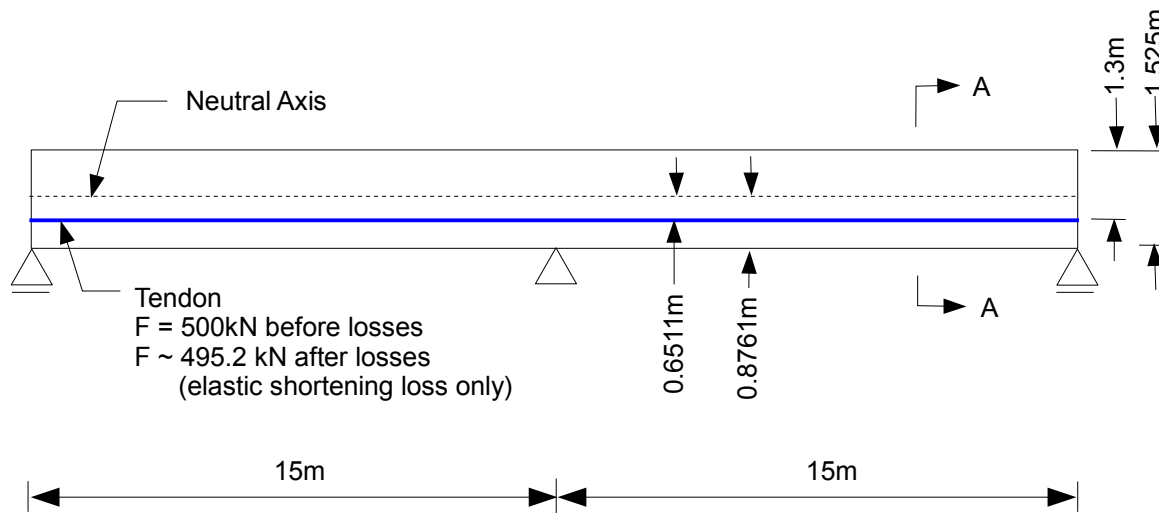
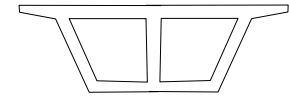


Obtaining hyperstatic (or secondary)
forces for bridge object
superstructures - test problem

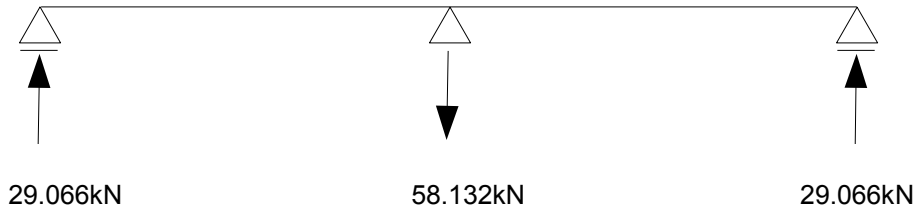
Geometry



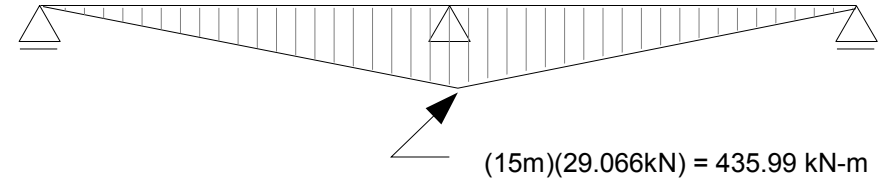
Elevation
(Schematically, Not To Scale)



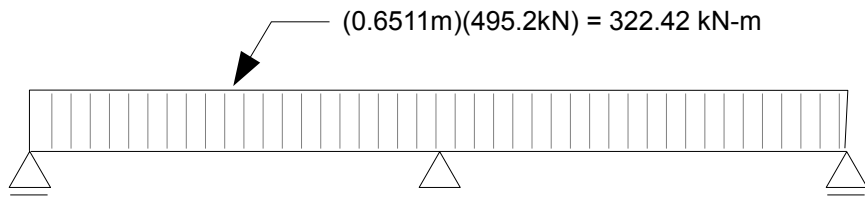
Section A-A
(Schematically, Not To Scale)



