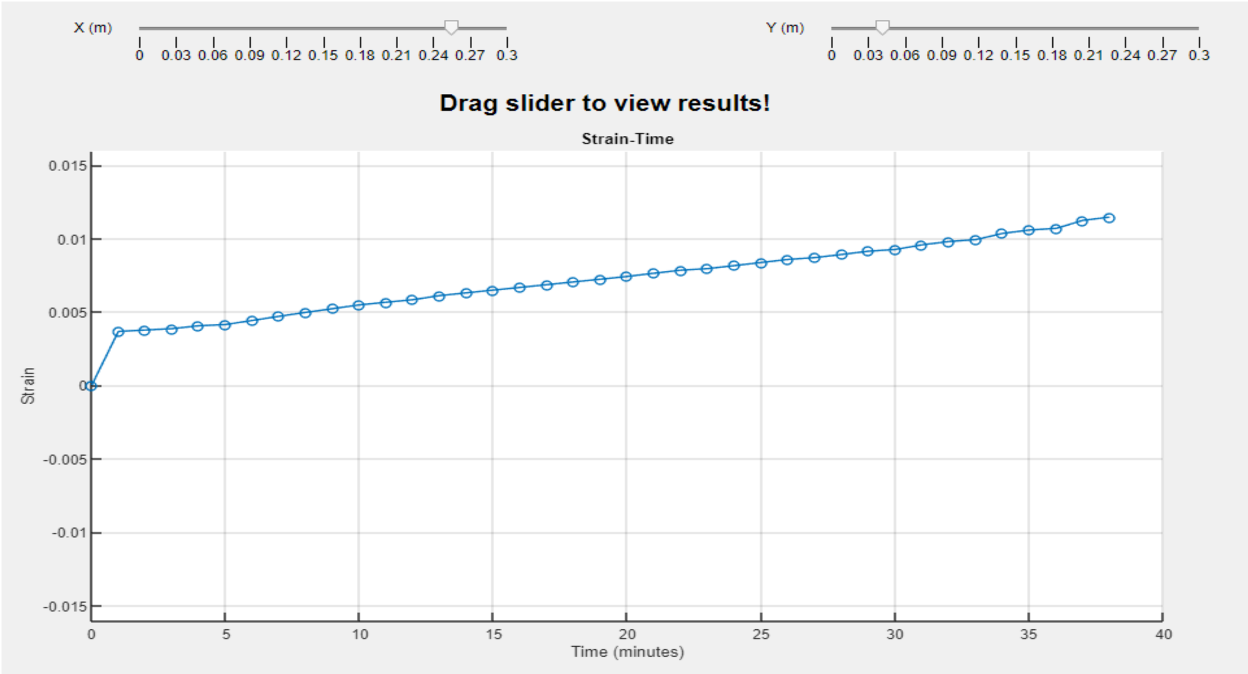


Strain is plotted in the following manner:

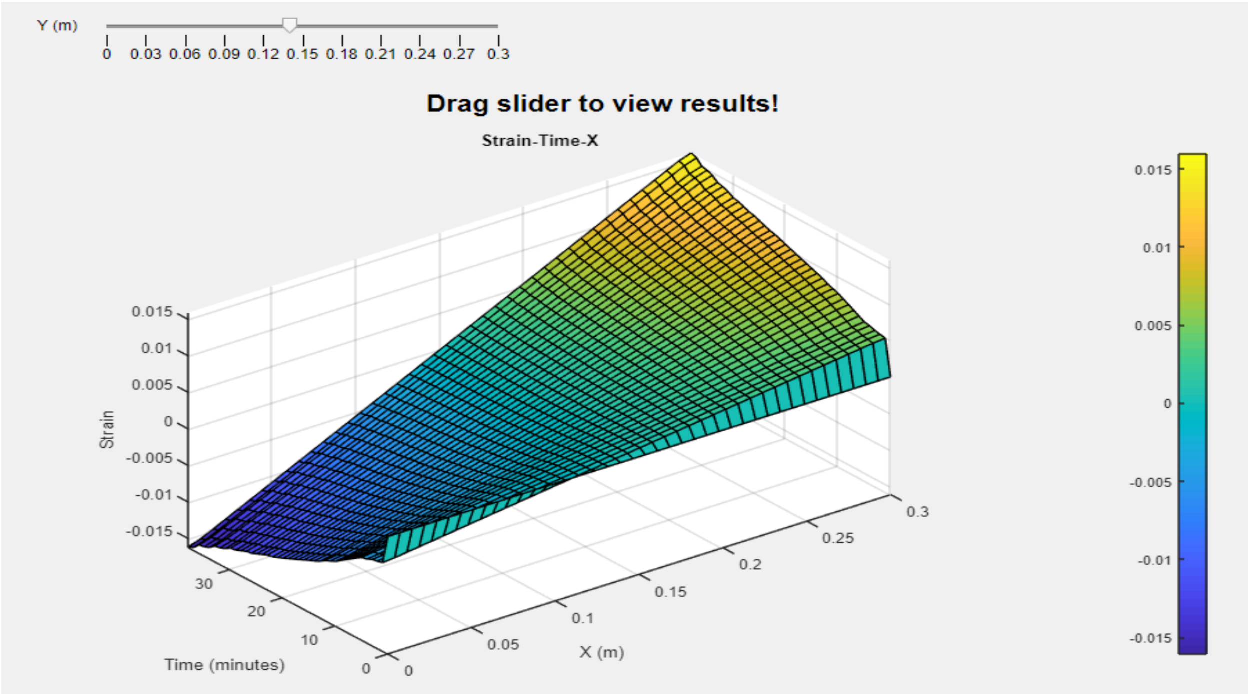
- Space (X, Y, or both) for a given time instant - 3D Surface Plot

