Erecting Steel Bridges
Recent Projects for WSDOT

Western Bridge Engineers' Seminar
September 25 – 28, 2011
Phoenix, Arizona

Washington State Department of Transportation

Highlights of Five Projects

- Hood Canal Floating Bridge Transition Spans
  - Installed nearly complete
- Nooksack River Truss
  - Cantilever Construction
- Typical Curved Girder Projects
  - NS ramp – North Spokane Corridor SR395
  - Wandemere – North Spokane Corridor
  - SR522 – BNSF Flyover ramp in Monroe

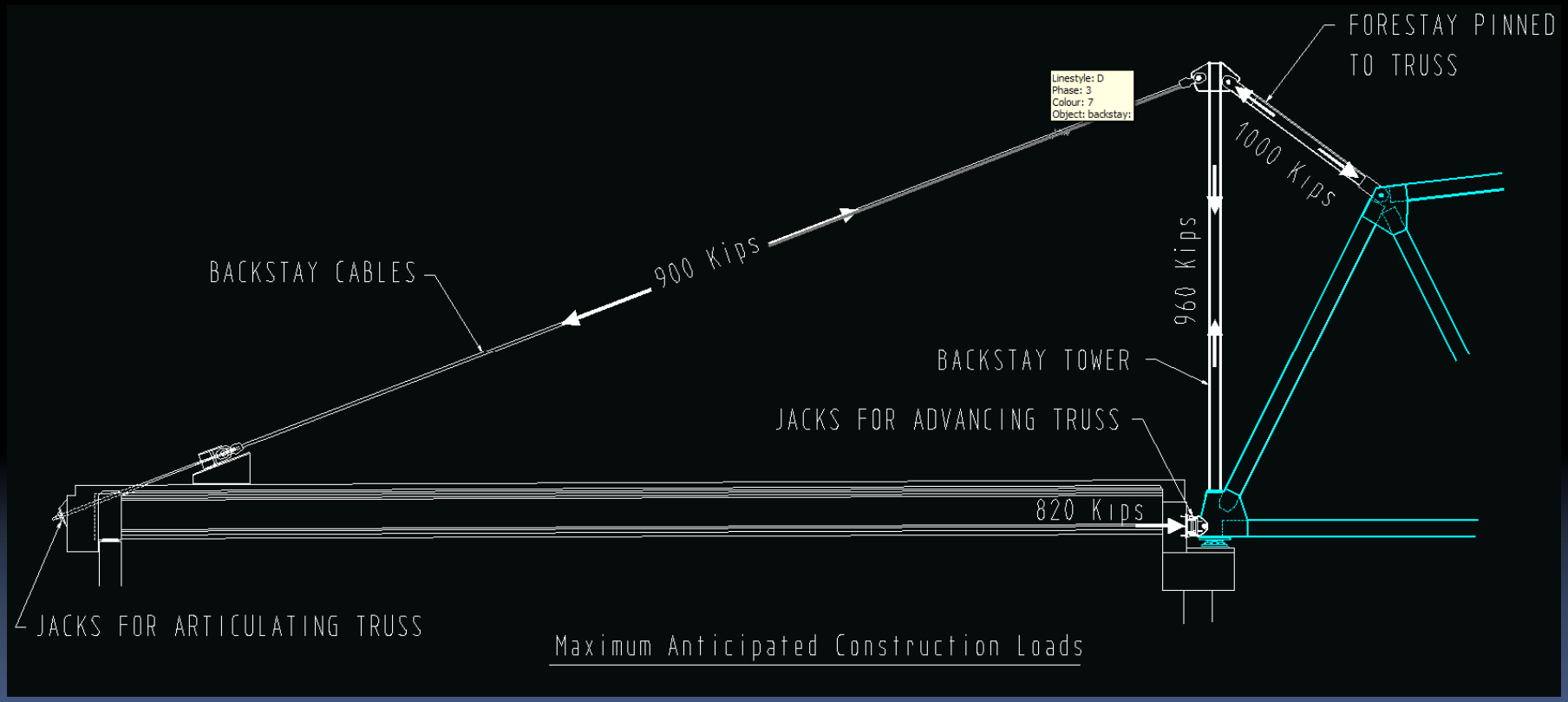

Hood Canal 280 ft Transition Span
Pick Weight = 760 Tons
2 barge cranes w/ 160 tons + 1 barge crane w/480 tons

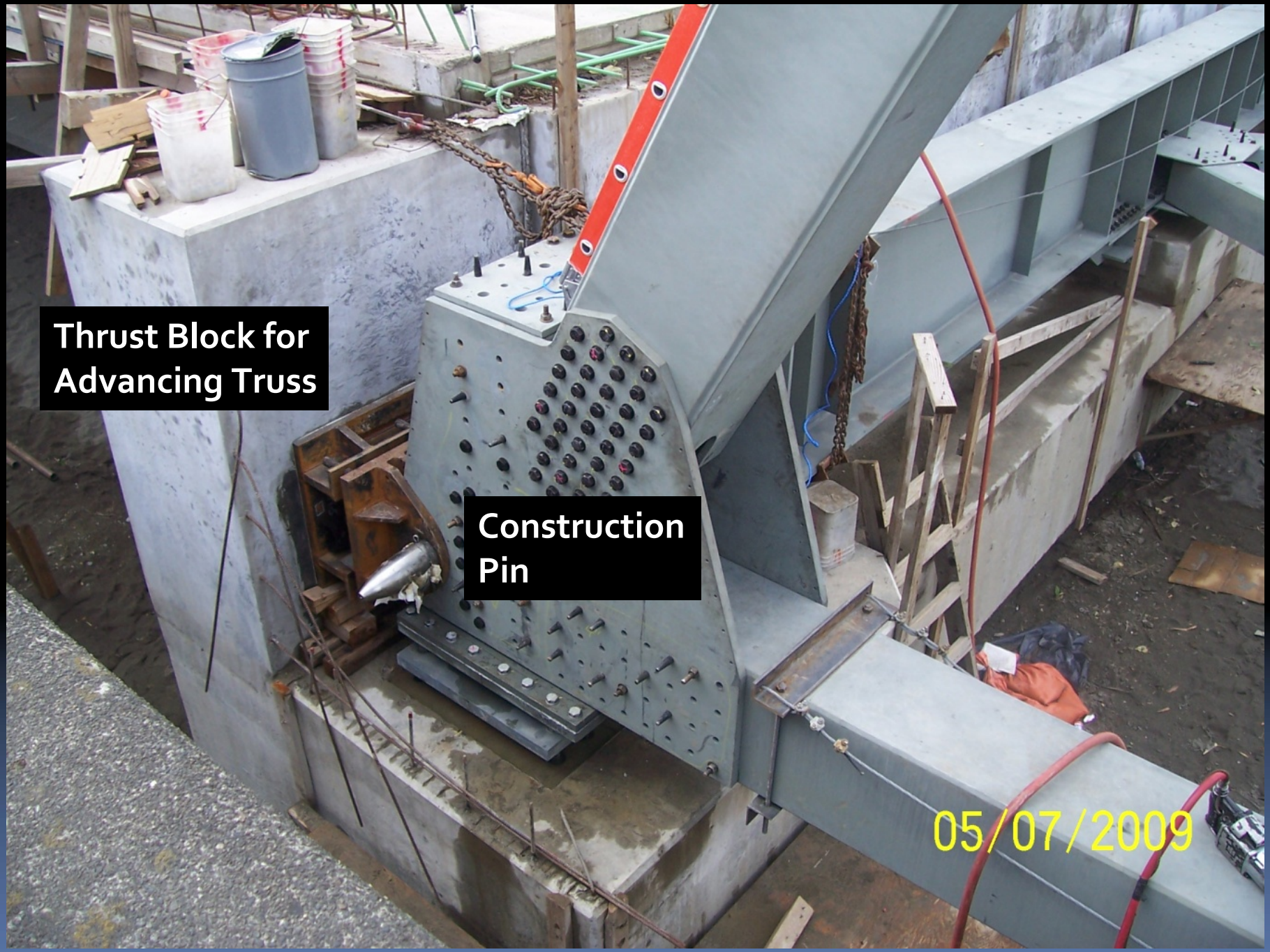
Truss Leaving Assembly Building
Oregon Iron Works

