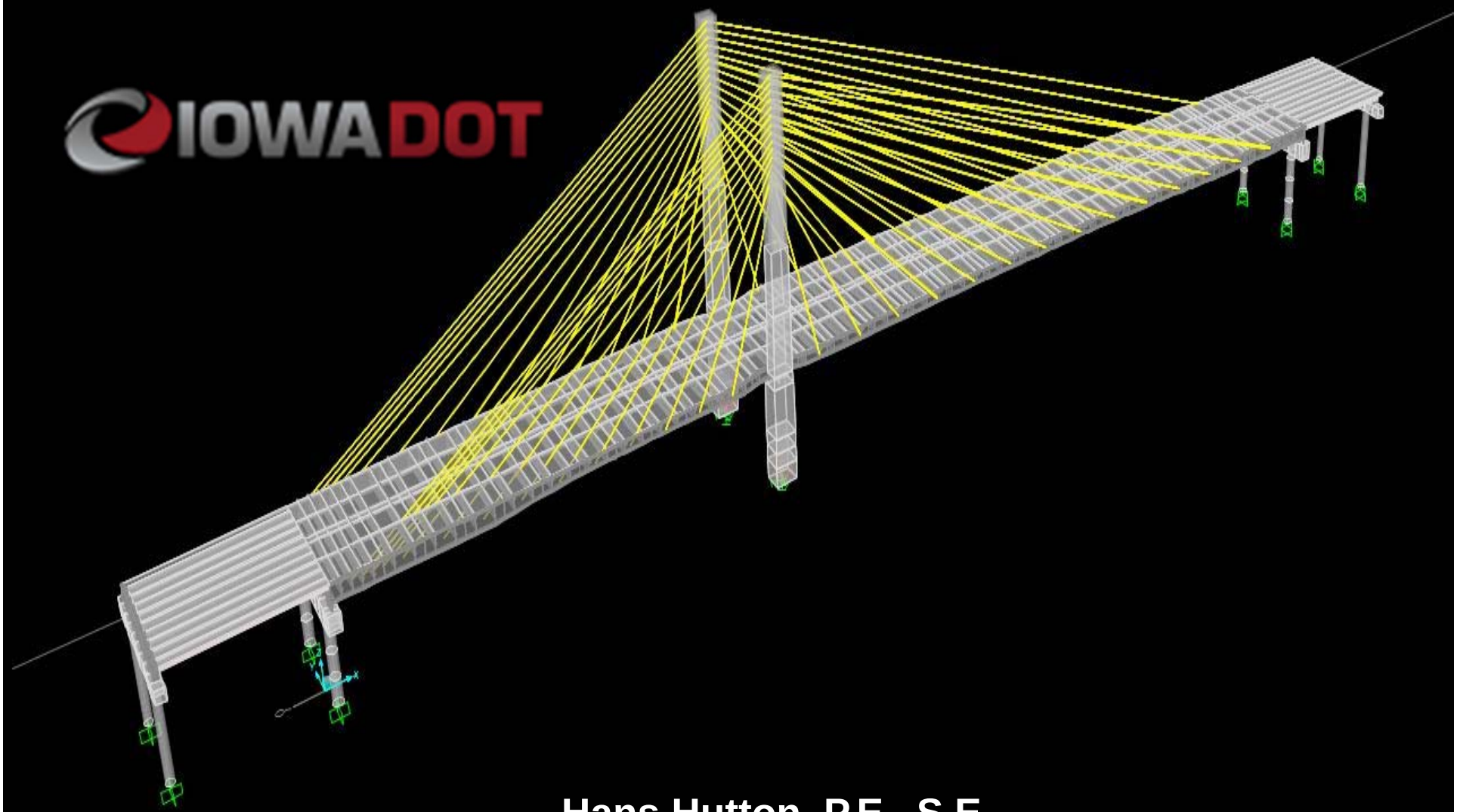
An Evolution of Analysis of Complex Structures



Hans Hutton, P.E., S.E.

Iowa DOT 3D Conference

Ames, IA

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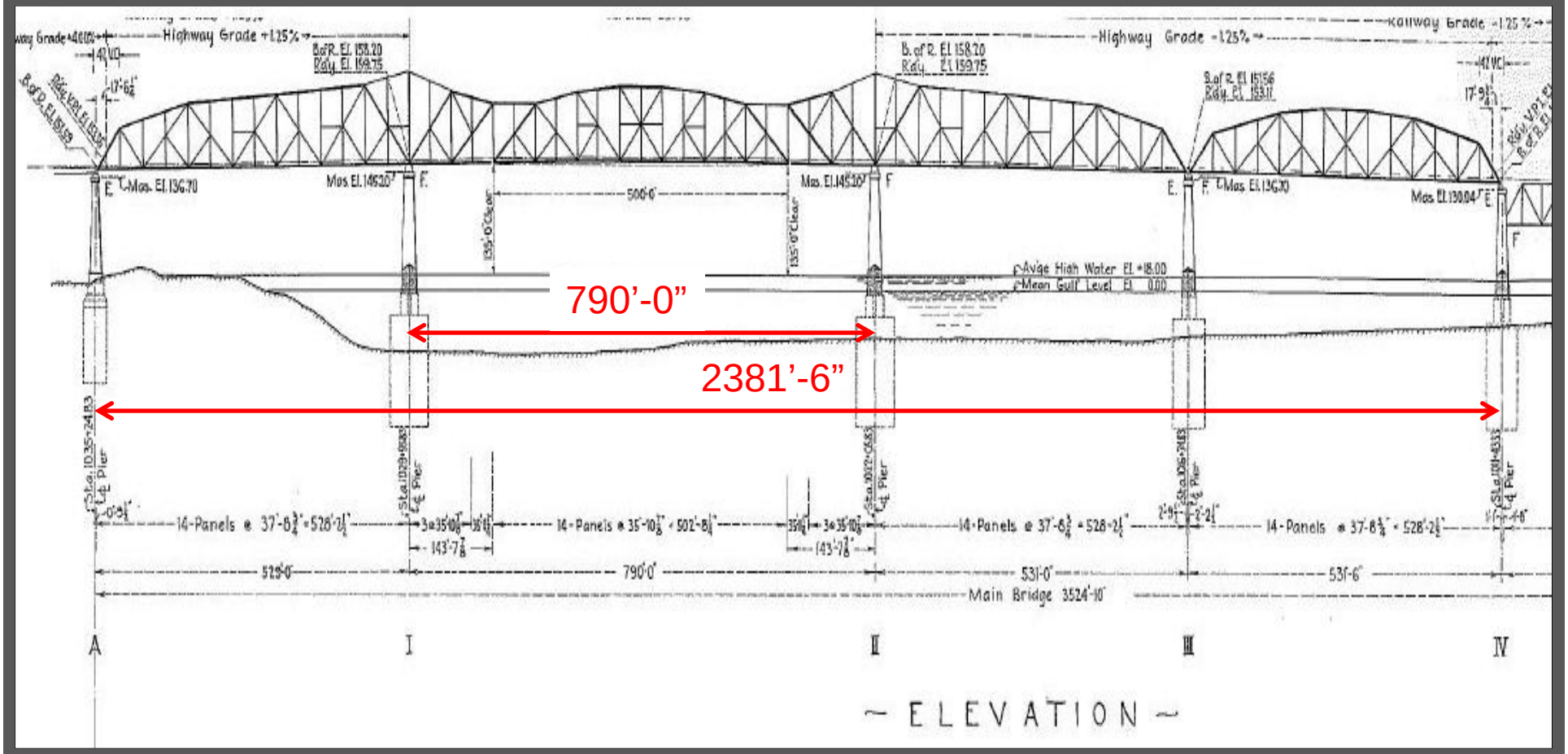
Huey P. Long Bridge over Mississippi River at New Orleans, LA - 1933