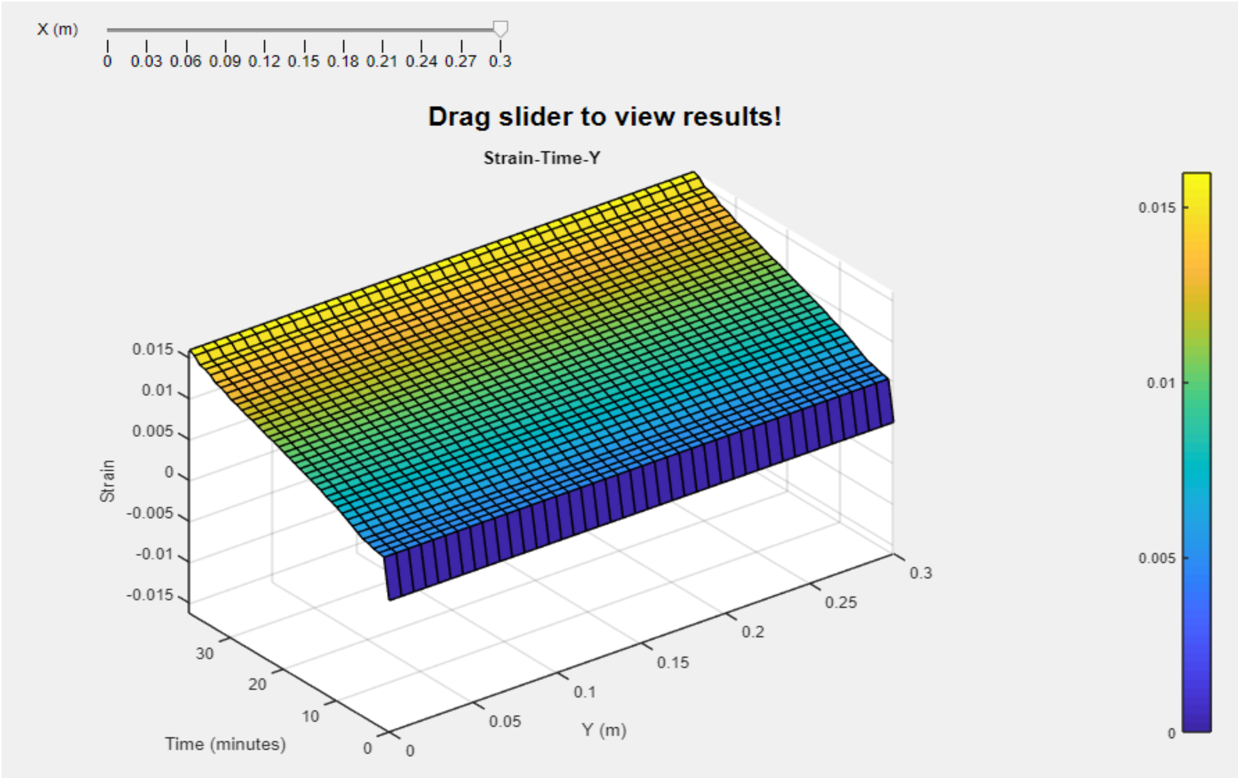


- Time (For a given X,Y) - 2D plot



- Space-Time (For a given X/Y) - 3D Surface Plot

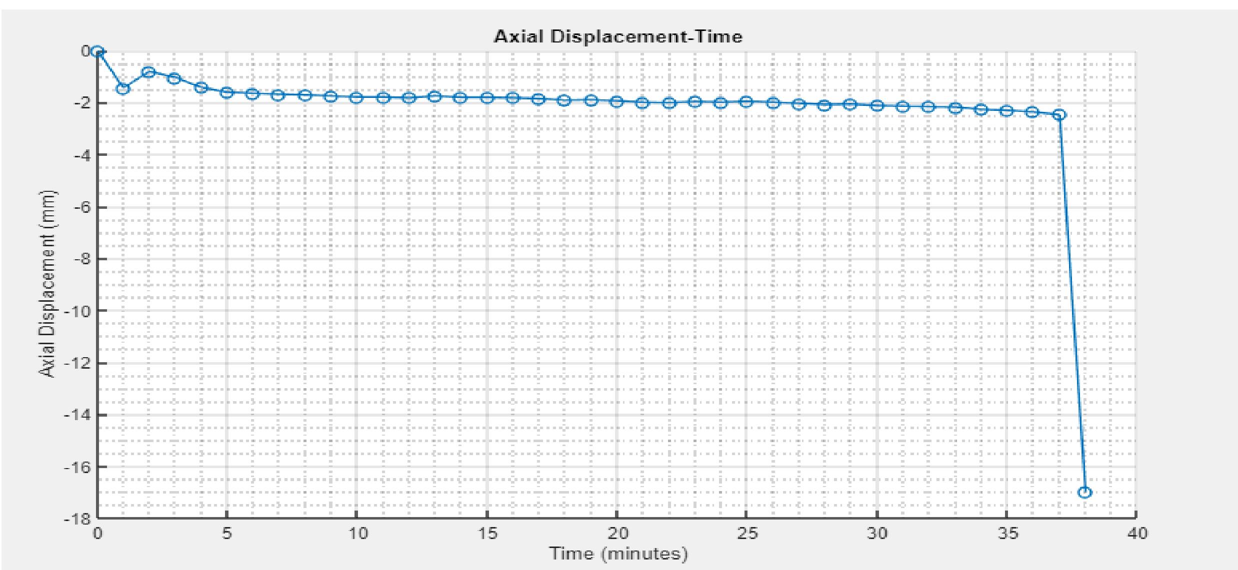




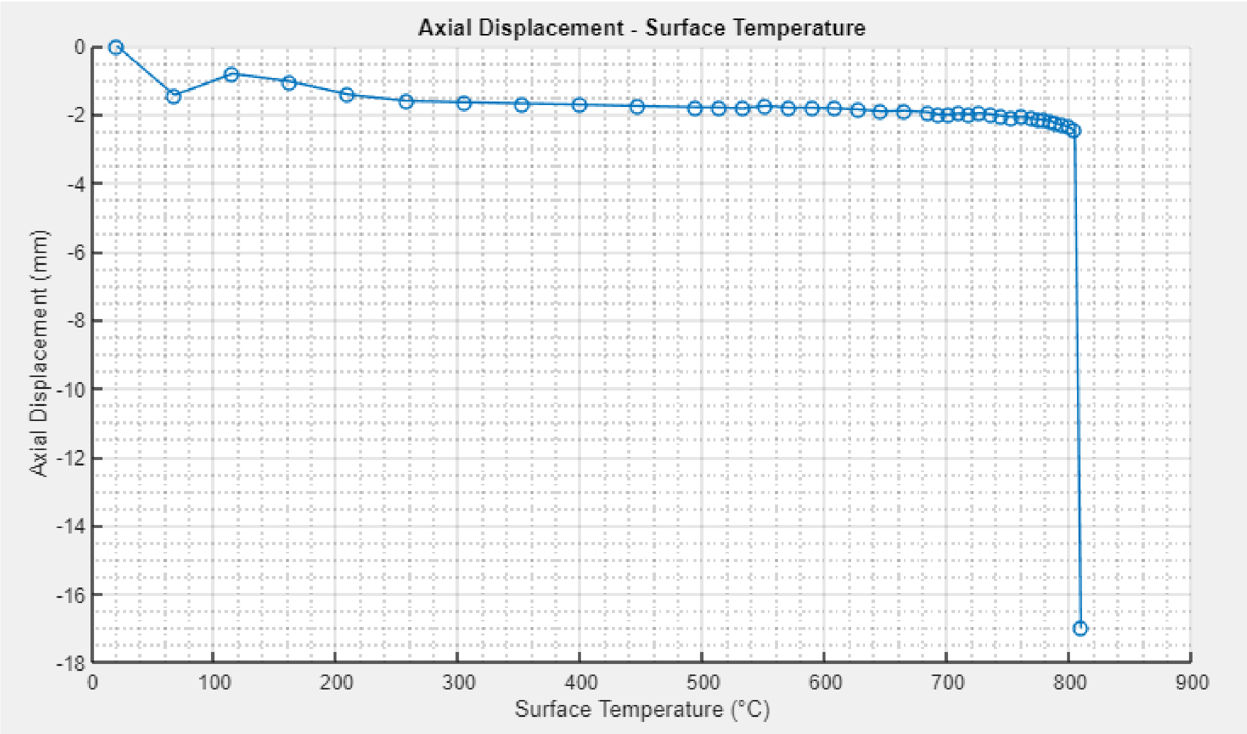