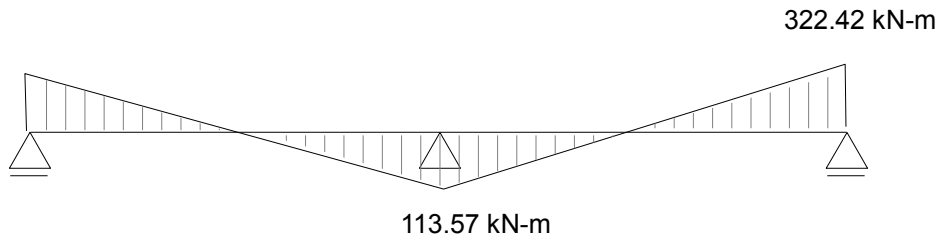
Reactions for the PS load case



Corresponding hyperstatic/secondary moment



Primary moment

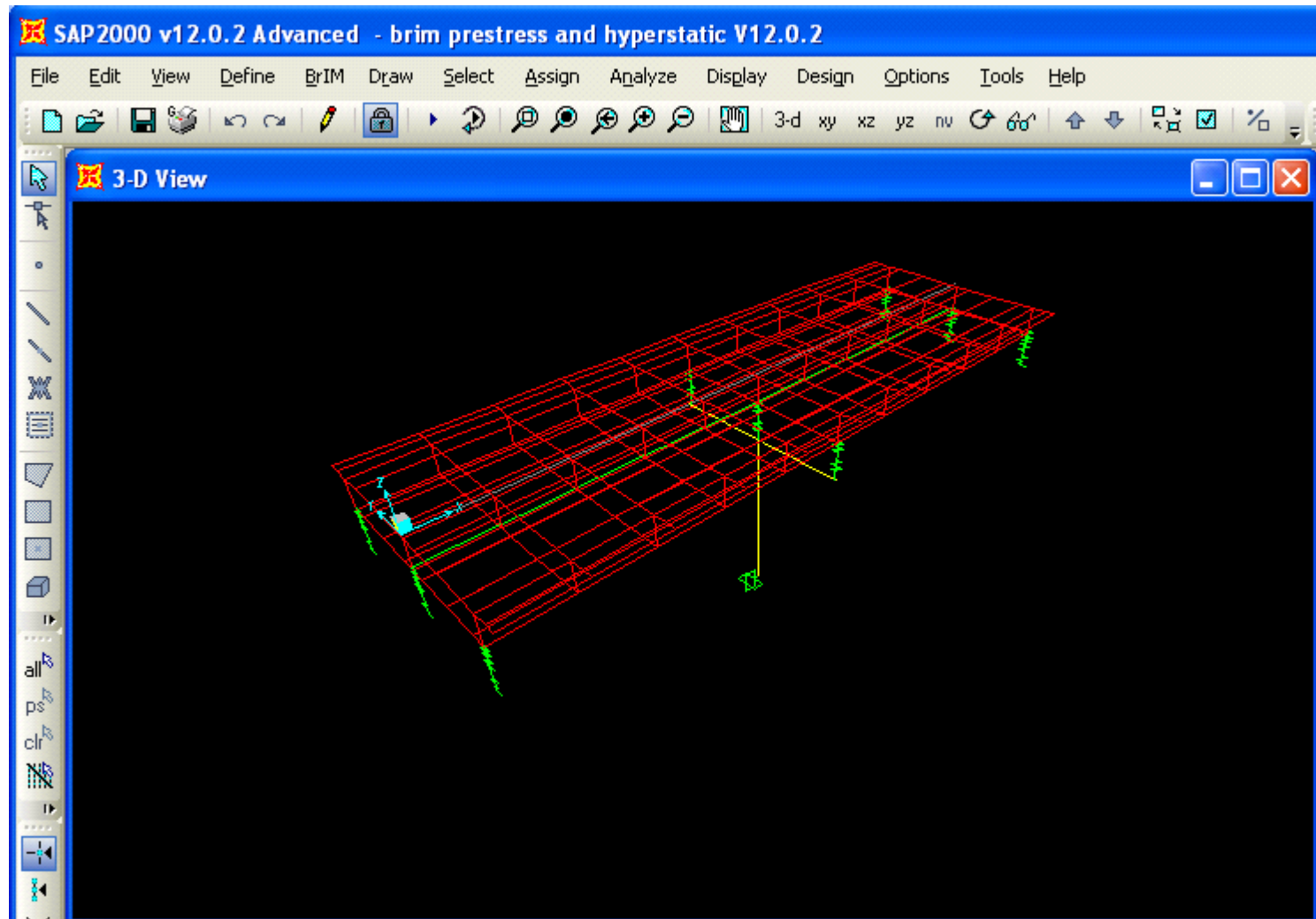


Total moment (primary + hyperstatic)