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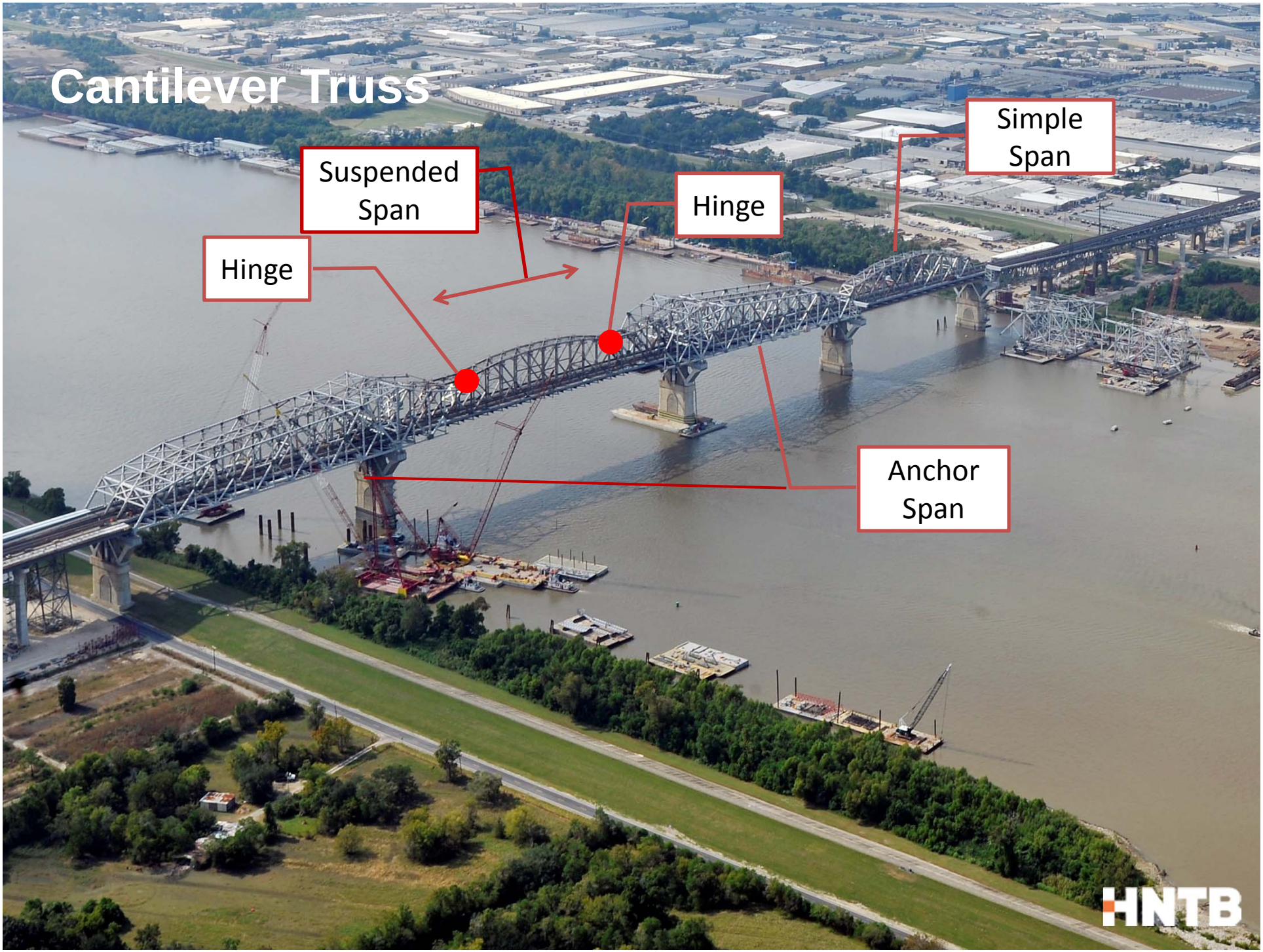
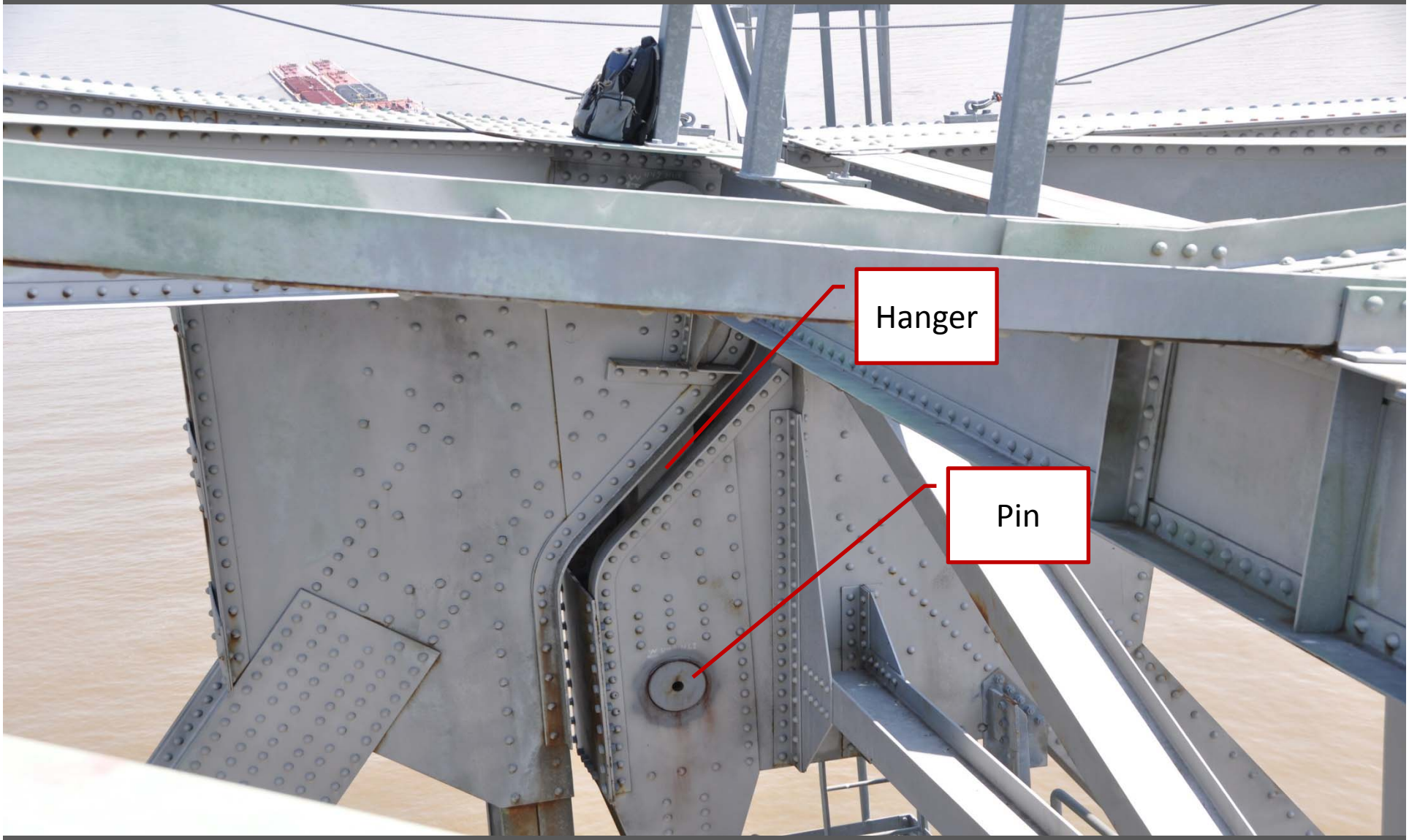
Cantilever Truss



Example of a Pin-Connected Hanger



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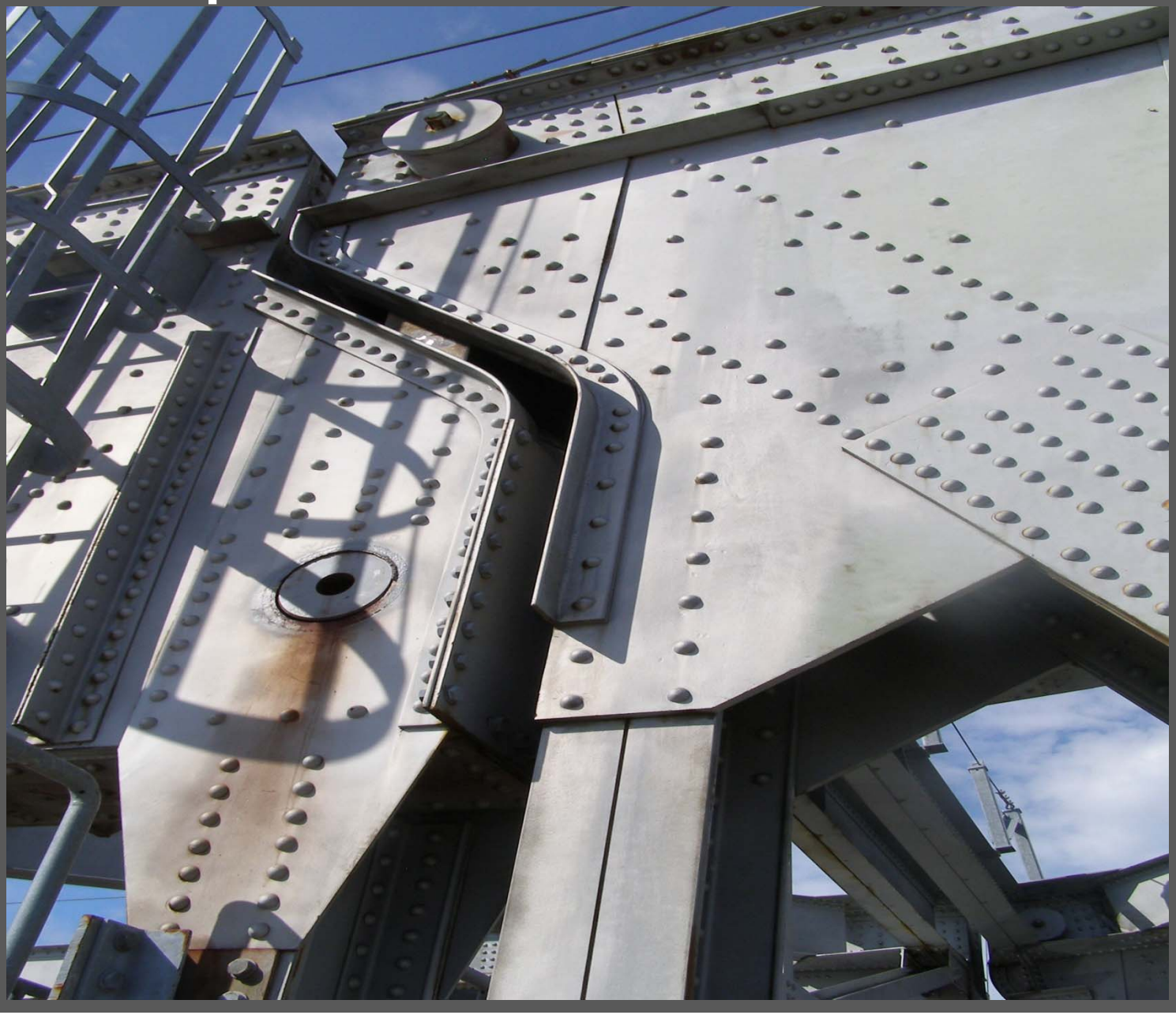
Example of a Pin-Connected Truss



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Example of a Pin-Connected Truss

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Methods of Dealing with Rigidity in Riveted Joints

1. Camber
2. Style of Truss (e.g. Warren vs. Baltimore)
3. Narrow Cross Sections
4. Estimate and Include Secondary Stresses

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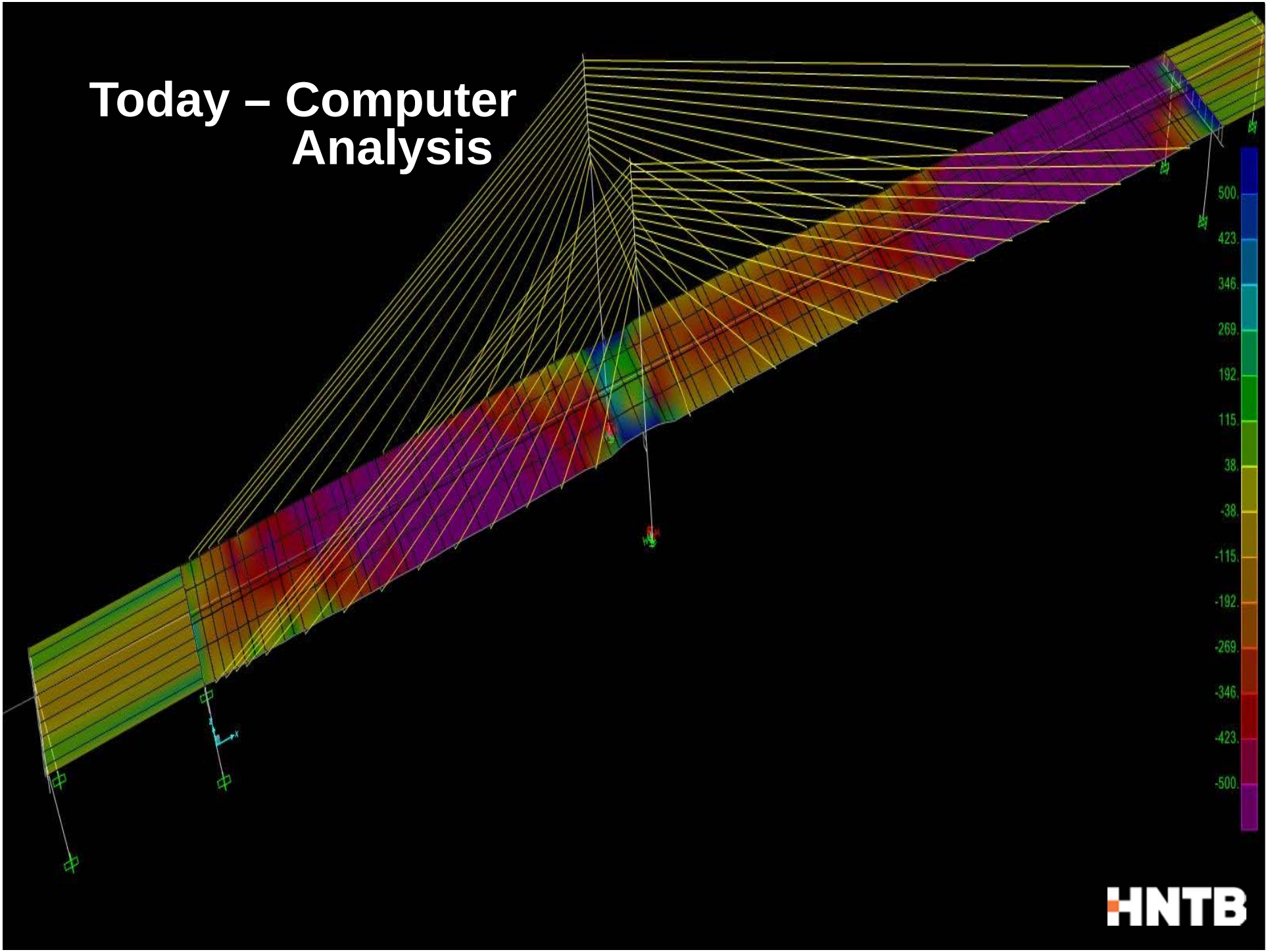
Today – Computer Analysis