2. Axial Deformation

Axial Deformation is plotted against:

- Time



- Surface Temperature (in fire analysis)

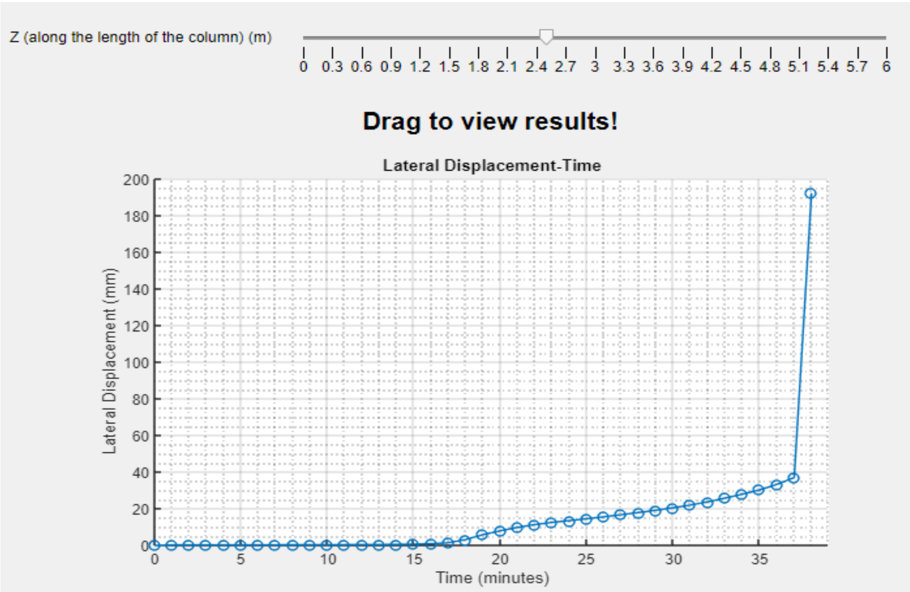


- Axial Load (In ambient analysis)

