TXDOT PROJECT NO. 0-7093

REFINED DESIGN METHODS FOR LEAN-ON BRACING

CTR Conference

RESEARCH TEAM

Research Personnel:

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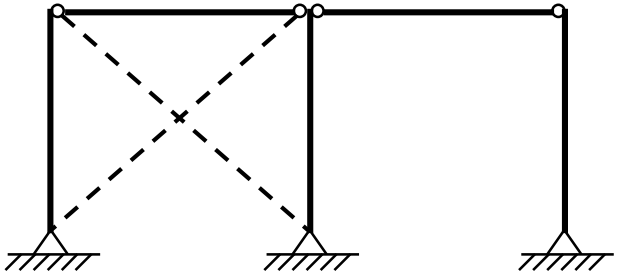
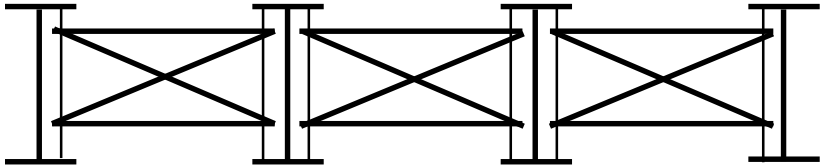
Conventional Bracing

- Cross frames in steel bridges serve many purposes; however a major role is to improve the LTB capacity during construction.
- Conventional practice is to place cross frames in each bay between adjacent girders.

Lean-On Bracing Details



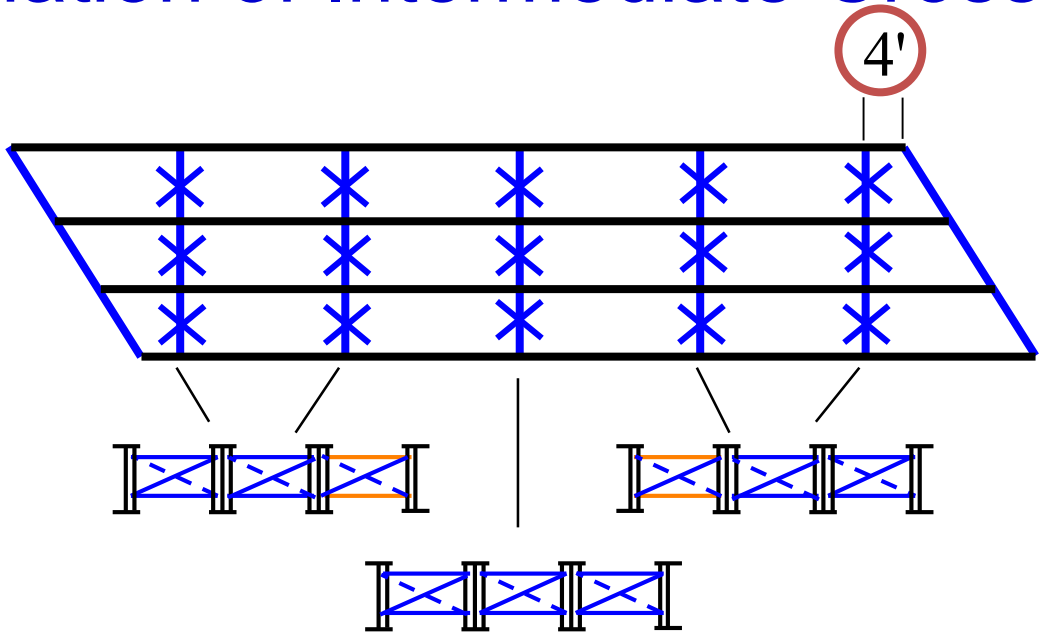
Lean-On Bracing in Frames



Lean-On Bracing in Bridges

Original Study: TxDOT Project 0-1772 (2003) and Implementation Study 5-1772

Elimination of Intermediate Cross-Frames



Conventional bracing: 5 X-frame lines x 3 X-frames per line
= 15 intermediate X-frames

Lean-on bracing: 7 intermediate X-frames

Benefits of Lean-on Bracing

- Cross-frames often represent the most expensive component on the bridge on a weight basis due to the significant fabrication and handling requirements. Therefore, improved economy can be achieved by minimizing the number of full cross-frames.
- Bridges with large support skew, can lead to significant stress ranges in cross-frames and girders from truck traffic. TxDOT study 0-6564 demonstrated that single-angle members have an AASHTO E′ Fatigue Category, which intensifies concerns of cross frame fatigue. Lean-on bracing reduces live-load induced stresses, which can alleviate potential problems.
- Installation of cross-frames in some regions of the bridge can be difficult and eliminating select cross-frames can facilitate the erection process.