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Some Benefits of Computer Analysis

1. Statically Indeterminate Structures
2. Influence Surface for Live Load Analysis
3. Geometric Nonlinearity
4. Material Nonlinearity
5. Time Dependent Effects (e.g. Creep & Shrinkage)
6. Effective Width of Deck
7. Step-by-Step Time History Analysis
8. Erection Analysis
9. High Order Finite Elements – Complex Geometry

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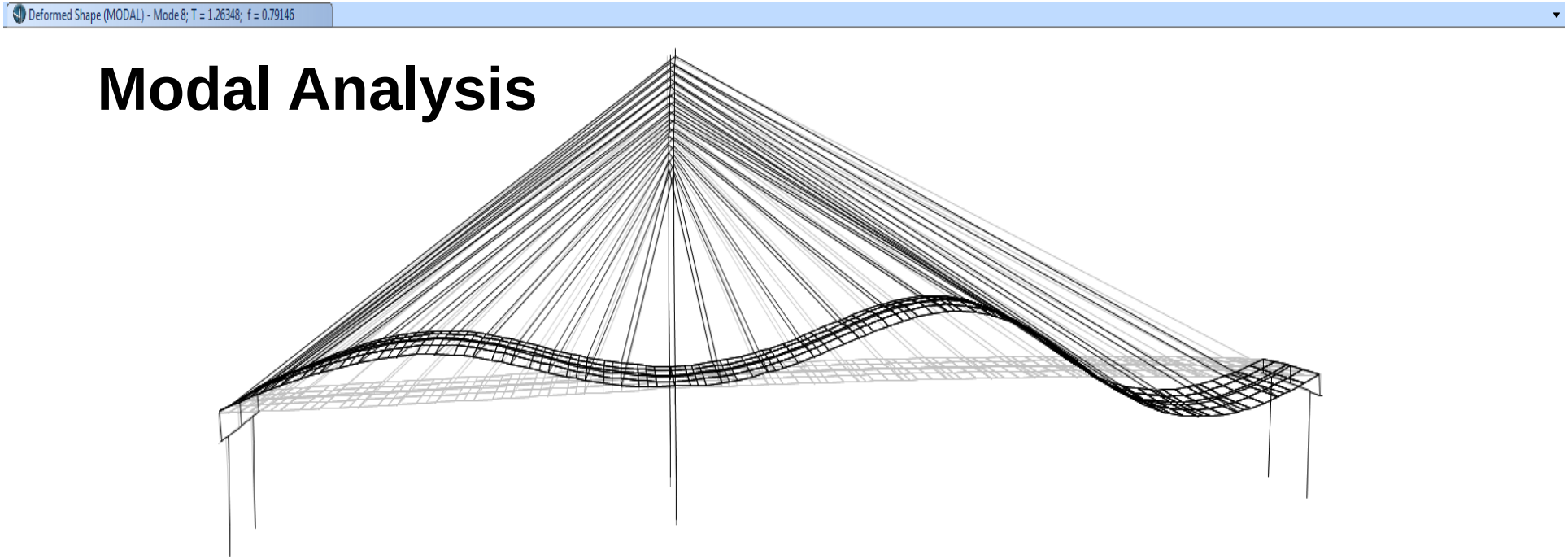
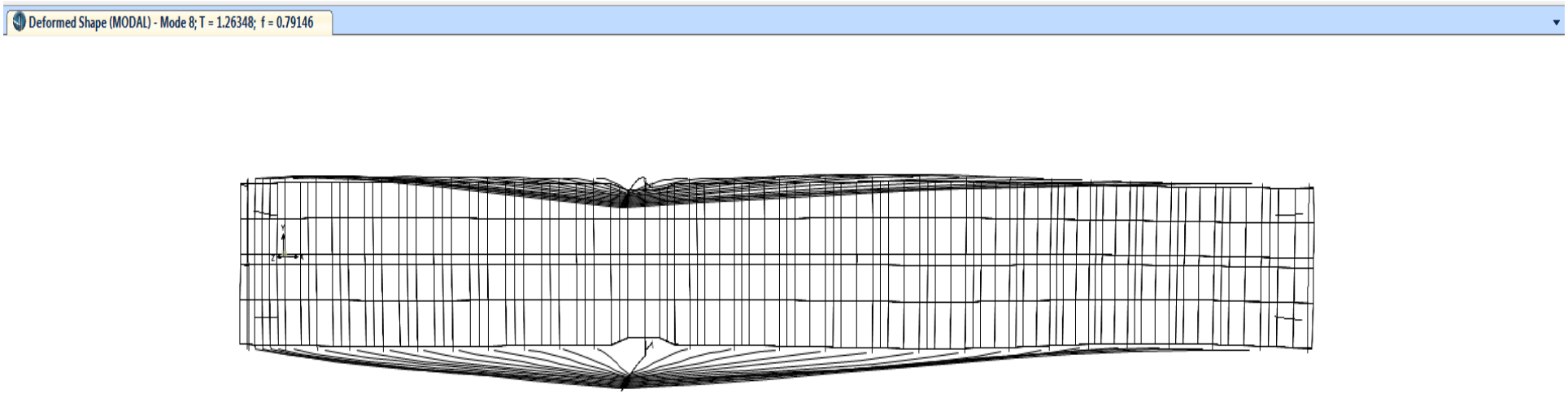
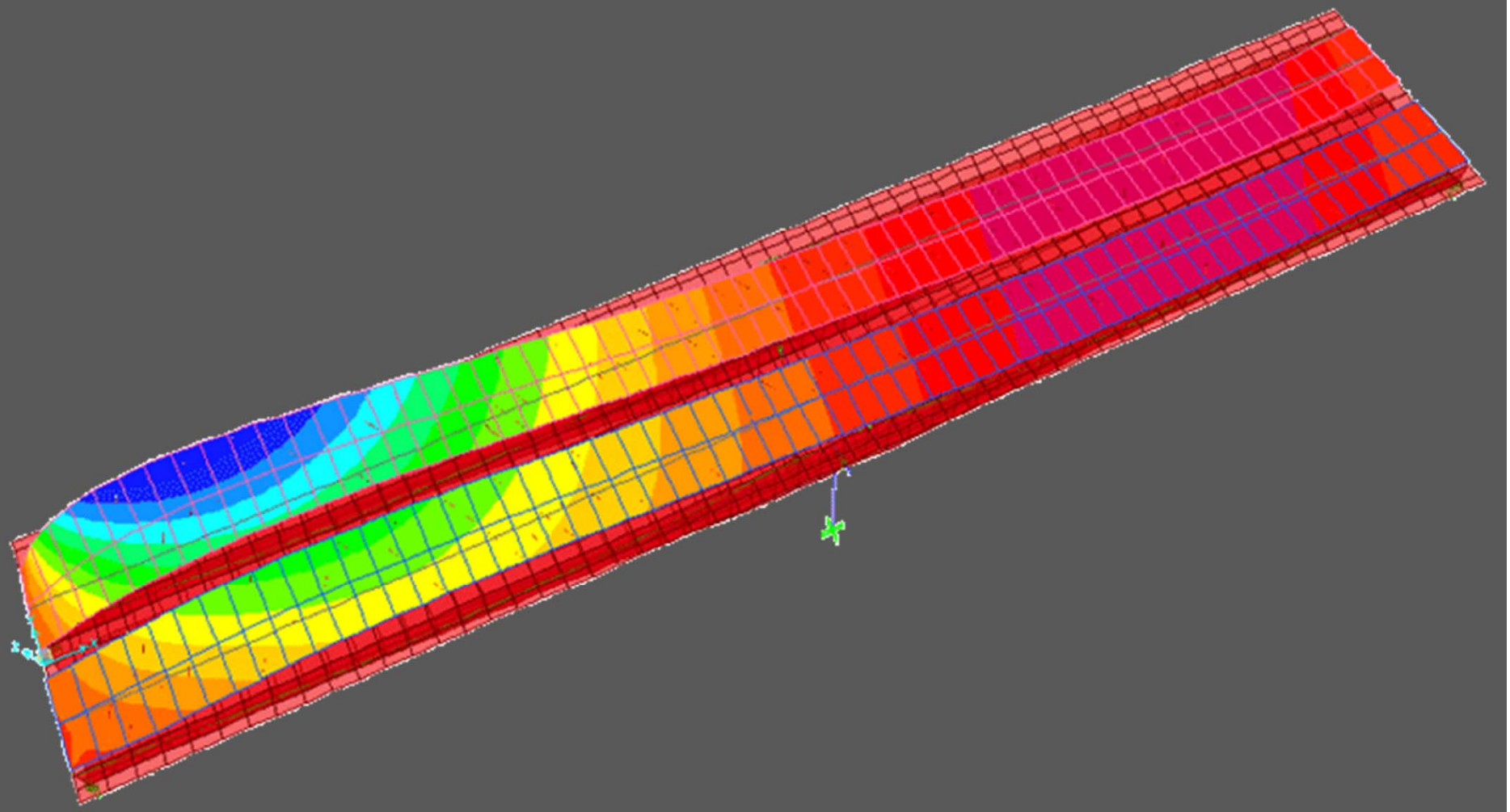
Modal Analysis