SAP2000 model results

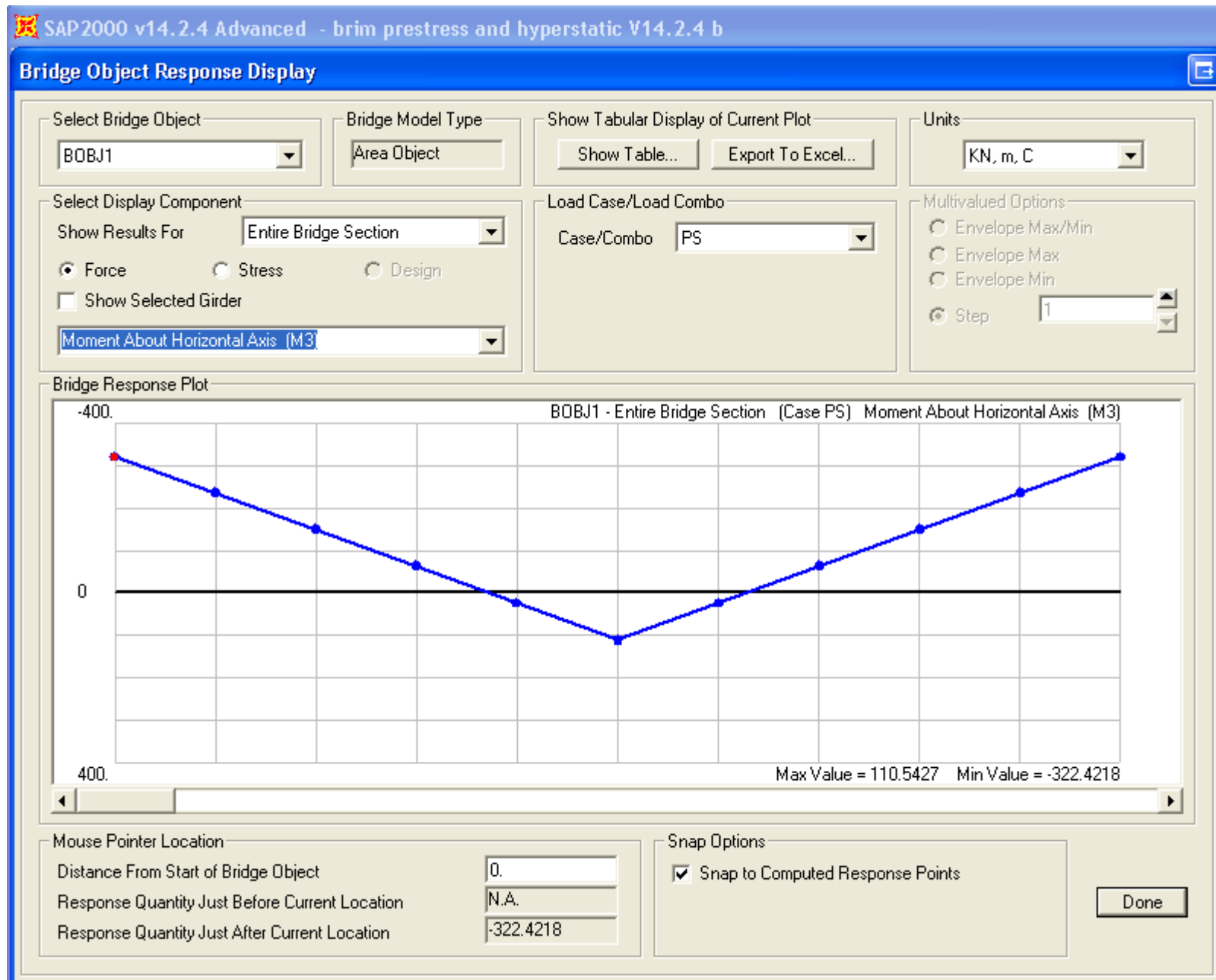
- Note that similar results can be obtained from CSiBridge.