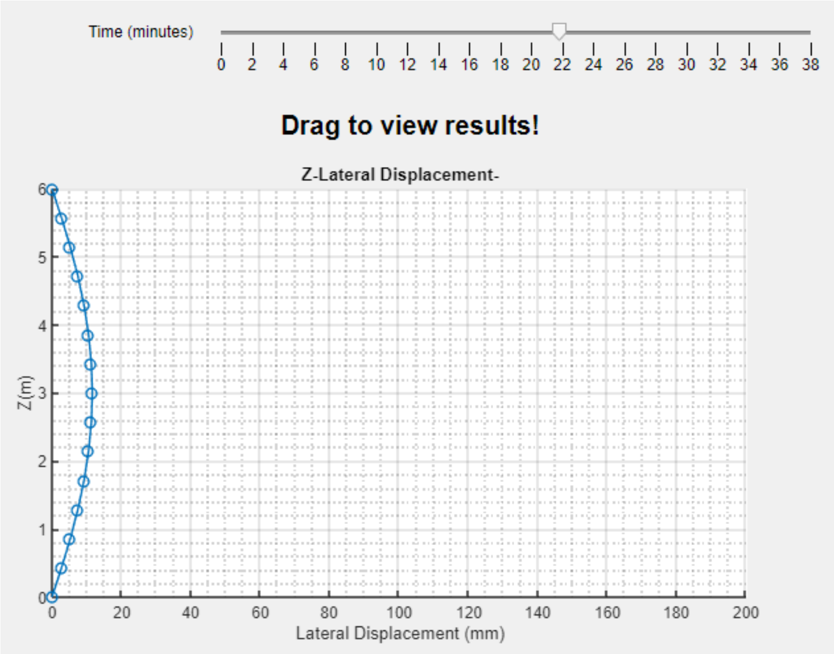
3. Lateral Deformation

Lateral Deformation is plotted against:

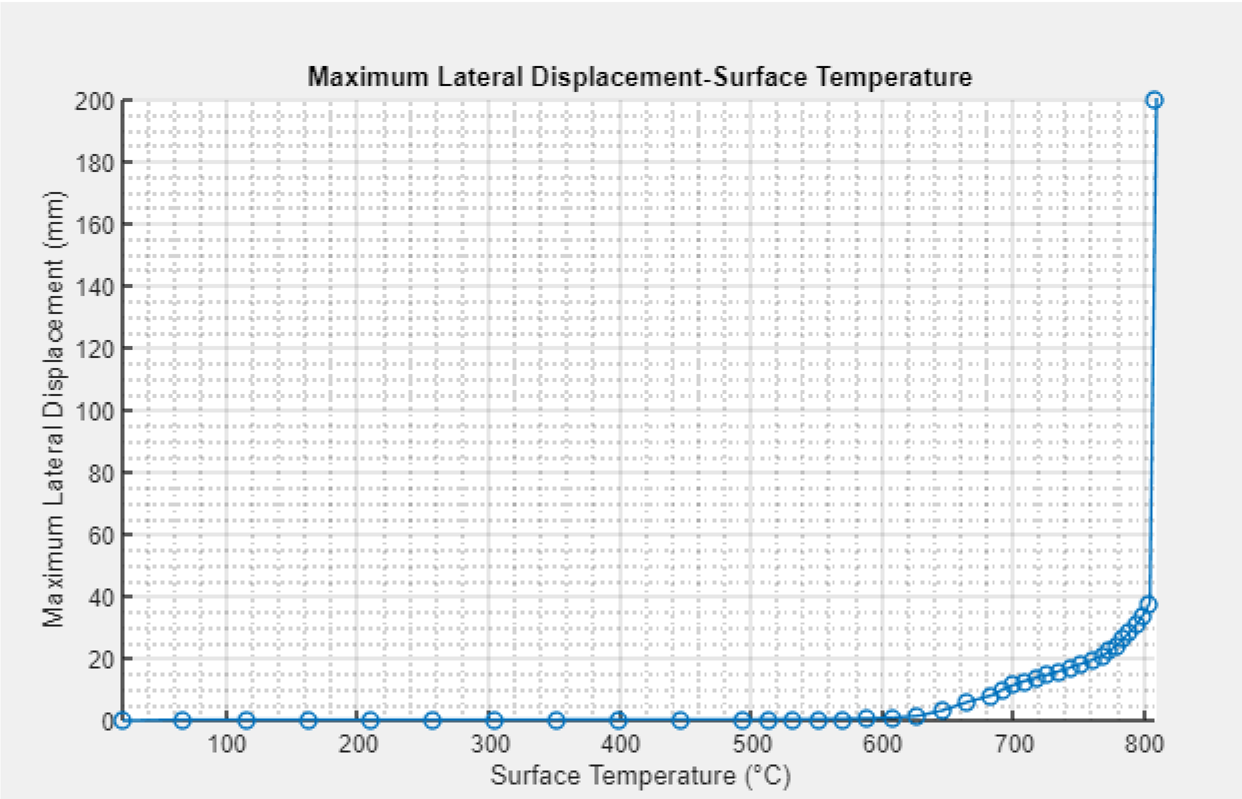
- Time (For a given point along the length of the column)