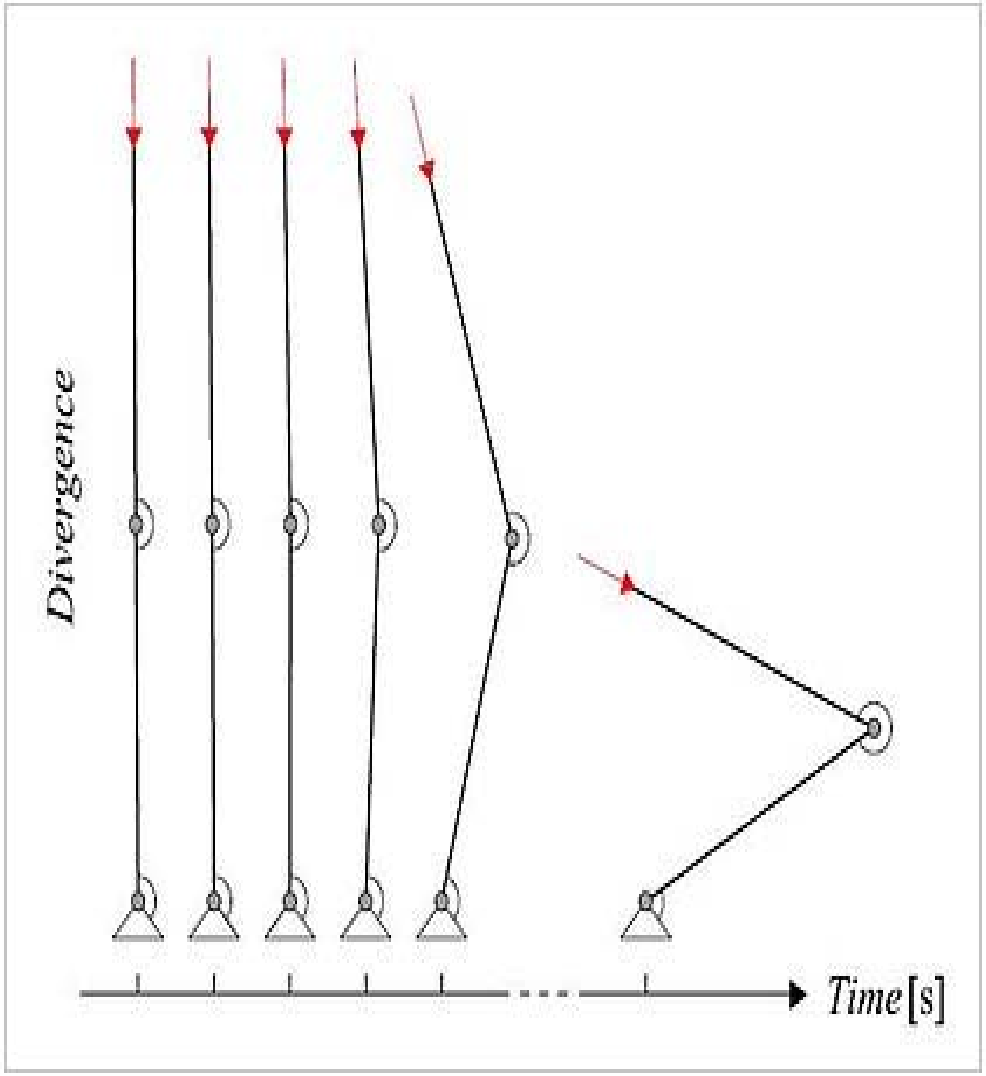




Influence Surface



Geometric Nonlinearity



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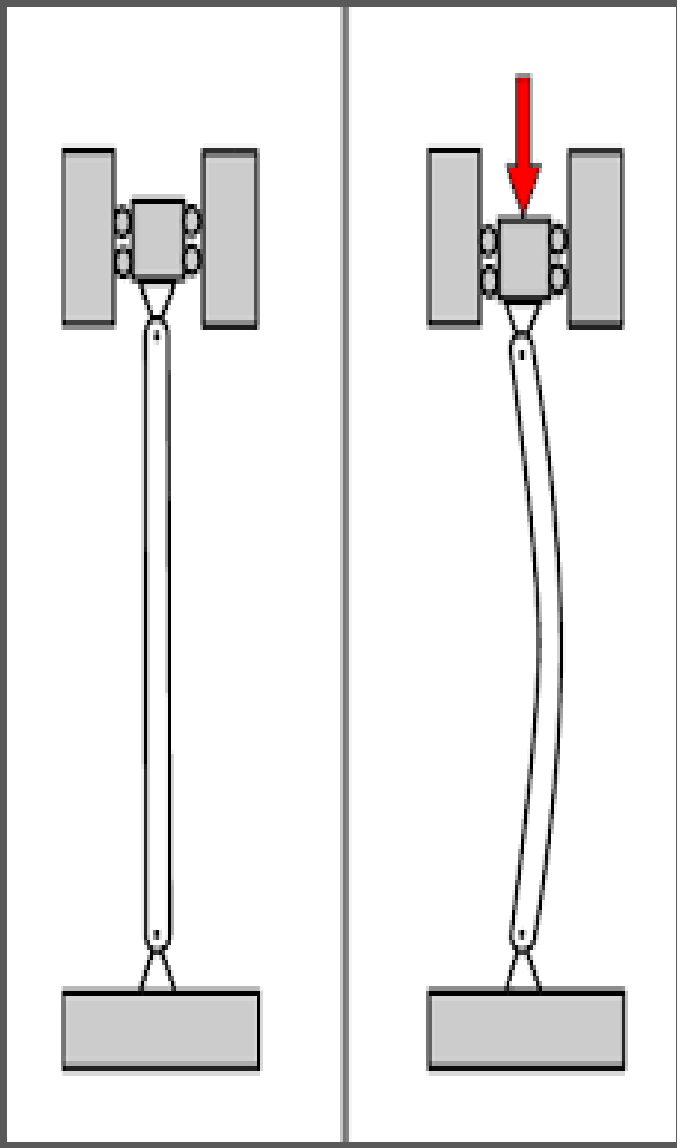
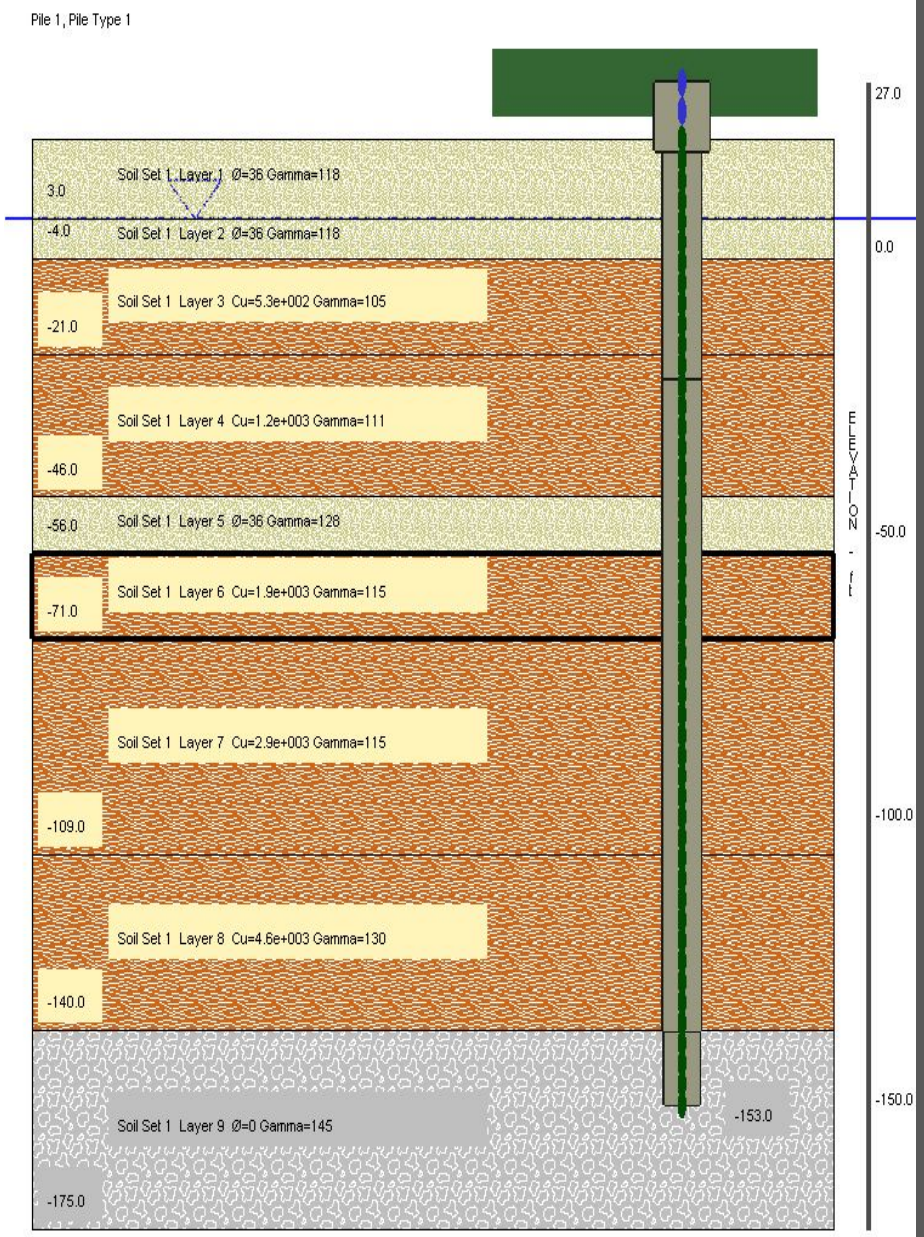
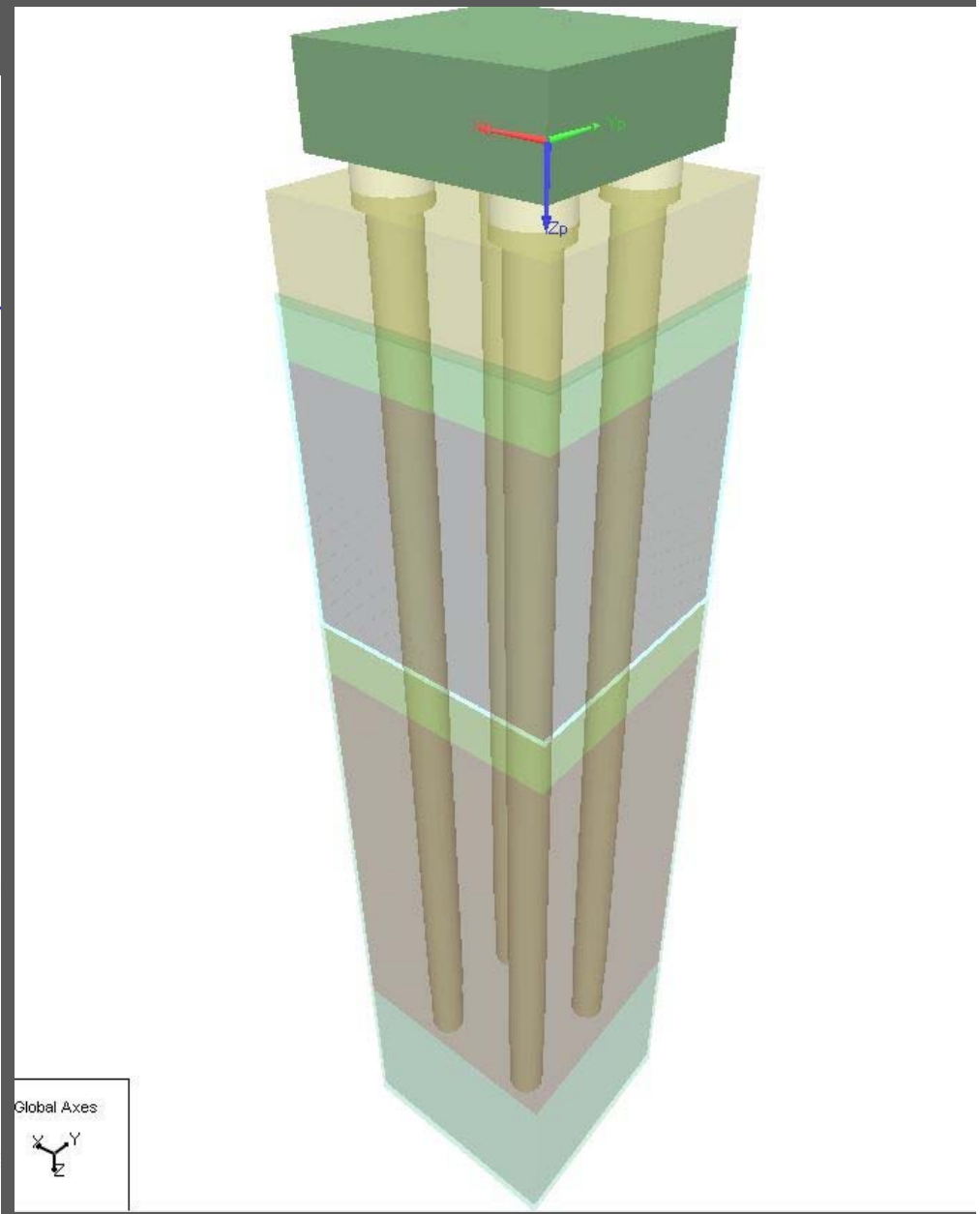