Span Loaded on Barge for Transport to Hood Canal


Nooksack River
Truss
350 ft Main Span
Total Steel Weight = 700 tons

Configuration of Backstay Details

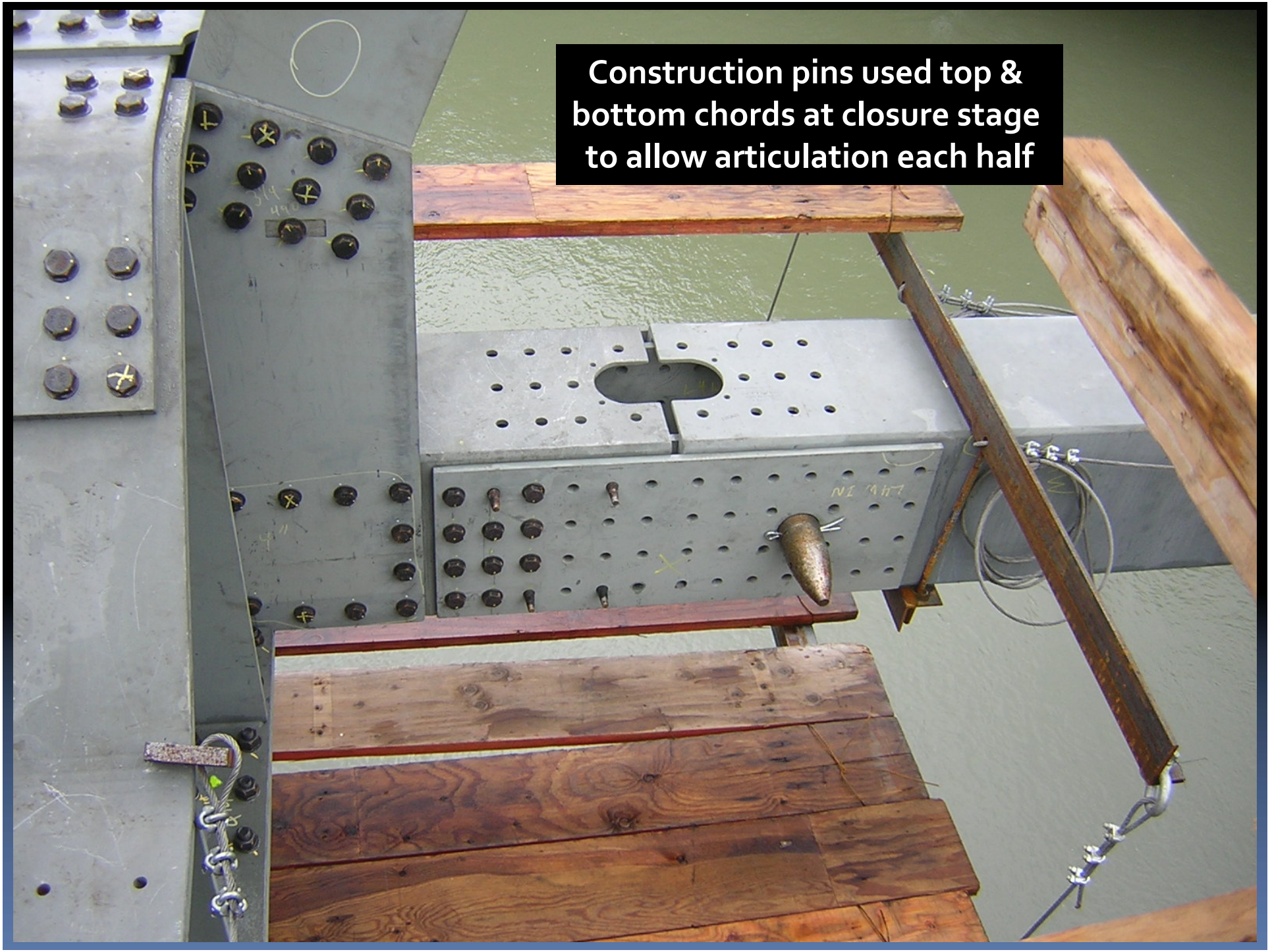



Thrust Block for Advancing Truss
Construction Pin
05/07/2009

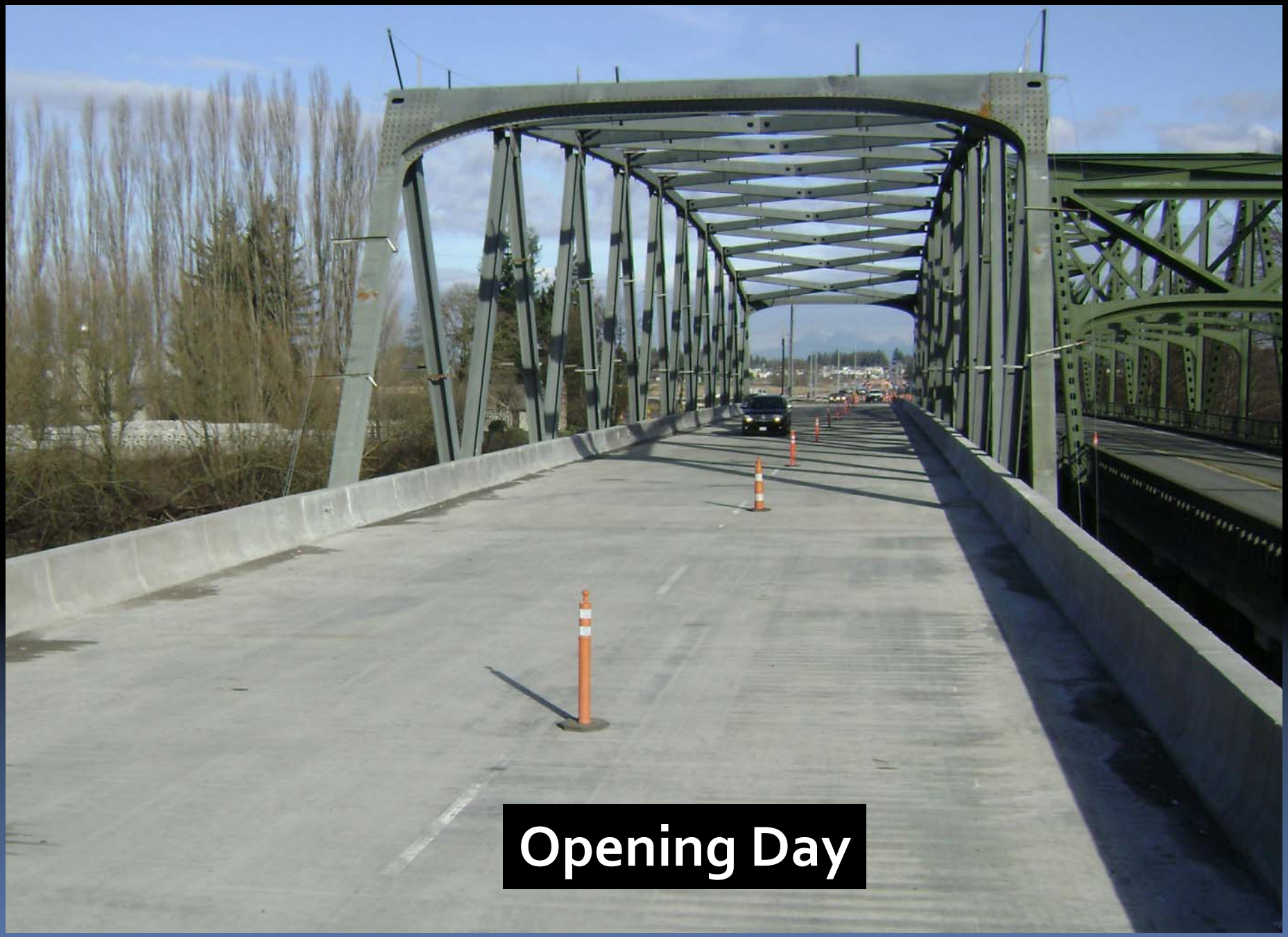

1st Panel + Backstay


Crosshead at Tie Down

Backstay Jacking Station


Construction pins used top &
bottom chords at closure stage
to allow articulation each half

Pinning last truss member at closure


Opening Day

Erecting Typical Curved Girders

Wandemere SR395 Bridges
Spokane

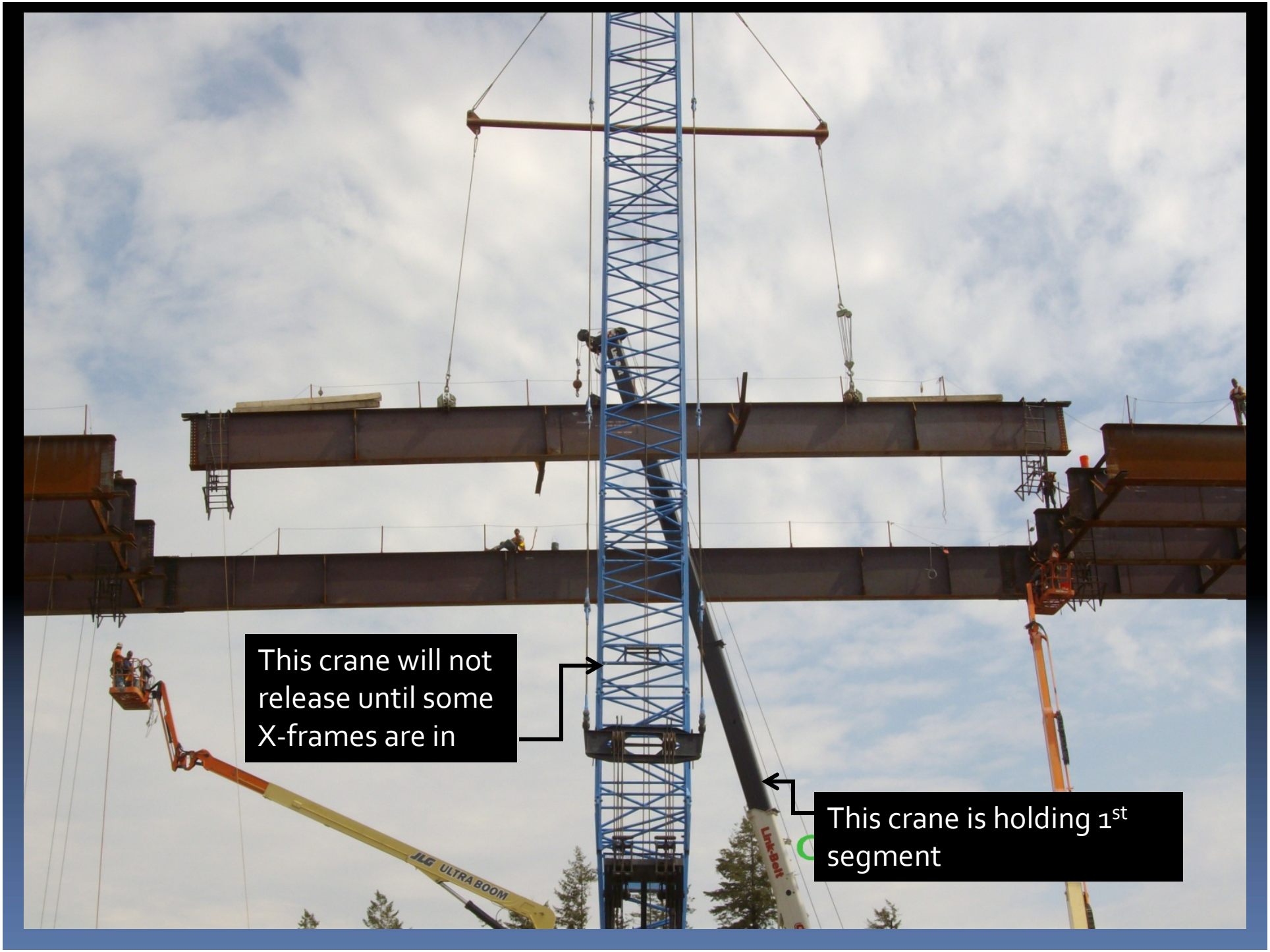
Things to be watching for during erection plan review:

- **Examine girder bracing carefully**
  1. Support conditions are very sensitive for stability
  2. Girders must have adequate positive lateral restraint at both top and bottom flanges, all supports
- **Review stability of segments at all critical stages**
  1. Longest unbraced lengths will occur before cross frames are installed (no one in the construction phase will have had experience with these conditions)
  2. Evaluate stability of these segments if cranes will release before cross frames are installed (solo first girder)
  3. Be wary of trying to set a curved segment with one crane – typical operations require two main cranes + smaller cranes to install cross frames. One crane is normally required to stabilize first girder while second is added with connecting cross frames.