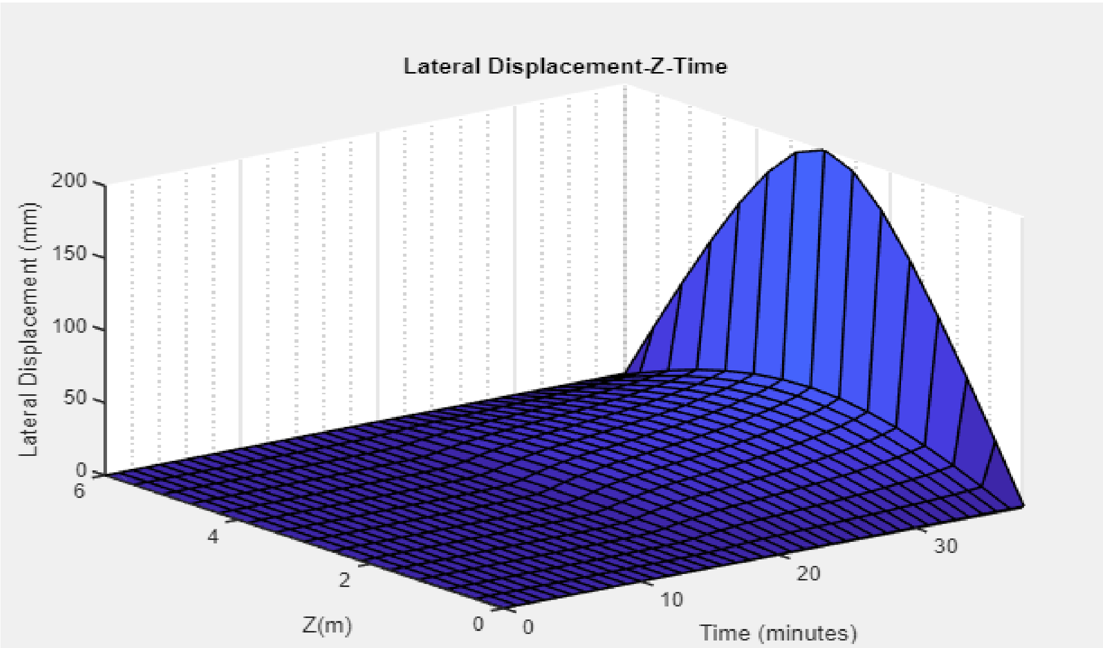
- Length (For a given time instant)



- Surface Temperature (in fire analysis)



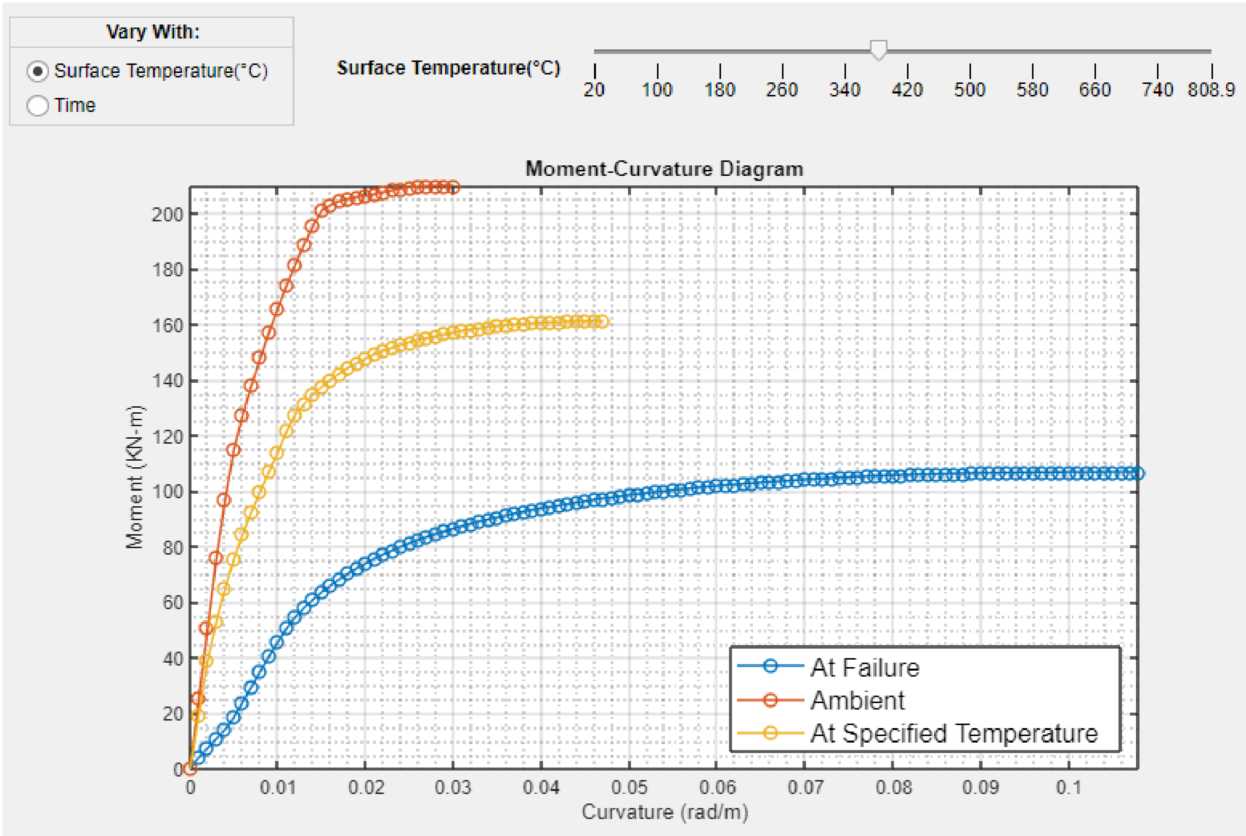
- Axial Load (In ambient analysis)
- Length-Time