Material Nonlinearity





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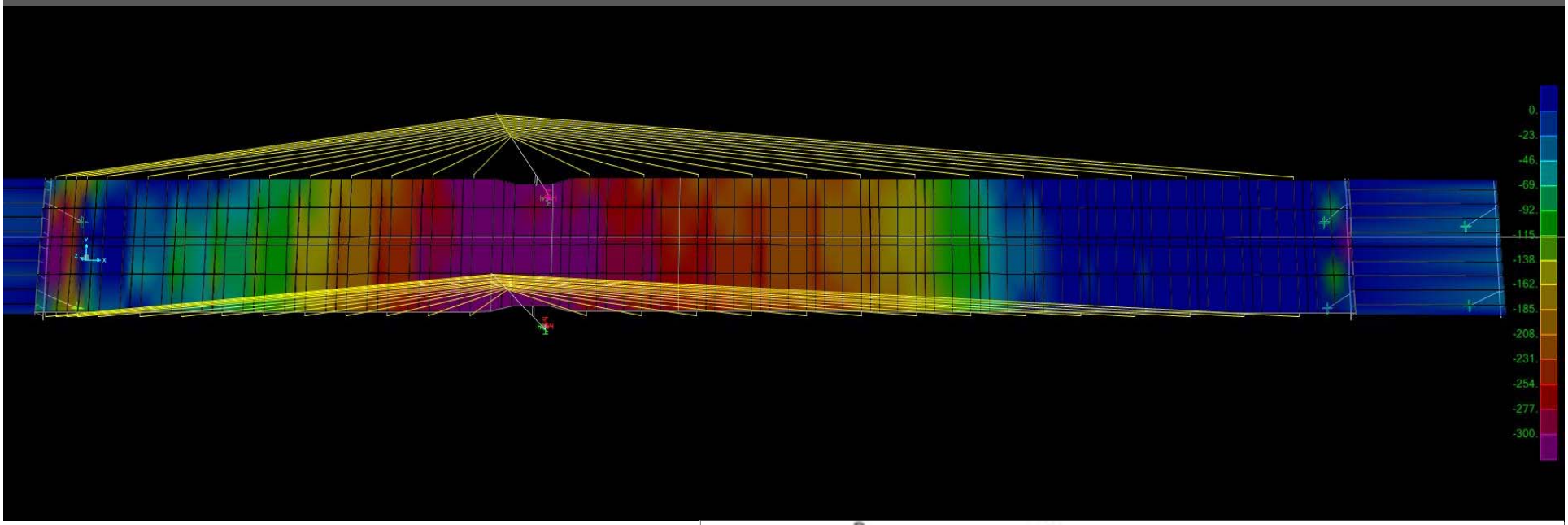
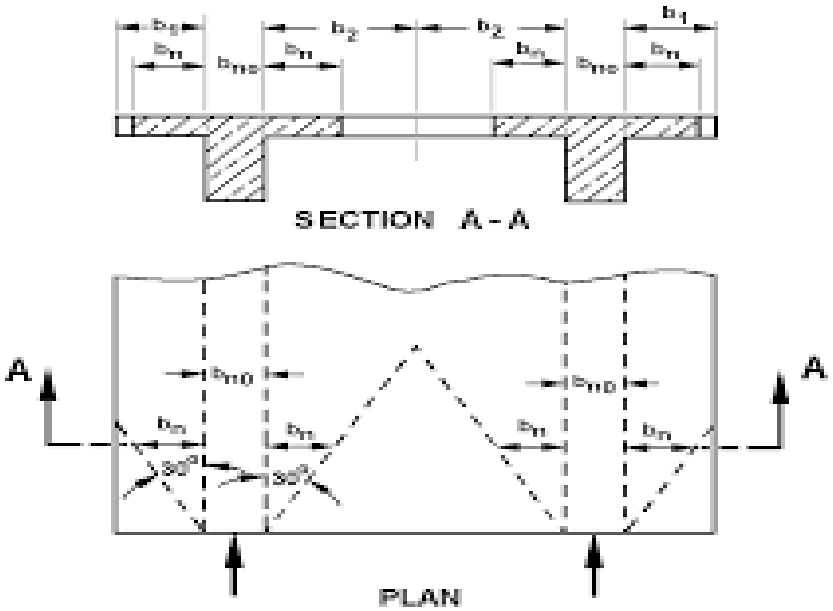
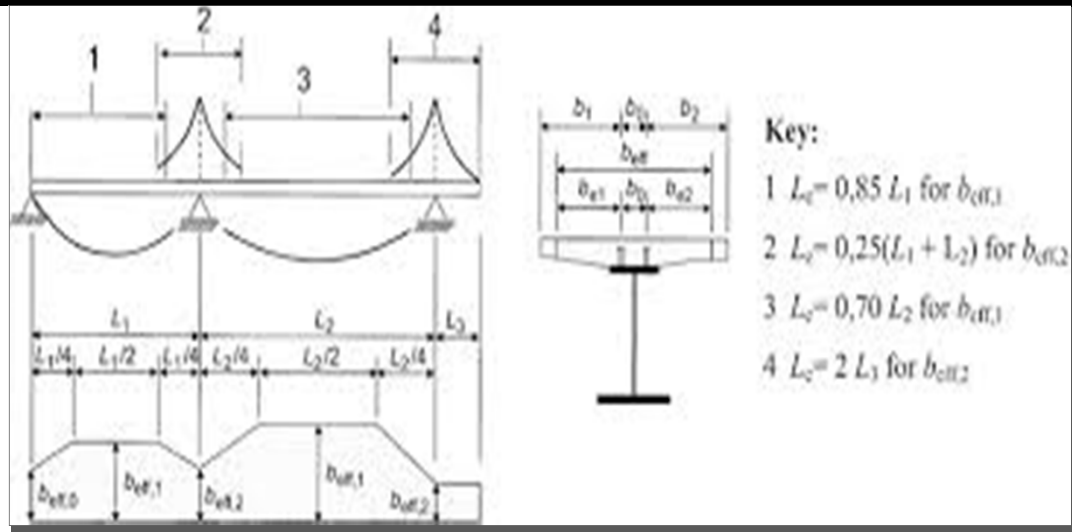
Effective Width of Deck