Model geometry

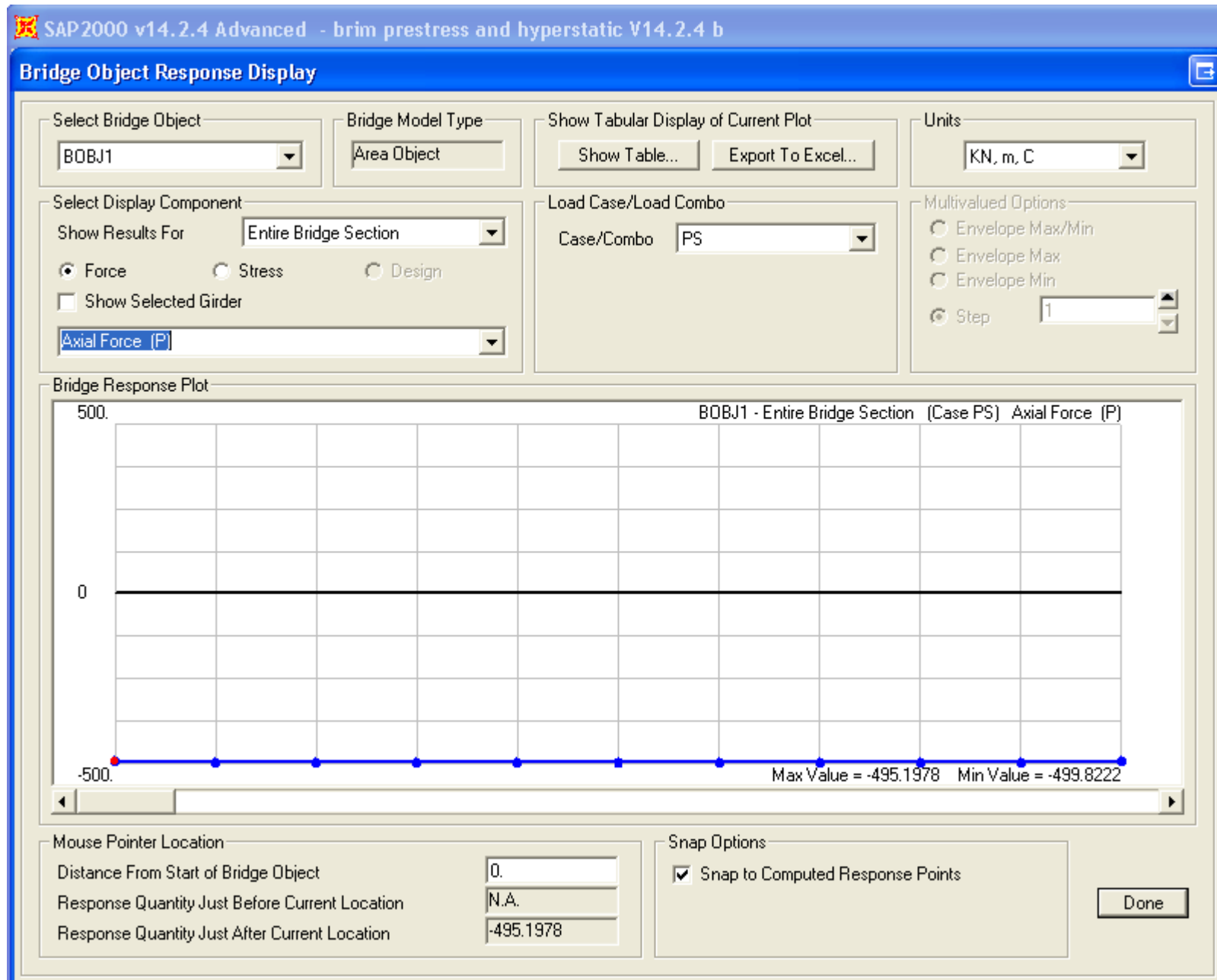


Total forces (primary + hyperstatic)

Concrete moment
(obtained as resultant of concrete forces; corresponds to total moment)



Concrete axial forces (obtained as resultant of concrete forces; corresponds to total axial forces)