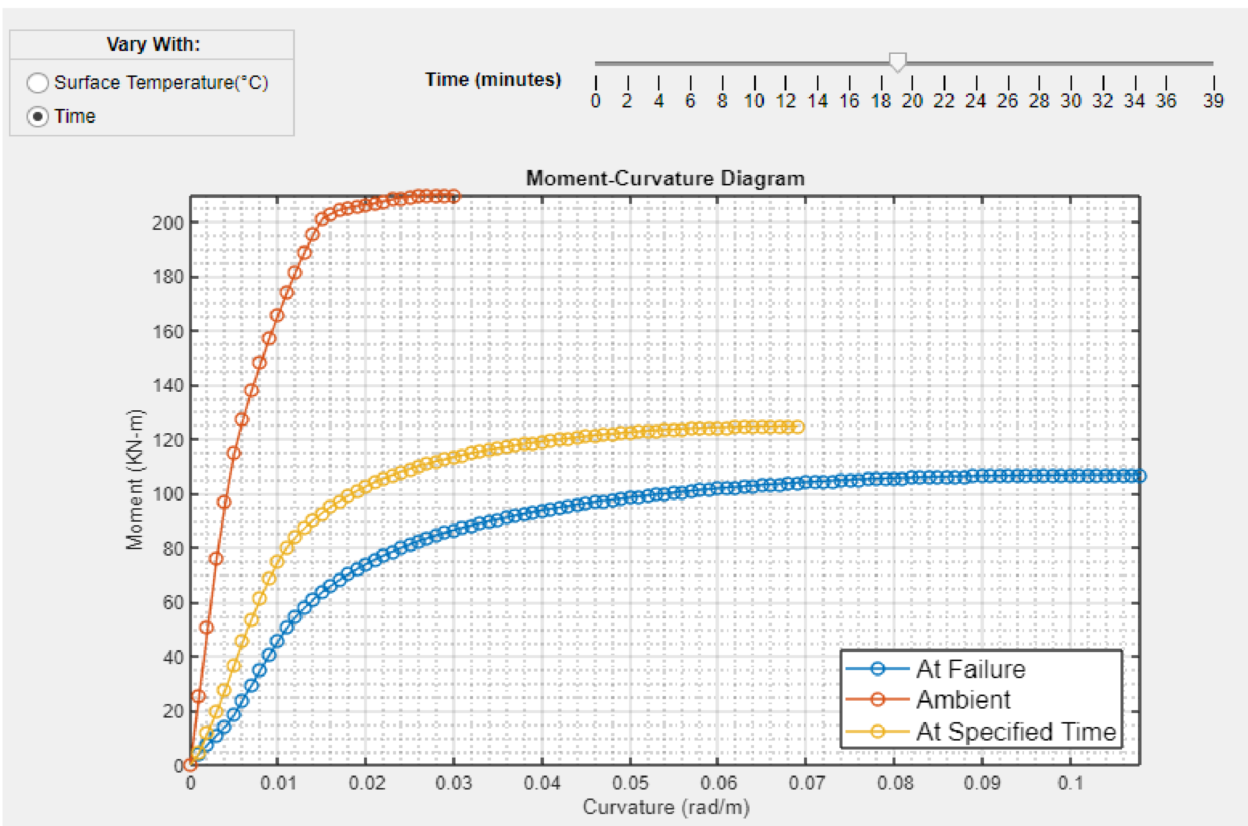
4. Moment-Curvature

The moment-curvature relationships at ambient/initial loading conditions and at failure are plotted in the same graph to understand the change in the moment capacity of the column. In addition to these two curves, another moment-curvature diagram is plotted for different:

- Surface Temperatures (Fire Analysis)
- Axial Load (In ambient analysis)



Vary With:
Surface Temperature(°C)
Time
Surface Temperature(°C)
20 100 180 260 340 420 500 580 660 740 808.9
Moment-Curvature Diagram
Moment (KN-m)
Curvature (rad/m)
At Failure
Ambient
At Specified Temperature



Vary With:
Surface Temperature(°C)
Time
Time (minutes)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 39
Moment-Curvature Diagram
Moment (KN-m)
Curvature (rad/m)
At Failure
Ambient
At Specified Time

Notes:

- Rounding/Interpolation were used wherever necessary to find the required parameter in the nearest fiber/station.
- Data points were indicated while plotting in 2D.
- A fixed scale was used for most graphs to enable better understanding of the outputs.