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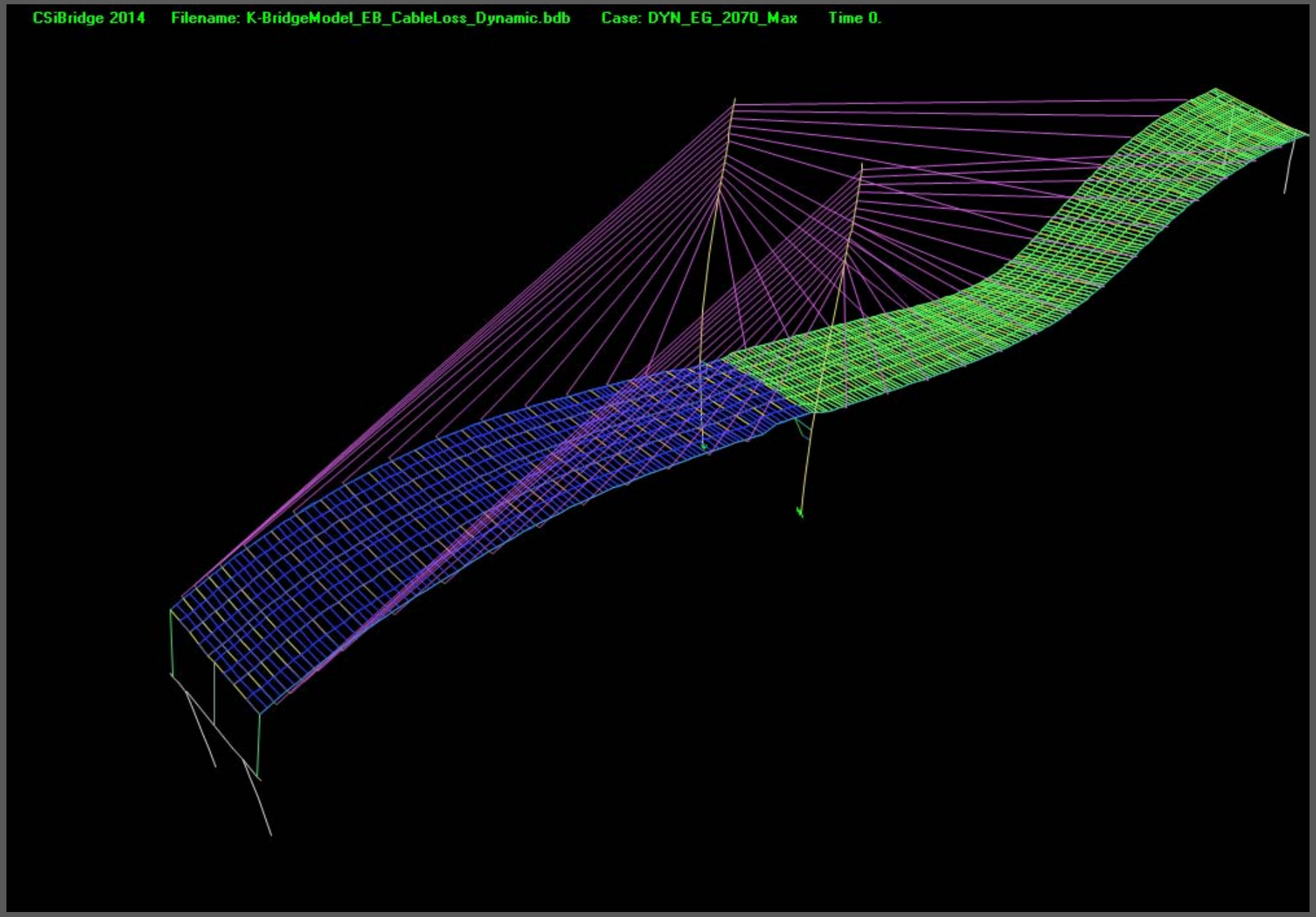
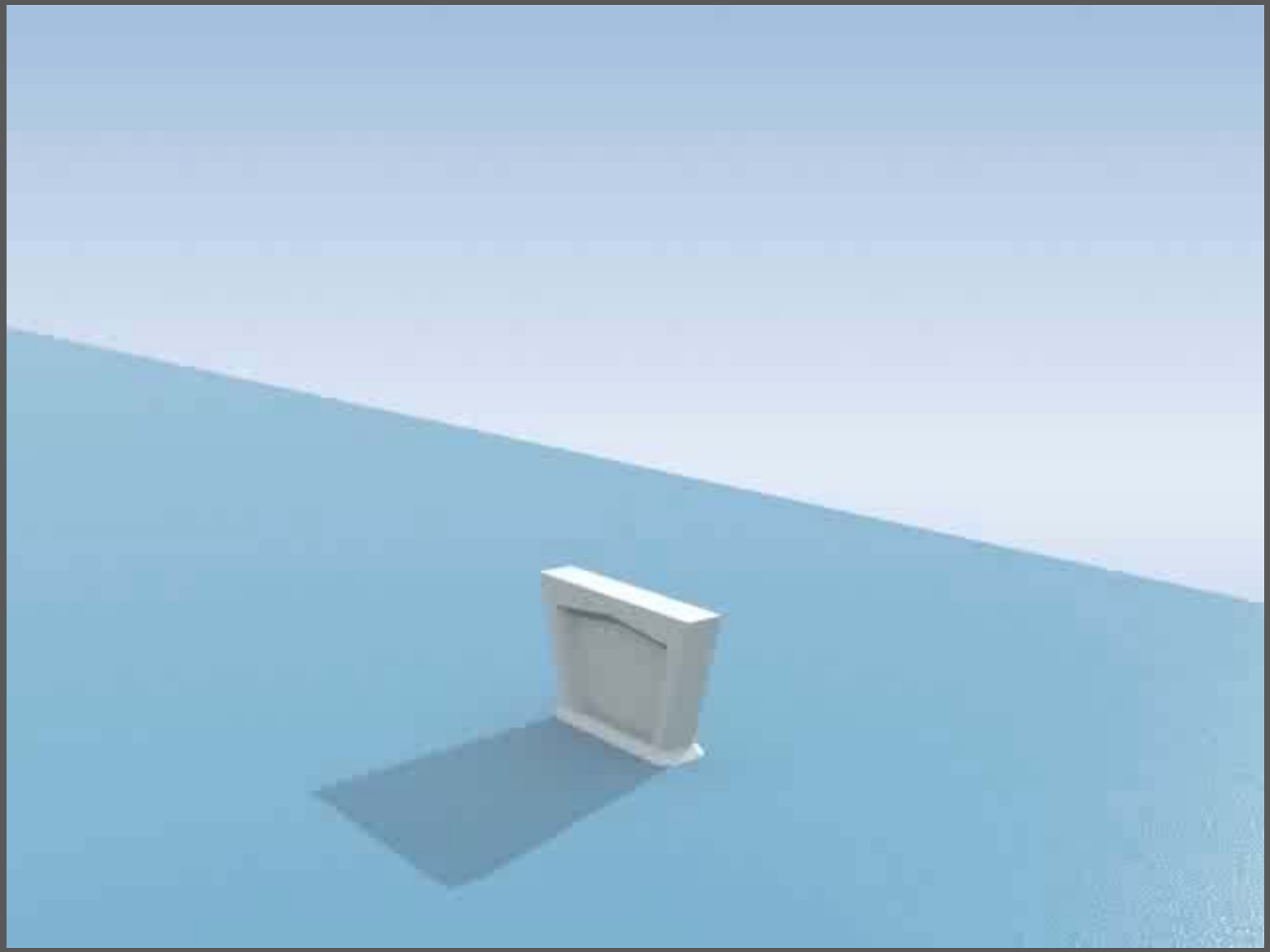
Time History Analysis



Erection Analysis & Time Dependent Effects



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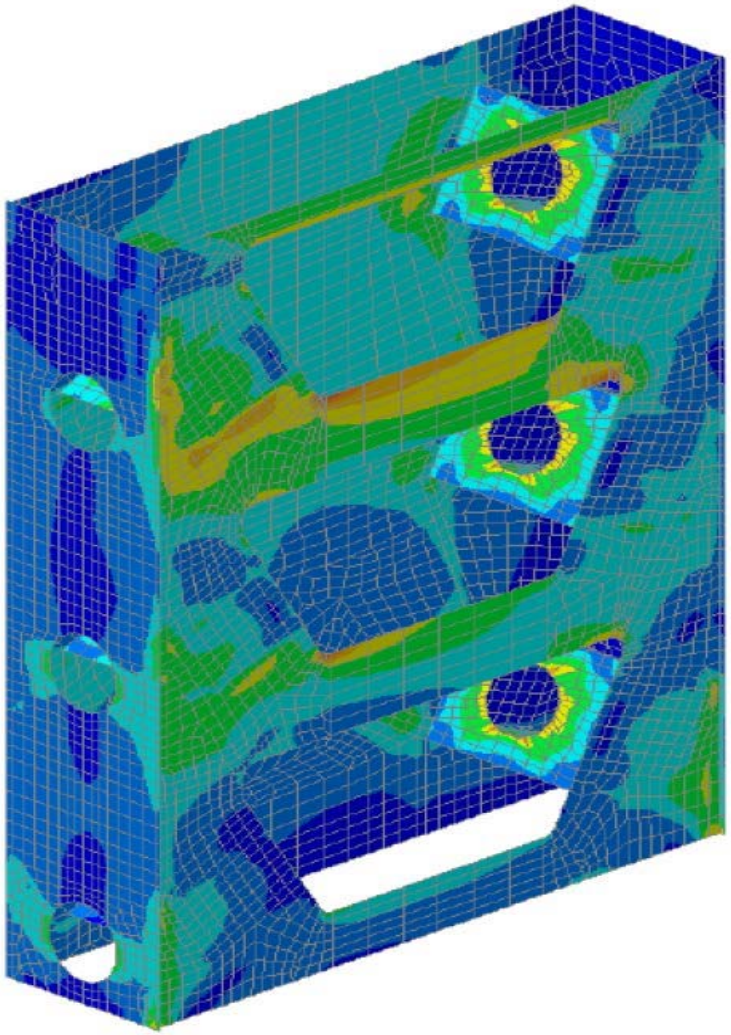
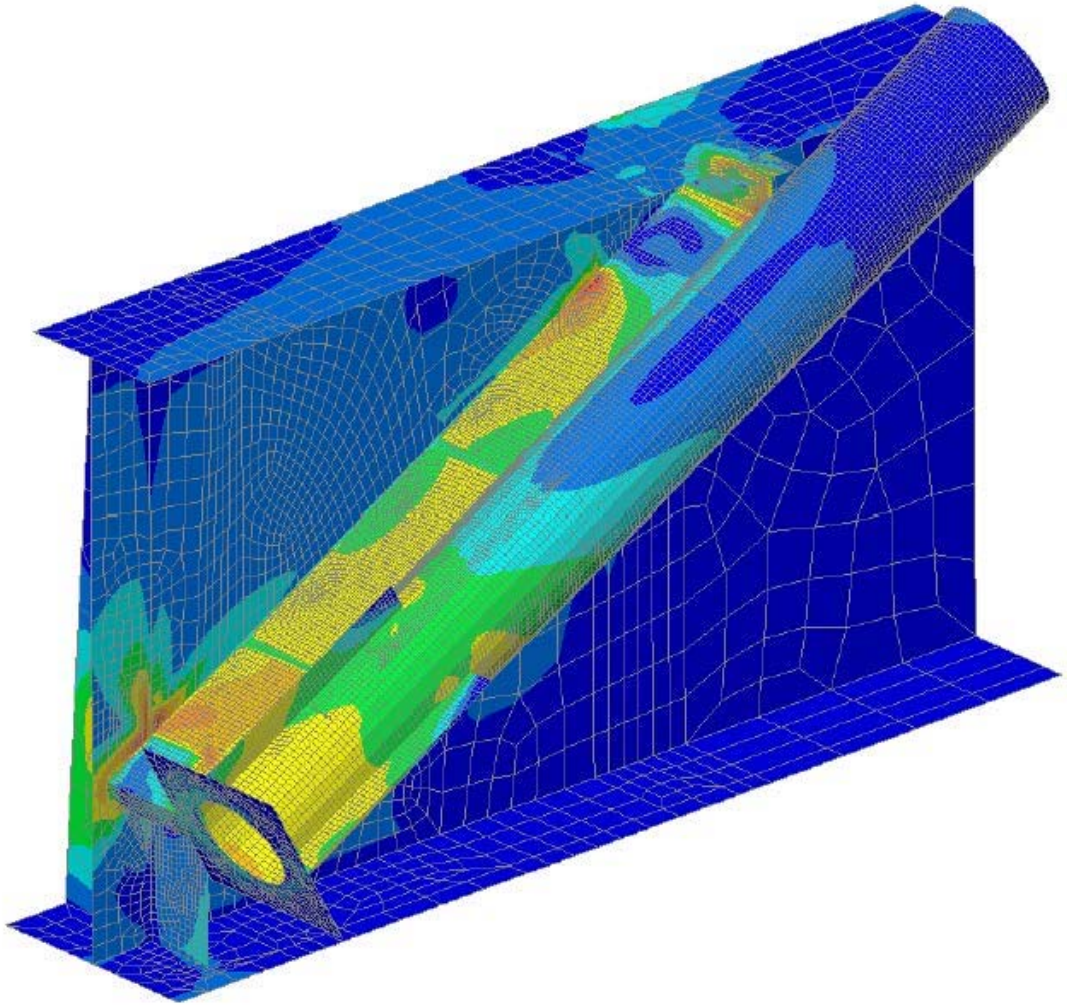
High-Order Finite Elements – Complex Geometry





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Wrong Answer?