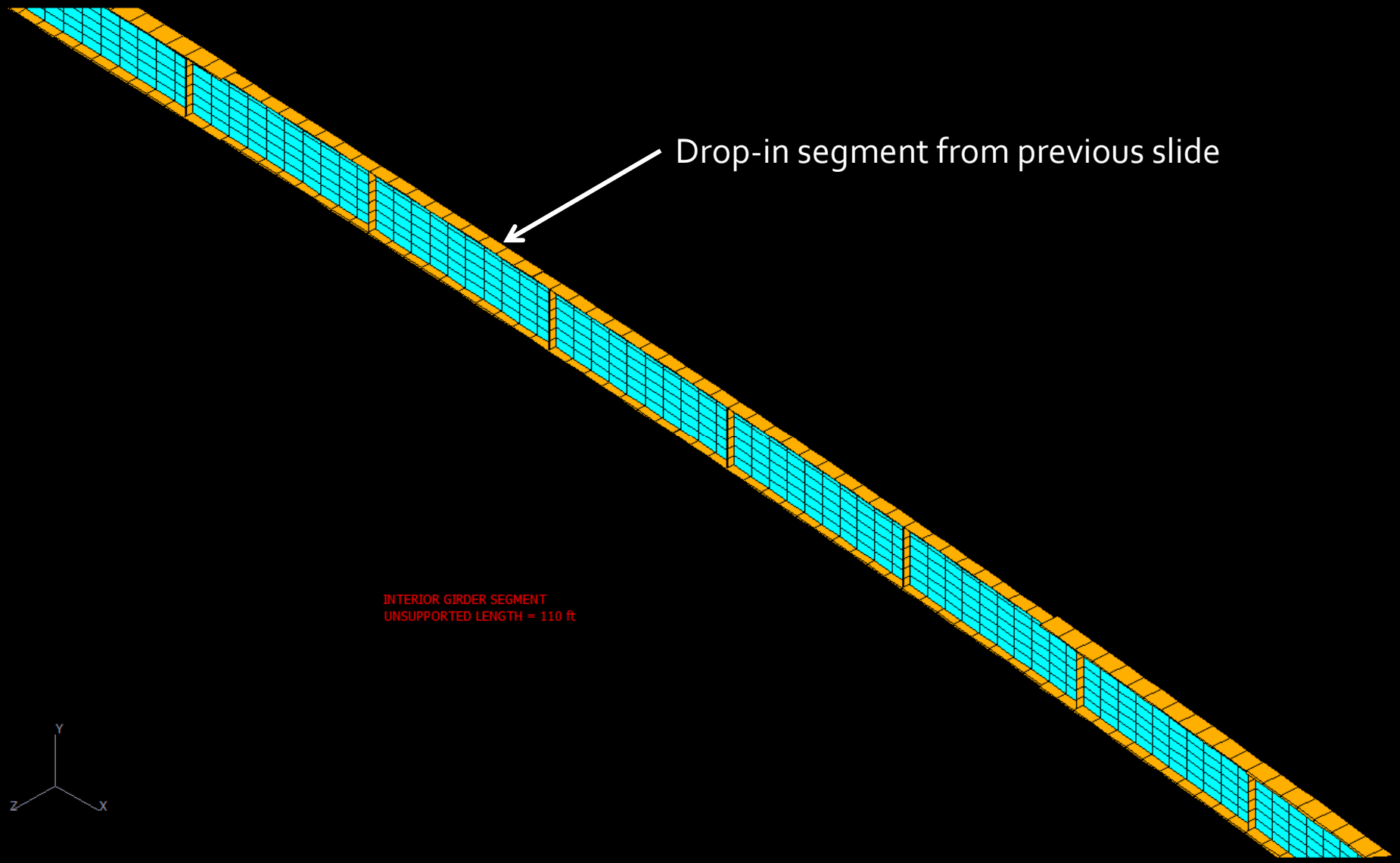

NS Ramp
North Spokane Corridor SR395

Wandemere Structures
SR 395 North Spokane Corridor

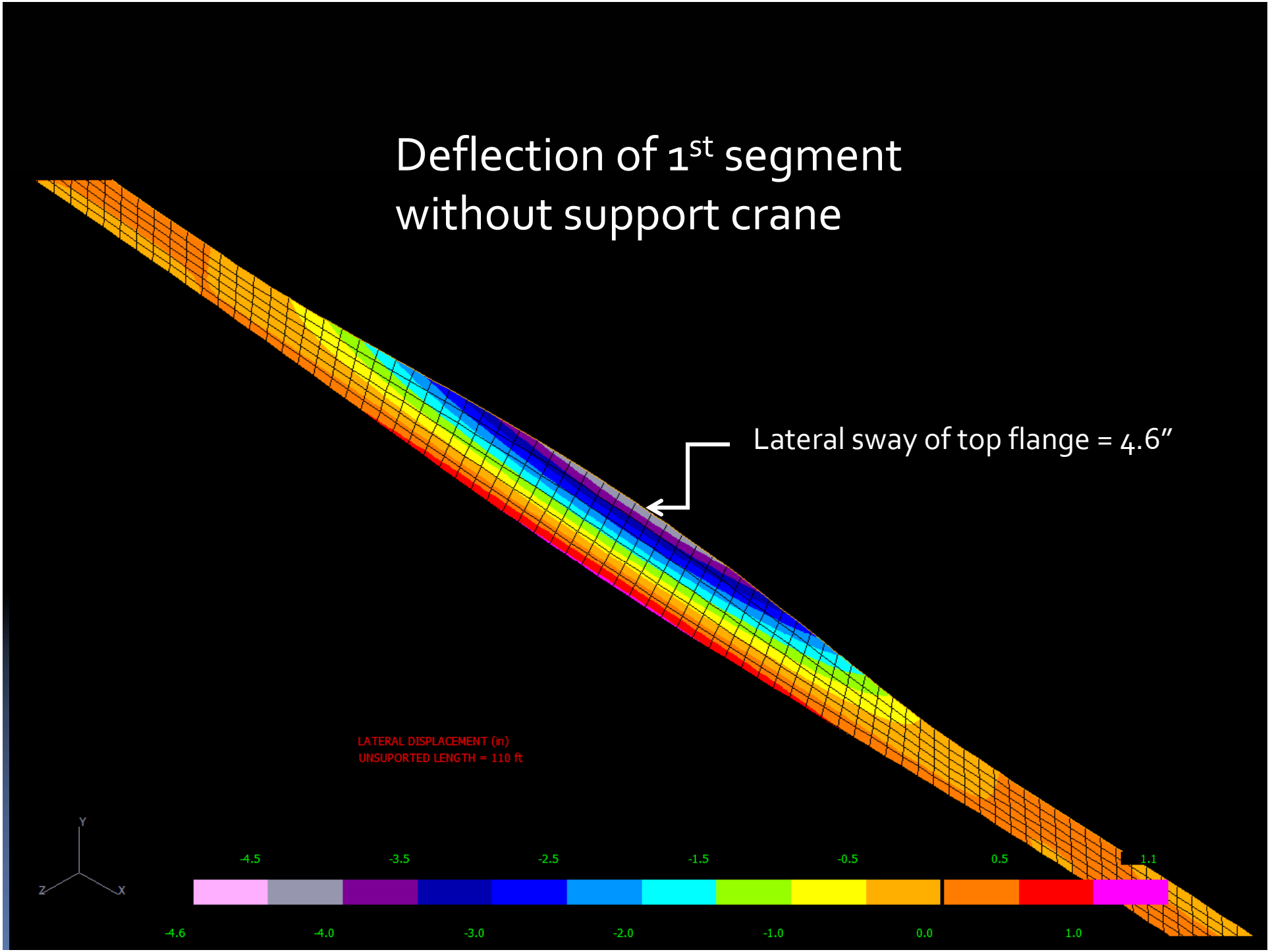

One crane is holding 1st segment
while another crane brings 2nd segment.
