EVALUATION OF THE NEED FOR LONGITUDINAL JOINTS IN BRIDGE DECKS ON DUAL STRUCTURES

Zhengyu Liu, M.S. Advisor: Brent M Phares

Background

Joints on Bridge Deck

- Snow, water and debris
- Deterioration of deck and girder

Advantage of Continuous Bridge Deck:

- Slow down corrosion

Drawback of Integral Abutment Bridge:

- Cracks in the deck

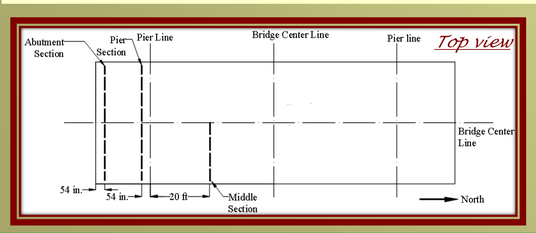
Design Manuals from DOTs:

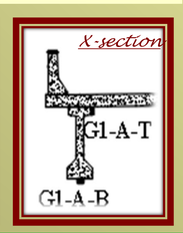
- DOTs have no agreement on the maximum bridge width

DOT	Deck Width		Skew and Span Configuration
D.C	>88 ft		
Montana	>88 ft		
Nevada	>120 ft		Multiple bridges with large skew
Illinois	No stage construction	>120 ft	
	Stage construction	>120 ft	
Minnesota	>100 ft		
Iowa	>60 ft		

Objective

- Determine the maximum width of a continuous deck
- Study other influential parameters





Field Testing

Live-load Testing

- 60 strain transducers (3 sections)
- Strain at the top and bottom flange
- A Iowa DOT dump truck (5 load cases)

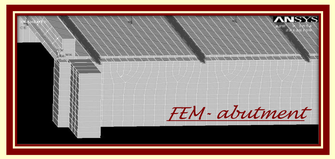
Long-term Testing

- Strain at the bottom of deck
- Temperature at abutment, bottom and mid-depth of deck
- Longitudinal and transverse displacement

Finite Element Model

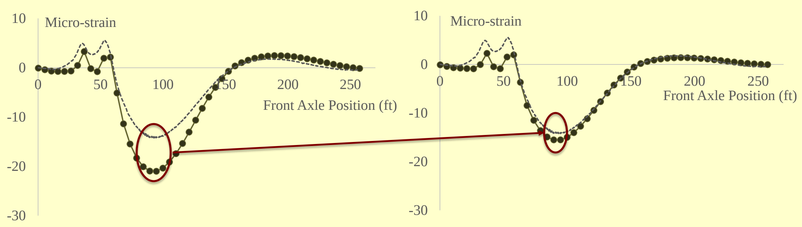
Development of Model

- ANSYS – Shell 181 & Beam 4
- Element size – 6in
- Smear of steel



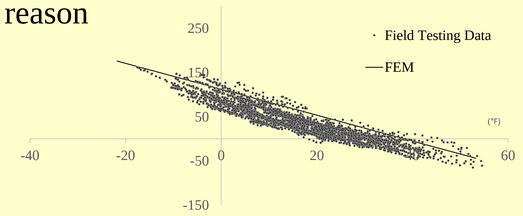
Calibration for Live-load Behavior

- Real bridge is stiffer



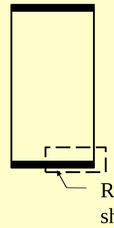
Calibration for Long-term Behavior

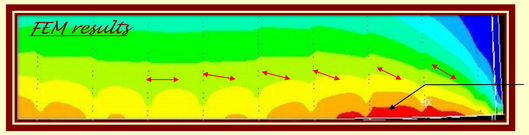
- Temperature is reason
- FEM is valid



Calibration for Crack Pattern

- Annual temperature can crack model





Parametric Study

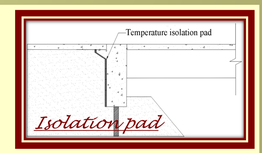
Parameters	Deck width	Bridge skew	Abutment	Girder spacing	Pier type	No. spans	Girder type
Study cases	40ft;90ft; 160ft	0°;45°	integral; stub	88in.; 176in.	expansion; fixed	one; three	steel; concrete
Results	Minimal	Minimal	Significant	No	No	No	No

Conclusion

- Strain/crack: ΔT and restraints
- Integral abutment bridges: crack regardless of bridge width
- Stub abutment bridges: less crack even with wide width
- Other parameters: minimal/no influence

Recommendation

- Stub abutment: if crack is a major concern
- Isolation of abutment from soil
- Vertical expansion joints in abutment
- Increasing the deck temperature steel
- Diagonal steel



IOWA STATE UNIVERSITY
Institute for Transportation

BRIDGE ENGINEERING CENTER