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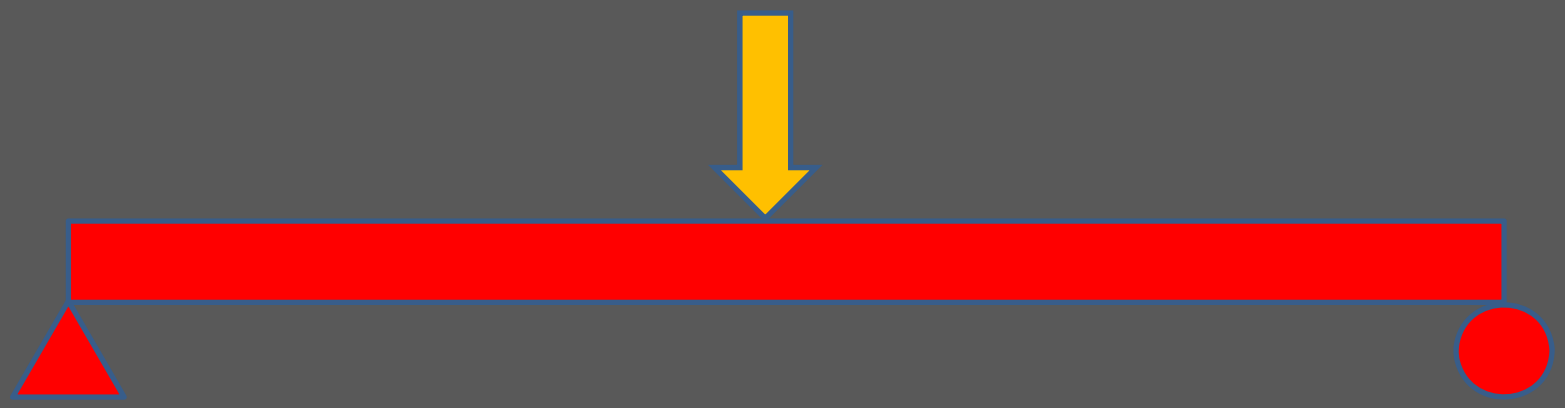
40-ft Simple Span with 1000-kip Force Midspan



Beam Properties:

- Web is ½” x 60”
- Flanges are 1” x 24”

Shear in Beam = 500-kip

Shear Stress in Beam = 500-kip/(0.5” x 60”) = 16.67-ksi

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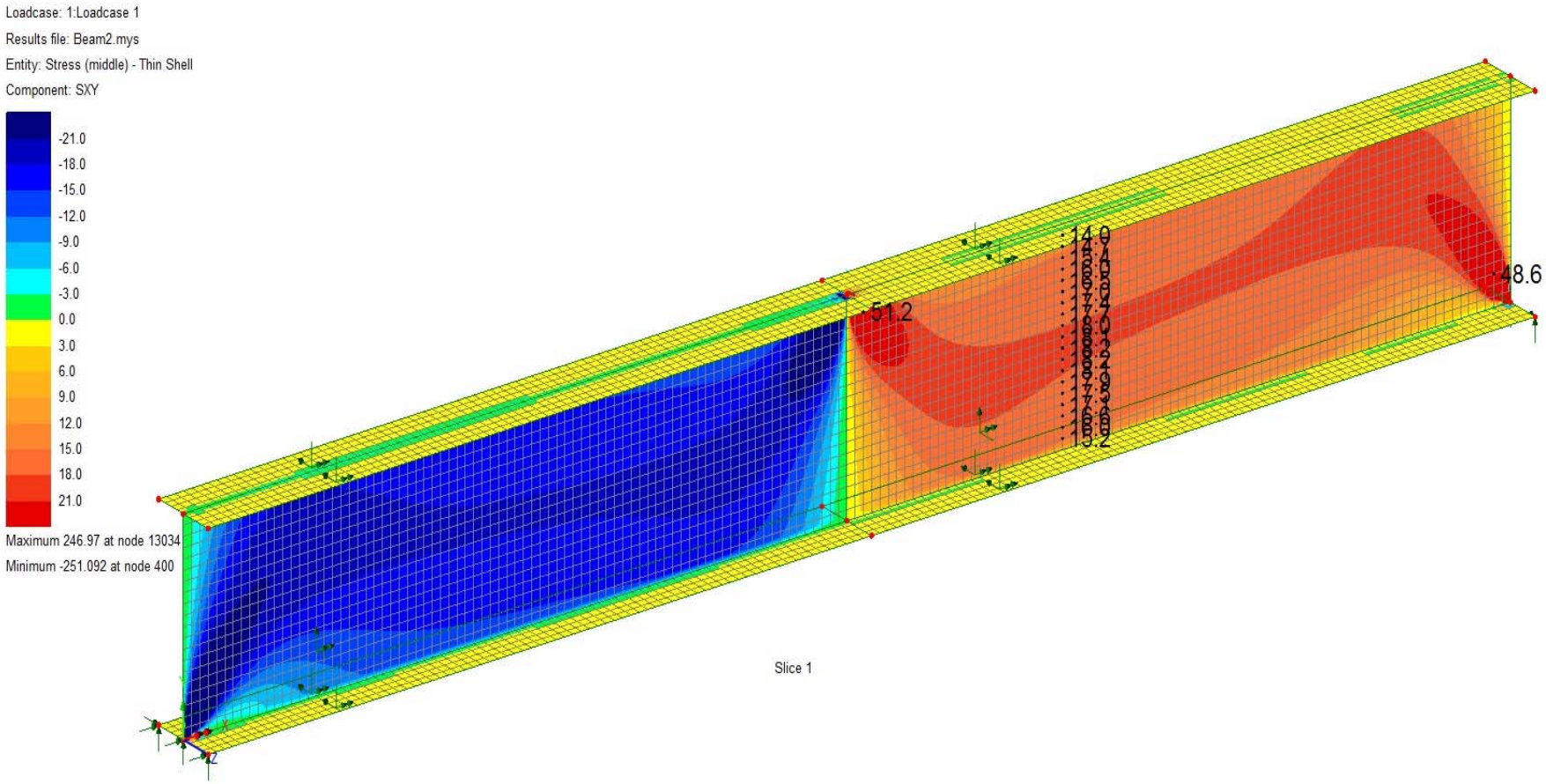
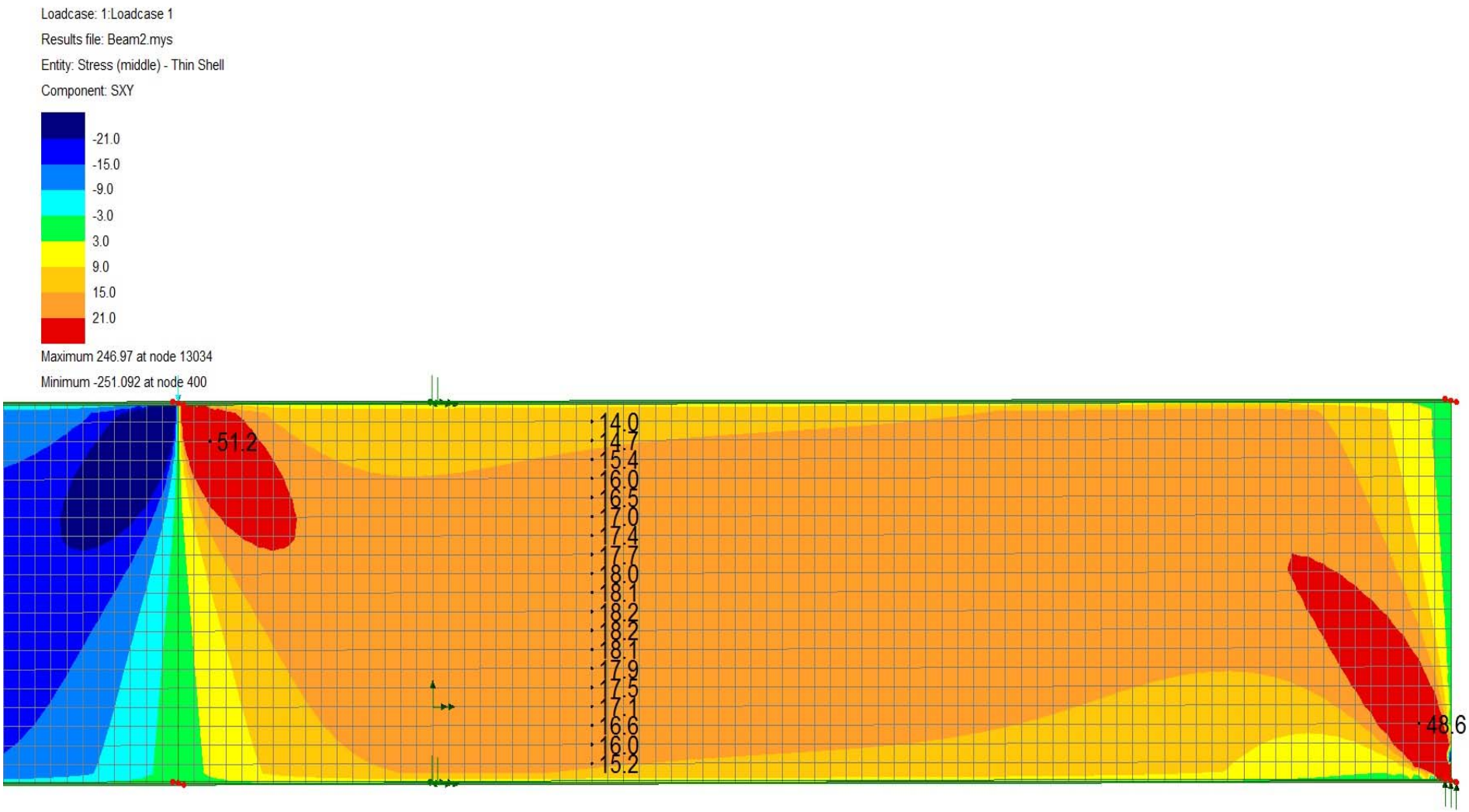
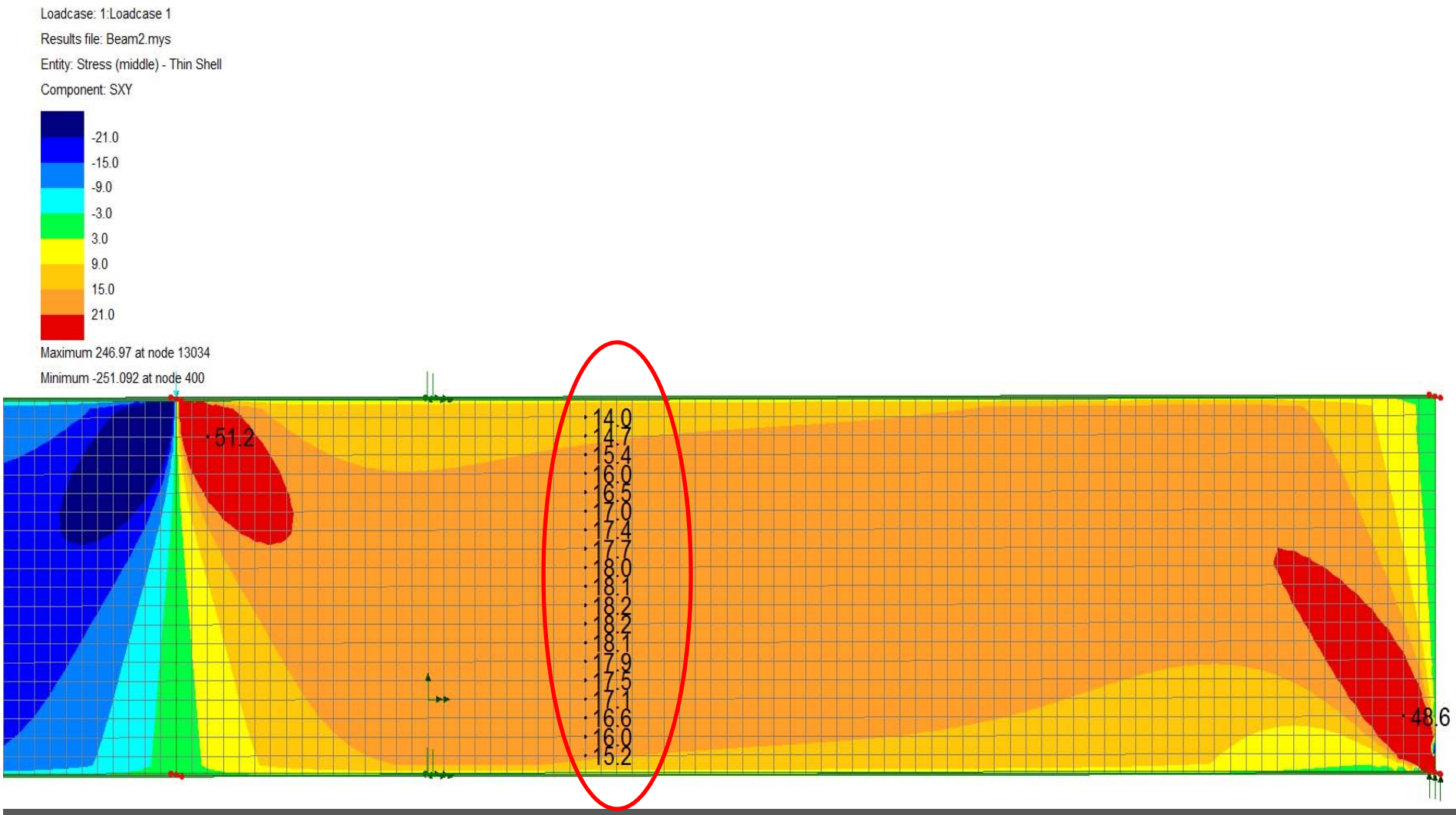
Finite Element Analysis Results