1st crane will not release until splice is made
and critical x-frames are installed.

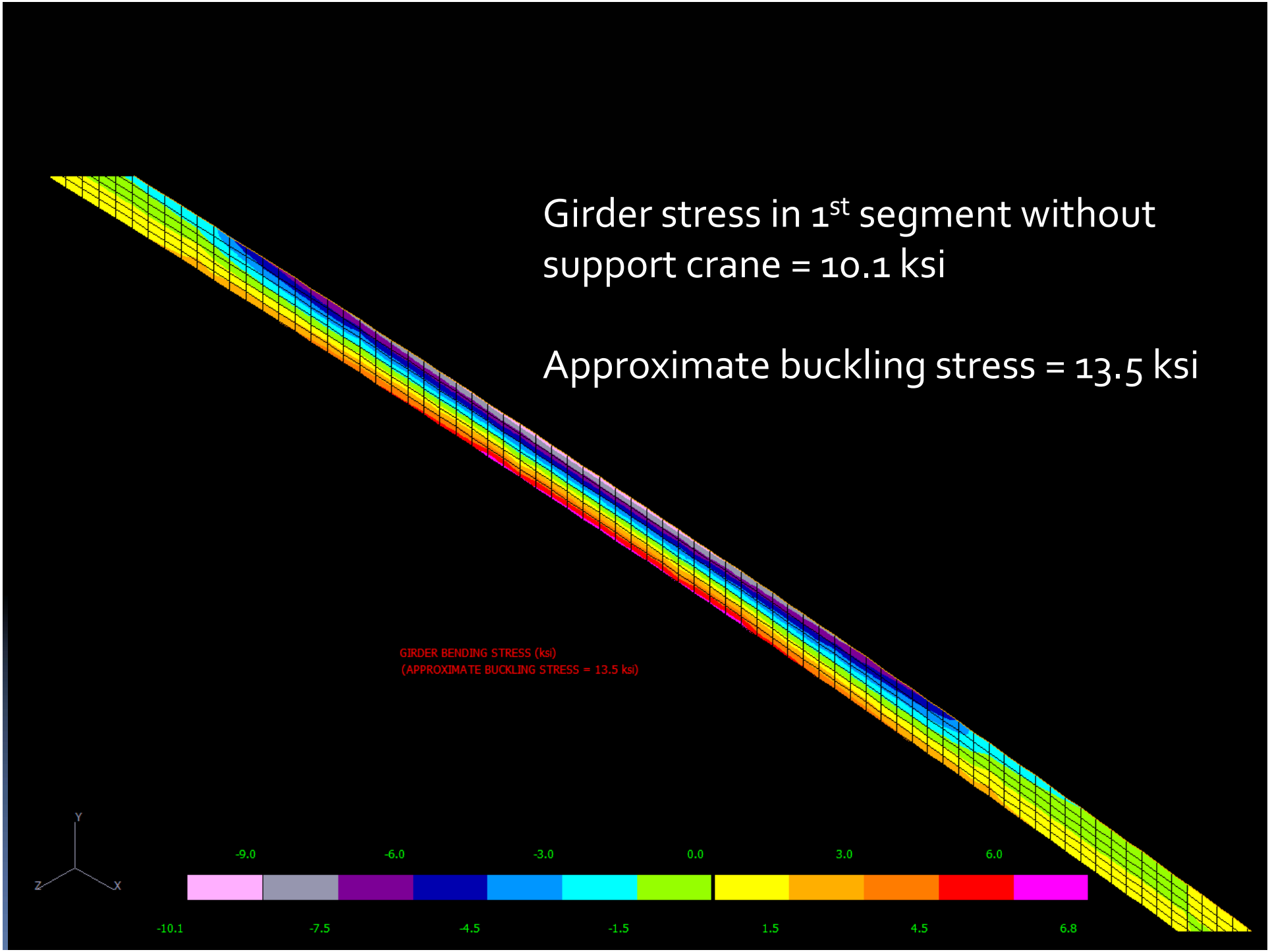

This crane will not release until some X-frames are in
This crane is holding 1st segment
JLG ULTRA BOOM
Link-Belt