Post-Processor

The post-processor (developed mainly for fire analysis) runs the pre-processor code multiple times (as required by the user). It has two main sub-components:

1. Variation with Axial Load

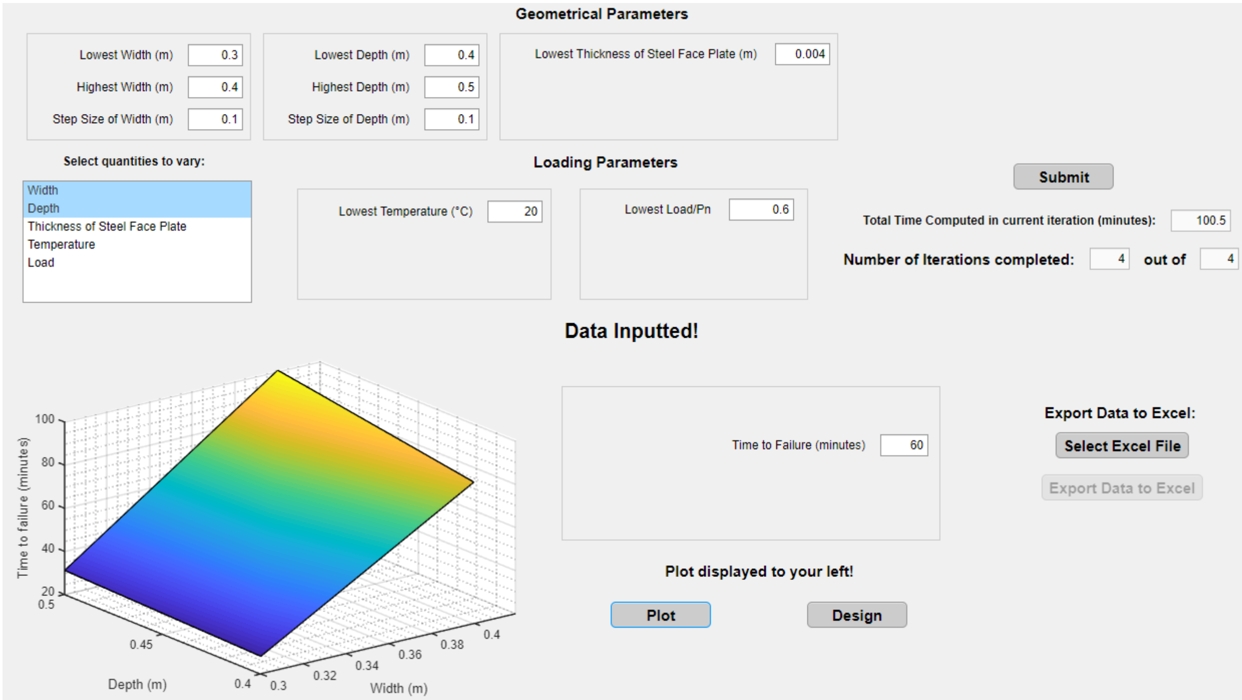
It generates plots of variation of Time to Failure, Surface Temperature (column curves), Axial and Lateral Deformations vs Axial Load.