Finite Element Analysis Results



Finite Element Analysis Results



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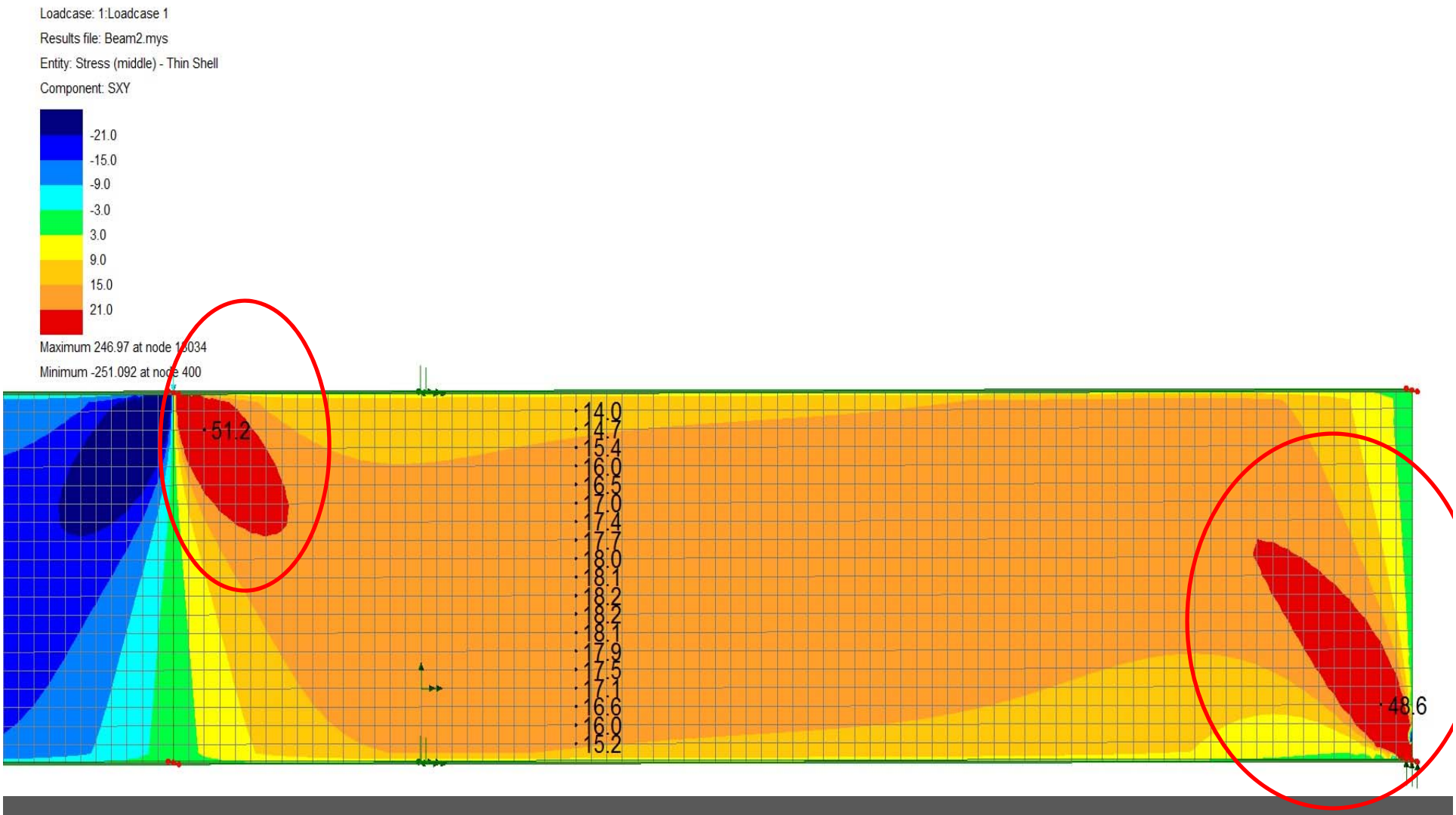
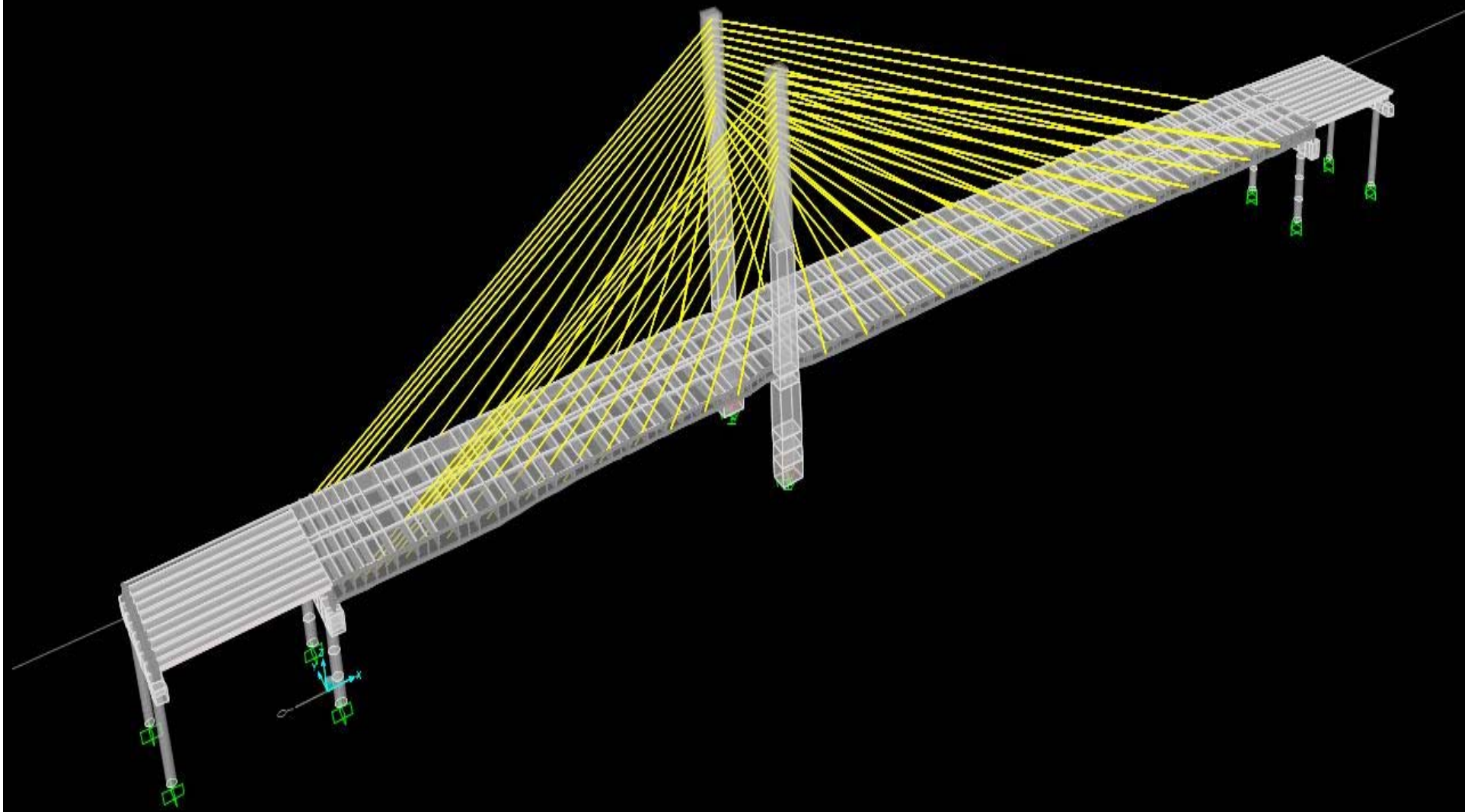
Finite Element Analysis Results



Questions



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