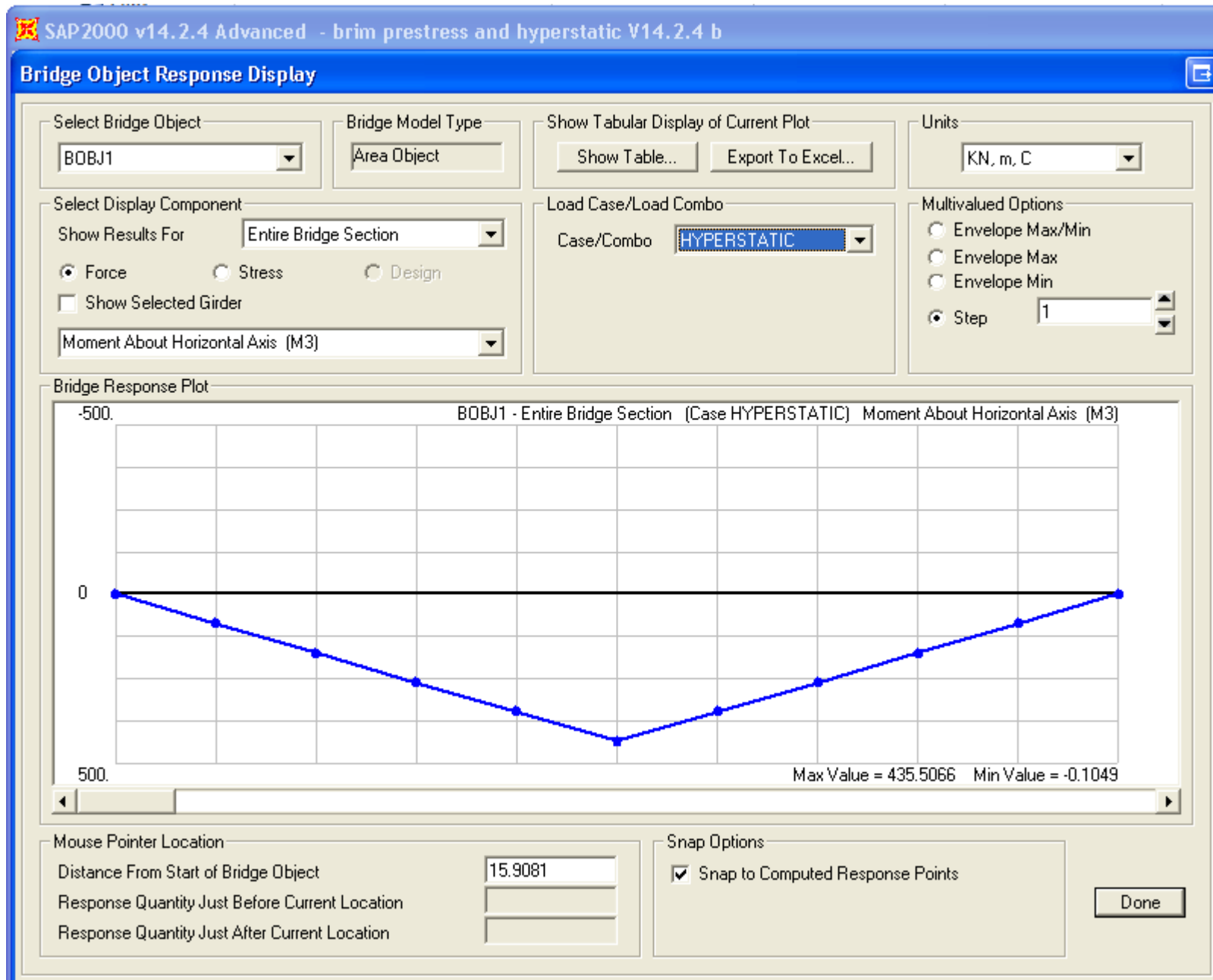


Hyperstatic Forces

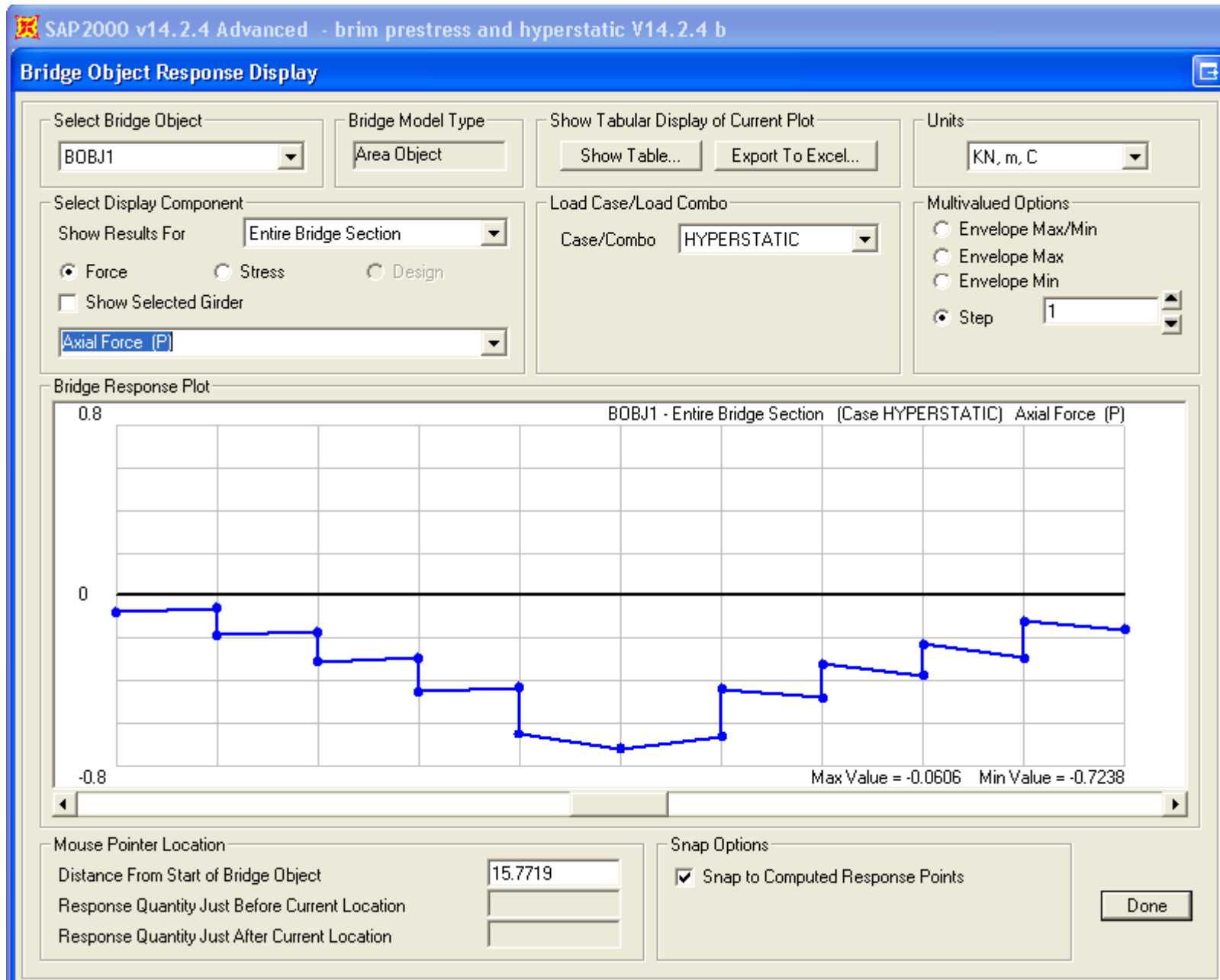
Approach 1 - via hyperstatic load case

- This approach may not be always reliable when substructure is modeled.

Hyperstatic moment



Hyperstatic axial force (essentially zero as expected)



Hyperstatic Forces

Approach 2 - as a Net Resultant of Design Section Forces

- Flexural design request check for prestressed concrete box girder superstructure fully accounts for secondary (hyperstatic) forces by calculating the demand forces as a sum of both the forces in the concrete and the tendons (which is by definition the hyperstatic force).
- Therefore, the hyperstatic forces can be indirectly obtained by plotting the demand forces for the flexural design request as shown on the following pages.

Define load combination containing only the load case in which the prestressing is applied.

Load Combination Data

Load Combination Name (User-Generated)

Notes

Load Combination Type

Options

Define Combination of Load Case Results

Load Case Name	Load Case Type	Scale Factor
<input type="text" value="PS"/>	Linear Static	1.
<input type="text" value="PS"/>	Linear Static	1.

Define dummy flexural design request for the load combination containing only the prestress load case

SAP2000 v14.2.4 Advanced - brim prestress and hyperstatic V14.2.4

Bridge Design Request - Superstructure - AASHTO LRFD 2007

Name d DUMMY PS NET RESUL

Notes

Bridge Object BOBJ1

Check Type Conc Box Flexure

Station Ranges

	Location Type	Start Type	Start Station	End Type	End Station	
1.	Both	Bridge Start		Bridge End		<input type="button" value="Add"/> <input type="button" value="Delete"/>

Design Request Parameters

Demand Sets

Name	Combo	Parameters	
DSet1	c PS	Modify/Show	<input type="button" value="Add"/> <input type="button" value="Delete"/>

The demand moments for this design request are obtained as a net resultant of forces (in concrete and tendons) acting on the cross-section, which matches the definition of the hyperstatic moment.