Objectives of TxDOT Research Study 0-7093

There is a national interest in lean-on. NSBA currently working on developing design guide based upon 0-1772. TxDOT encountered their own issues when designing SH-105 (normal support bridge). This means there are still many unknowns…

- The development of optimal layouts of cross frames systems.
- Recommendations where we might remove 10 to 15% of cross frames using lean-on bracing with no changes in the design procedure.
- Recommendations for design parameters such as in-plane girder stiffness, effects of eccentric connections, cross frame type, etc.

Scope of Project 0-7093

"Develop refined methods for designs utilizing lean-on bracing concepts"

- Monitor and field test bridges utilizing lean-on bracing
- Use load test data to validate finite element models
- Validated models are then used to perform parametric studies
- Refine existing design expressions

Lean-on Bracing Implementation Study (TxDOT Project 5-1772)

"Improve the economy and application to Texas bridges"

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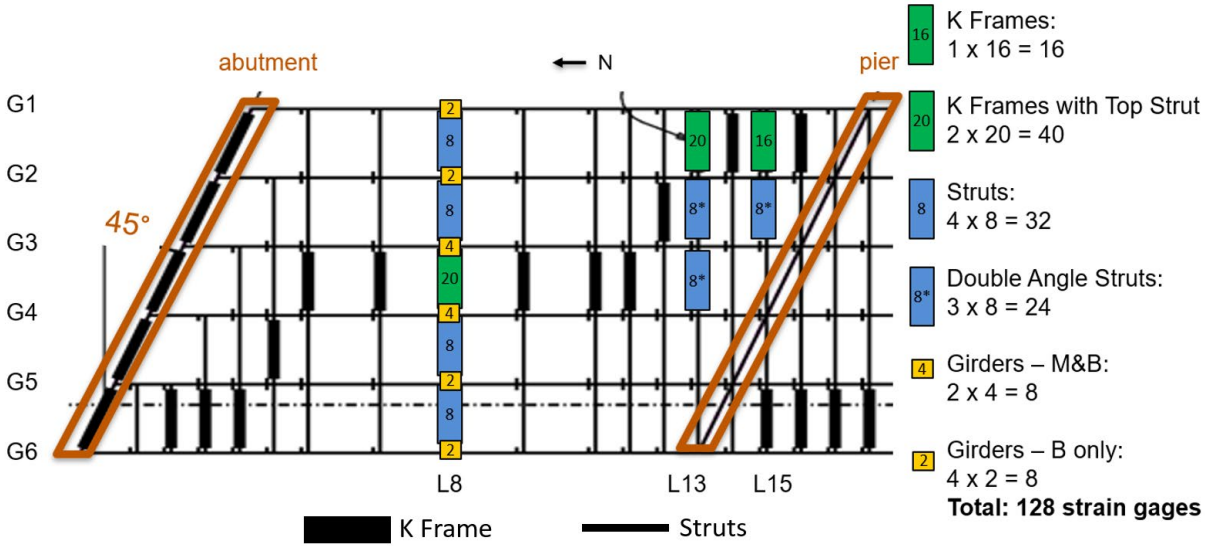
REFINED DESIGN METHODS FOR LEAN-ON BRACING

Field monitoring: Two bridges with lean-on bracing were instrumented and load tested. One was a bridge with normal supports and the other had a 45 degree support skew. The research team also has data from a bridge with a 60 degree support skew that was monitored in study 5-1772.