Model for Checking Segment Stability



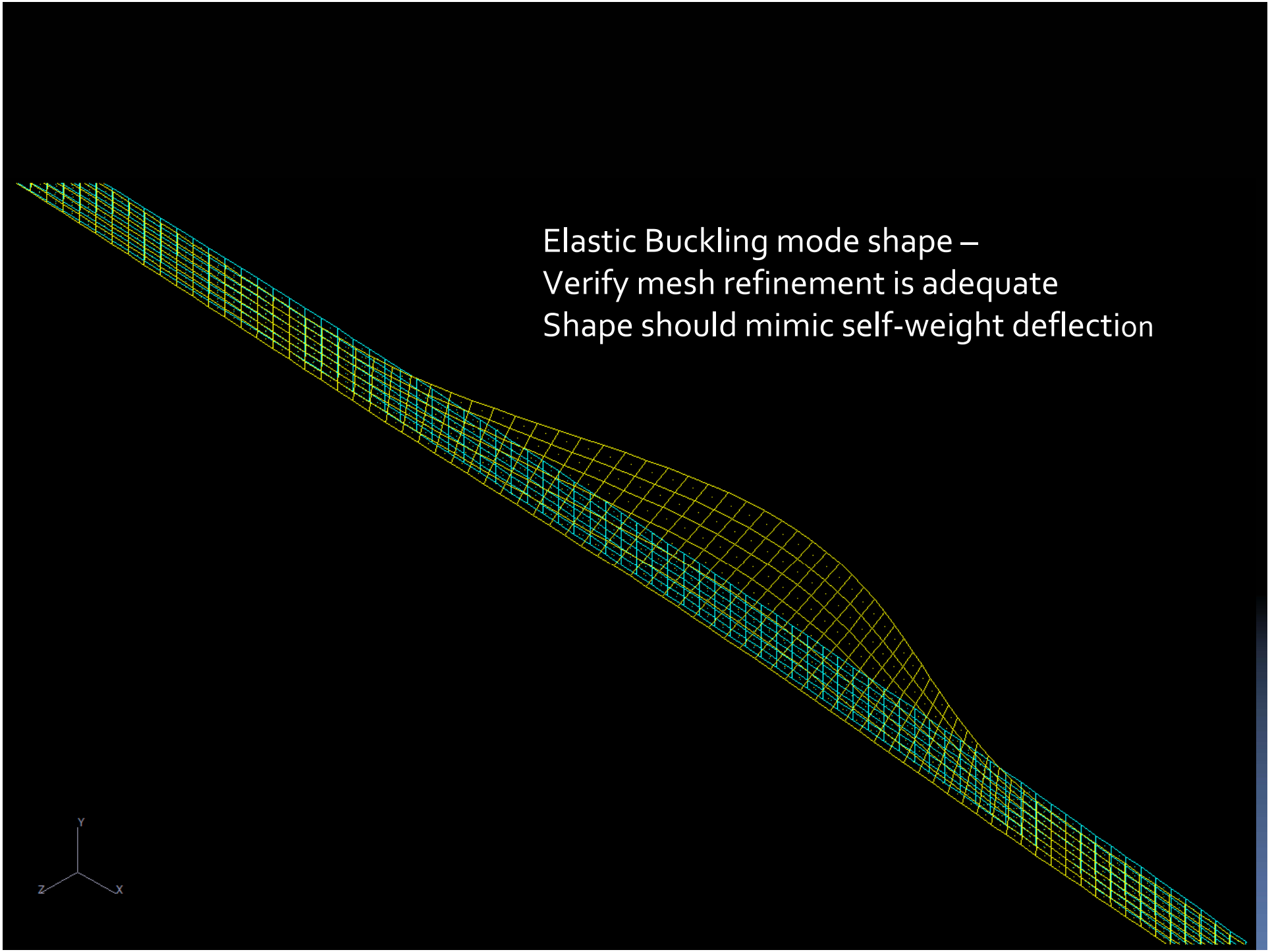
Deflection of 1st segment without support crane





Girder stress in 1st segment without support crane = 10.1 ksi

Approximate buckling stress = 13.5 ksi

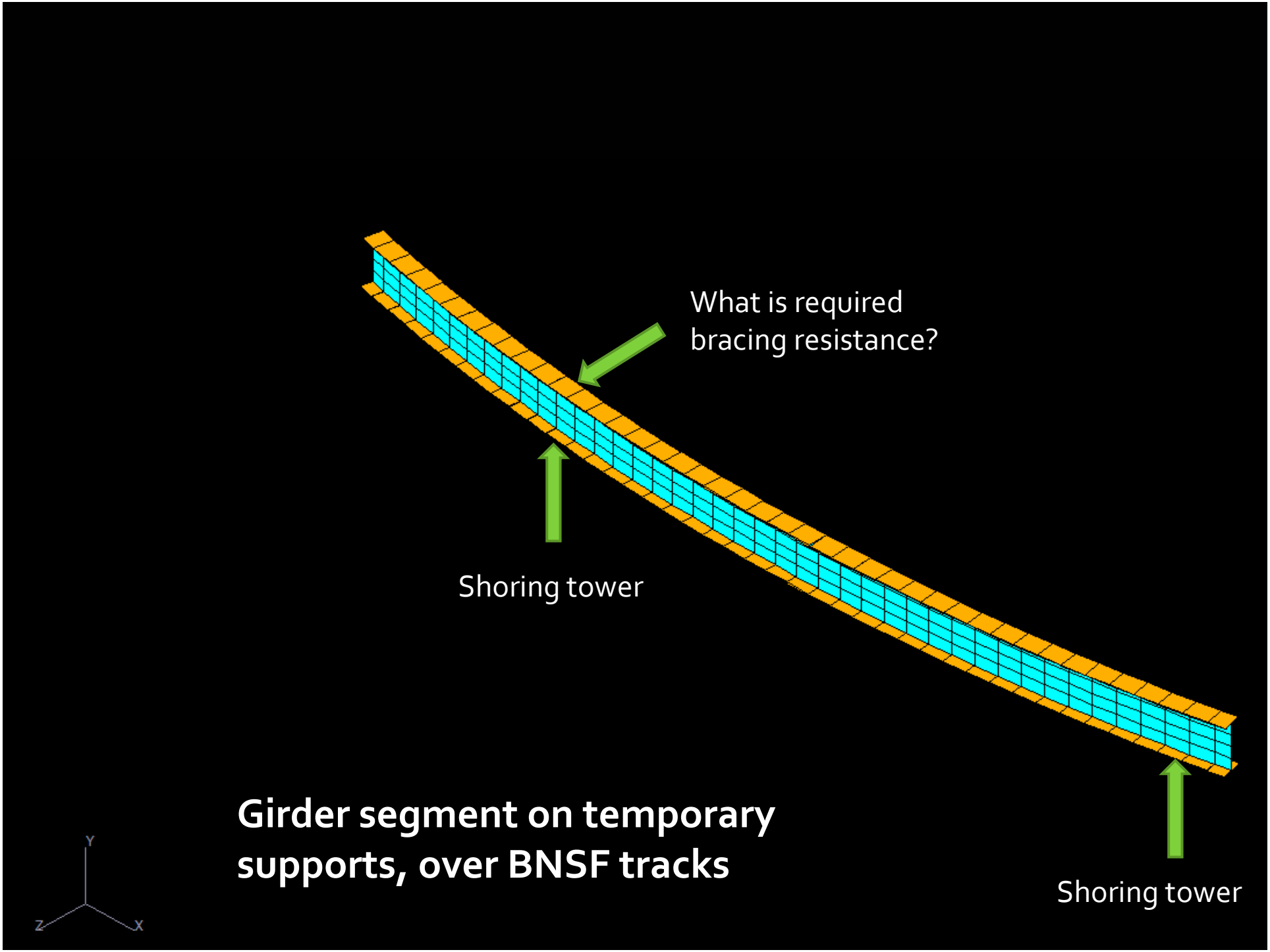

Elastic Buckling mode shape –
Verify mesh refinement is adequate
Shape should mimic self-weight deflection
Y
Z
X