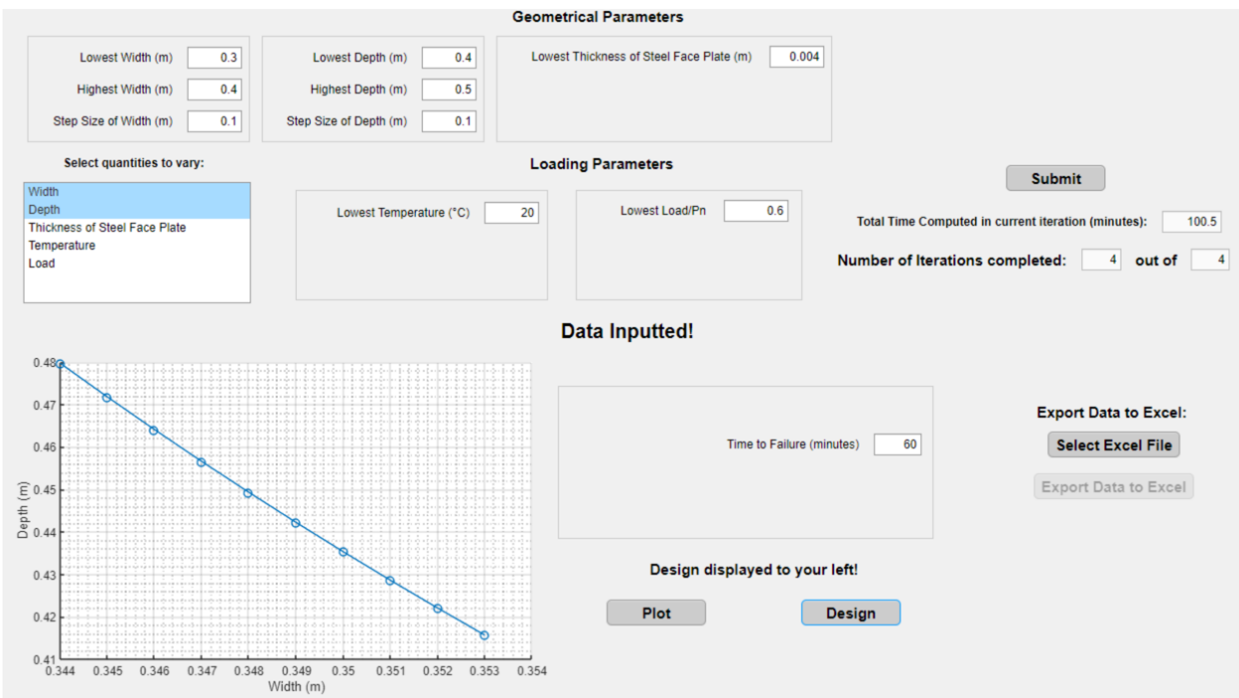
2. Variation with Geometry

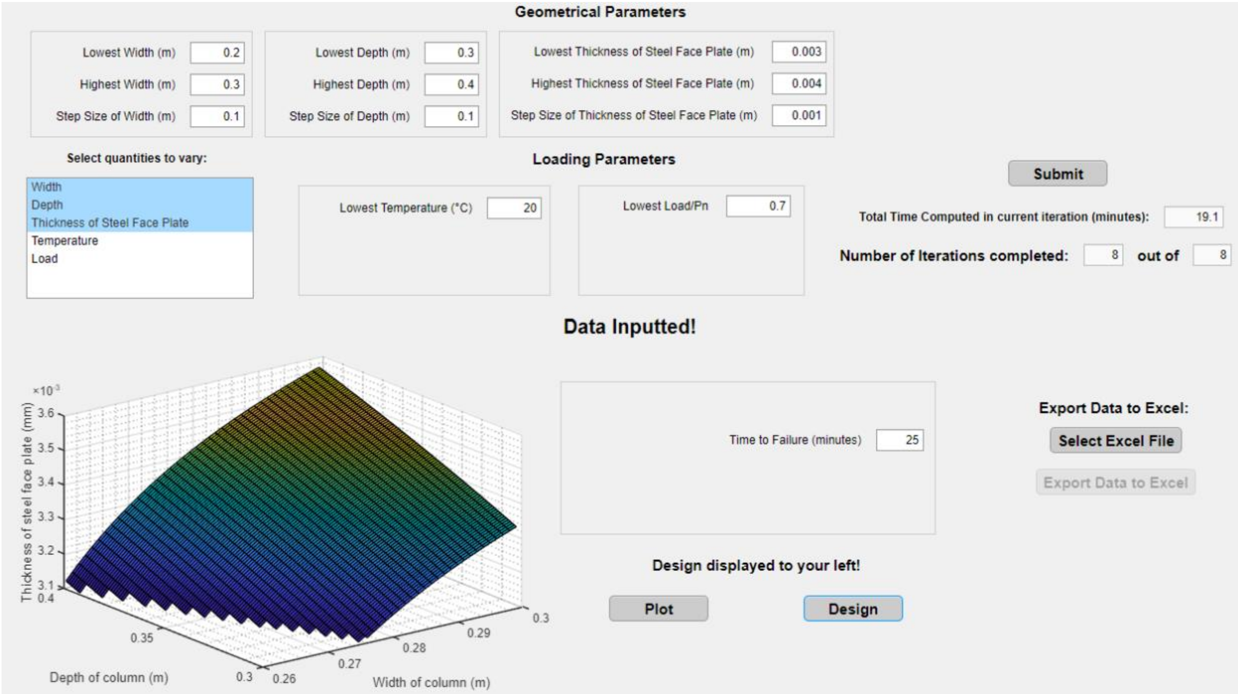
This component uses the Time to Failure (Fire Rating) as the main design parameter. It can be used for parametric studies as well as to generate column curves etc. The user has the freedom to vary one or more of the following parameters:

- Width of the column
- Depth of the column
- Thickness of Steel Face Plate
- Thickness of Fire Protection Layer (if applicable)
- Initial Temperature (generally not used)
- Axial Load

and observe the variation of Time to Failure. The user can then give the Fire Rating and the Axial Load (if varied initially), and the code generates a plot/surface with all possible design values using interpn, an inbuilt MATLAB multi-dimensional interpolation function. Wherever one or two quantities were varied, the Time to Failure could also be plotted with their variation as a line or surface plot respectively.


Geometrical Parameters
Lowest Width (m) 0.3
Highest Width (m) 0.4
Step Size of Width (m) 0.1
Lowest Depth (m) 0.4
Highest Depth (m) 0.5
Step Size of Depth (m) 0.1
Lowest Thickness of Steel Face Plate (m) 0.004
Select quantities to vary:
Width
Depth
Thickness of Steel Face Plate
Temperature
Load
Loading Parameters
Lowest Temperature (°C) 20
Lowest Load/Pn 0.6
Submit
Total Time Computed in current iteration (minutes): 100.5
Number of Iterations completed: 4 out of 4
Data Inputted!
Time to Failure (minutes) 60
Export Data to Excel:
Select Excel File
Export Data to Excel
Plot displayed to your left!
Plot
Design
Time to failure (minutes)
Depth (m)
Width (m)


Geometrical Parameters
Lowest Width (m) 0.3
Highest Width (m) 0.4
Step Size of Width (m) 0.1
Lowest Depth (m) 0.4
Highest Depth (m) 0.5
Step Size of Depth (m) 0.1
Lowest Thickness of Steel Face Plate (m) 0.004
Select quantities to vary:
Width
Depth
Thickness of Steel Face Plate
Temperature
Load
Loading Parameters
Lowest Temperature (°C) 20
Lowest Load/Pn 0.6
Submit
Total Time Computed in current iteration (minutes): 100.5
Number of Iterations completed: 4 out of 4
Data Inputted!
Time to Failure (minutes) 60
Export Data to Excel:
Select Excel File
Export Data to Excel
Design displayed to your left!
Plot
Design
Depth (m)
Width (m)



3. P-M Interaction Diagram (to be included for fire analysis as well?)

For variation in axial load, the moment at failure is recorded to generate the P-M Interaction Diagram. This curve is generated to verify the variation of Moment-Curvature relationship with the Applied Load.

Exporting Data to Excel

Both the pre-processor and the post-processor had the provision of exporting all the output data to MS Excel. This is useful for conducting parametric studies.