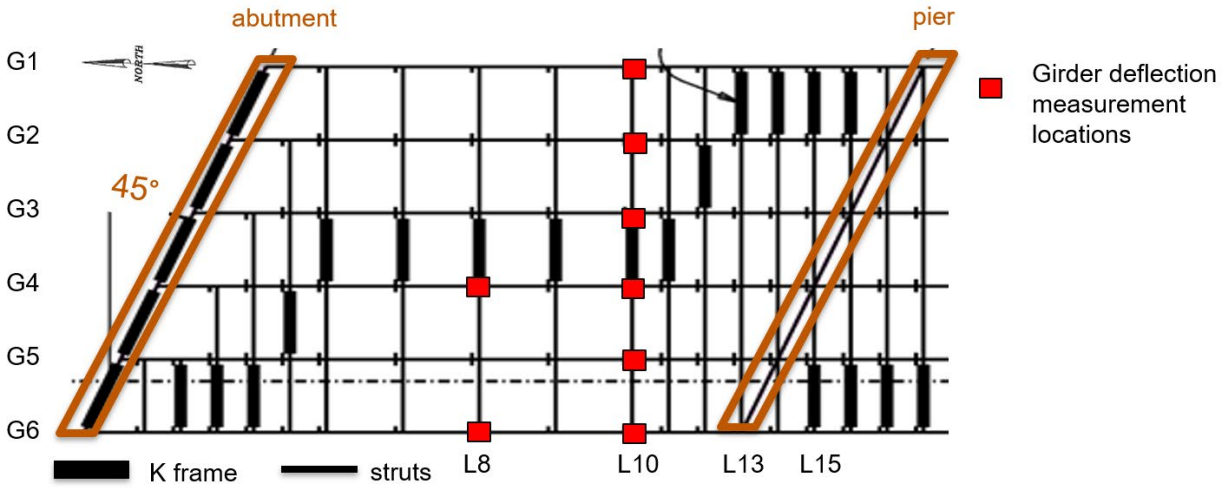
SH-105 Bridge: Normal Supports TxDOT (East of Navasota)

Chisholm Trail Bridge:
North Texas Toll Authority (South of Fort Worth)

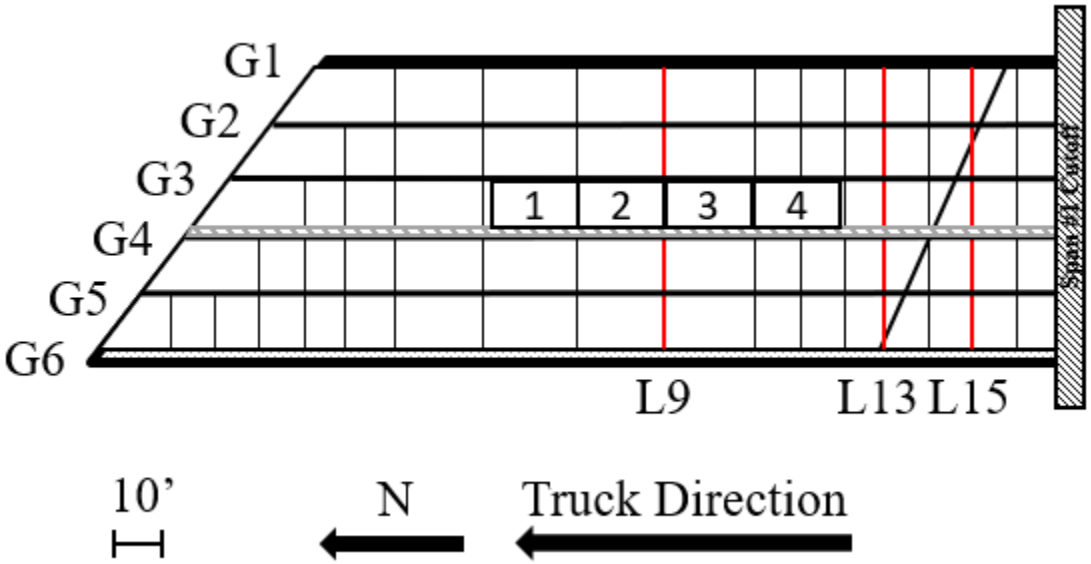
Chisholm Trail Bridge Strain Gauge Layout:



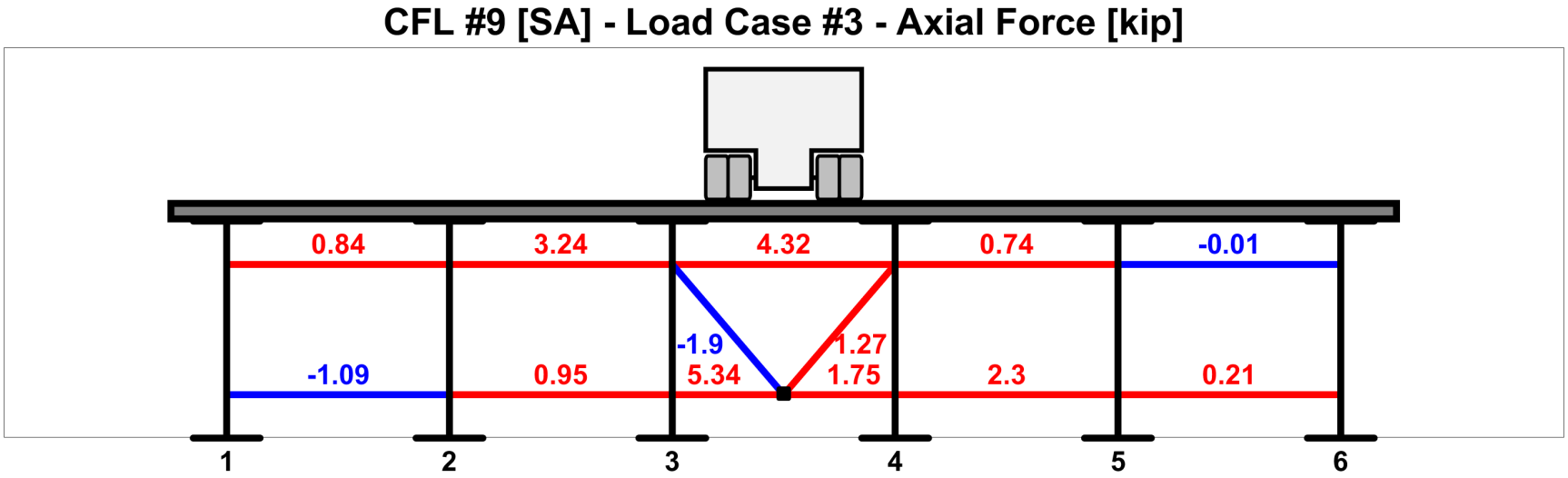
Chisholm Trail Bridge Girder Displacement Layout:



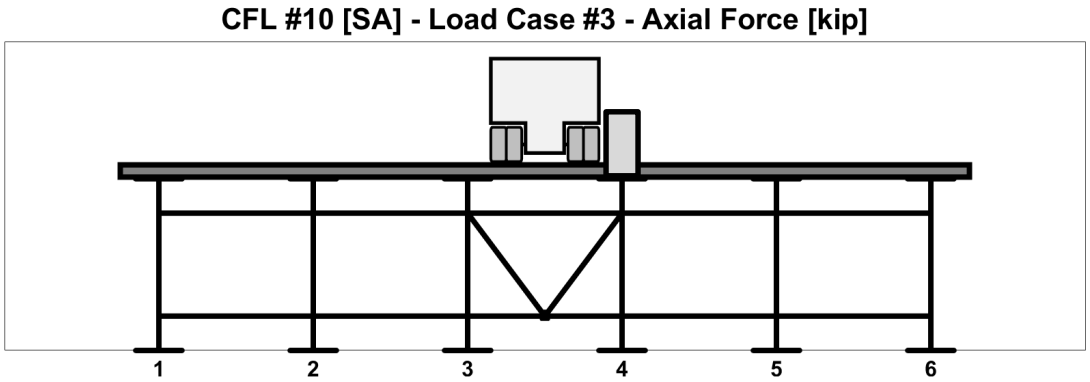
Example: Live Load Case 3 (of 6)

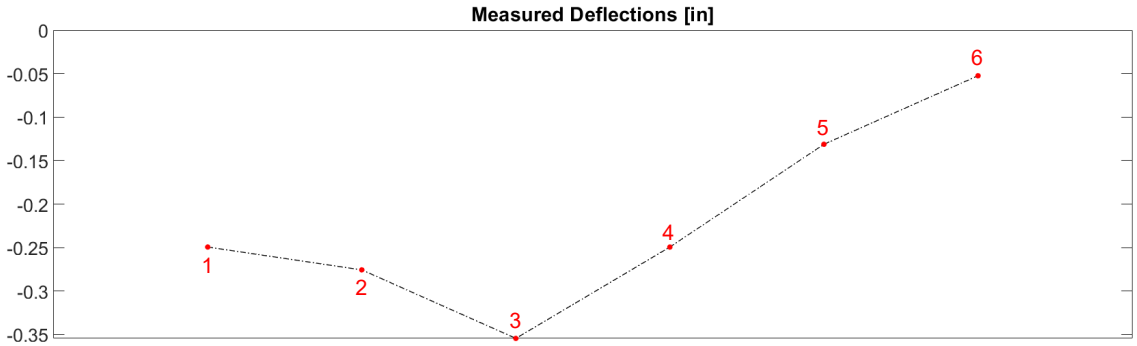


Chisholm Trail Result Example:



Chisholm Trail Result Example:





Current Work: Model Validation and Parametric Studies

- Validate models for Chisholm, SH105, and Lubbock in Abaqus
  - Verification data already processed

- Outlining parametric study variables and ranges
  - Sensitivity studies will be conducted
  - Reduce ranges / amount of variables based upon initial studies

Questions?