SR522 – BNSF Flyover Ramp in Monroe


3 cranes + manlifts in operation
SB
TRUCTURES
Seattle, Washington

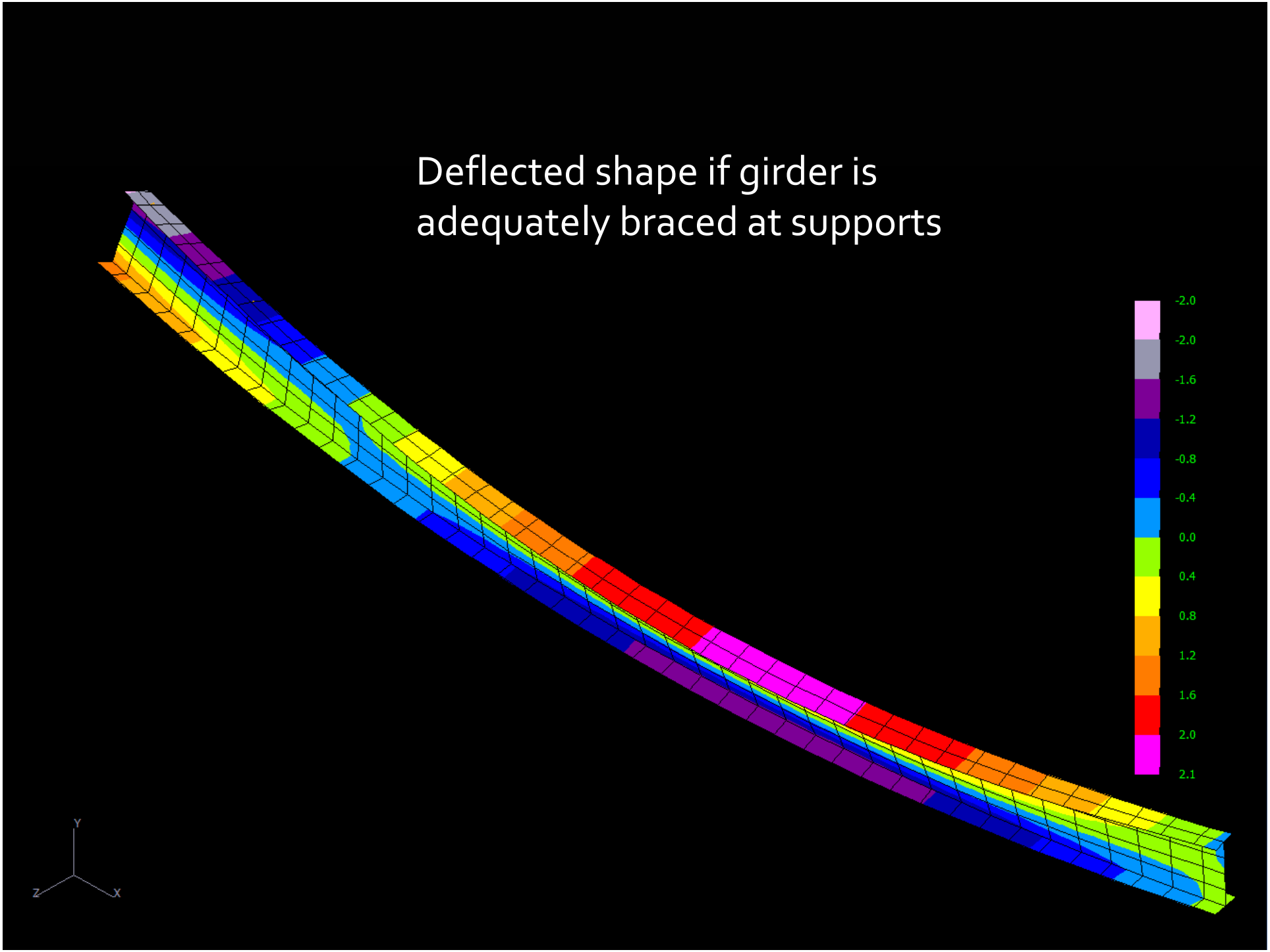
After smaller crane takes partial load:

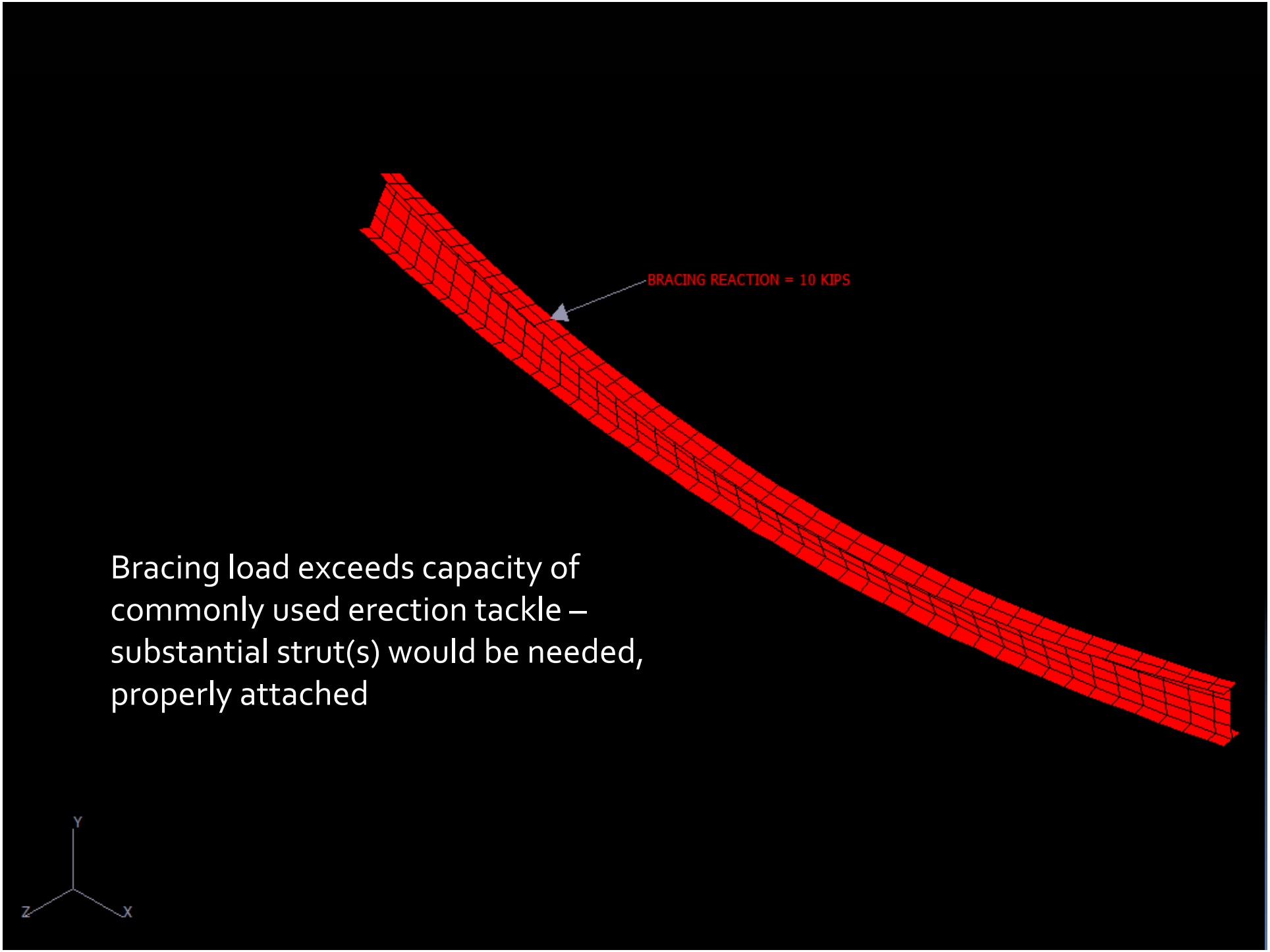
- Large crane will detach &
- Swing in 2nd segment of pair,
- Make field splice to partial completion,
- Install essential cross frames
- Detach the cranes



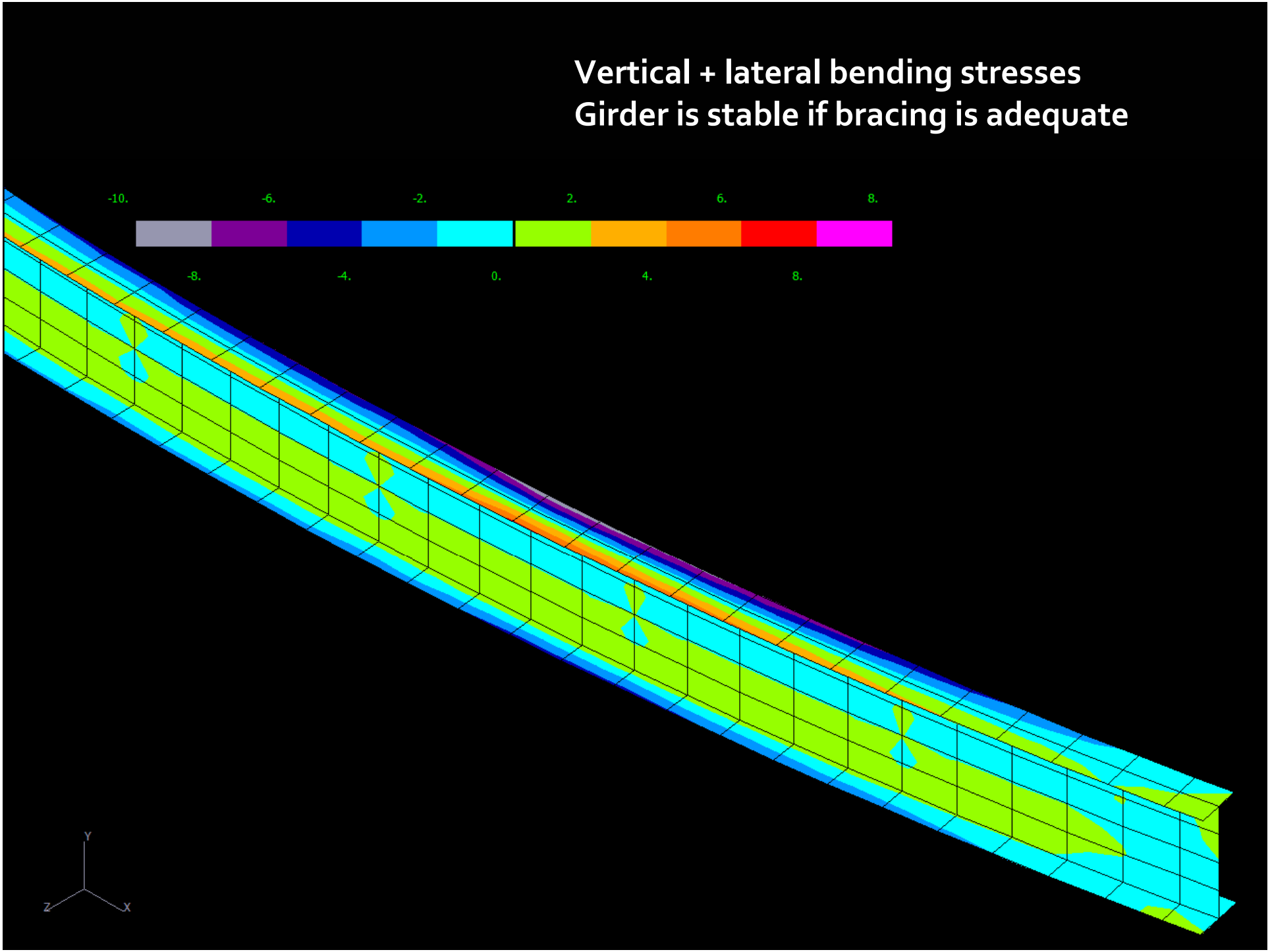
Girder segment on temporary supports, over BNSF tracks

Deflected shape if girder is adequately braced at supports





Bracing load exceeds capacity of commonly used erection tackle – substantial strut(s) would be needed, properly attached


Vertical + lateral bending stresses
Girder is stable if bracing is adequate
-10.
-6.
-2.
2.
6.
8.
-8.
-4.
0.
4.
8.
Y
Z
X

Analysis Issues

- Curved girders should be treated as unique, do not use straight girder approximations or standard rules of thumb
- Use adequate refinement for mesh sizing
  - Plotting buckling mode is effective model verification
- Support conditions are very sensitive and must be representative of actual field conditions
- Free software is available from the University of Texas (UT Bridge)
- Margin of safety is valuable information where stresses are relatively low (<< Fy)
- Be prepared to evaluate the plans quickly