Innovative Metal Deck for Efficient Infrastructure

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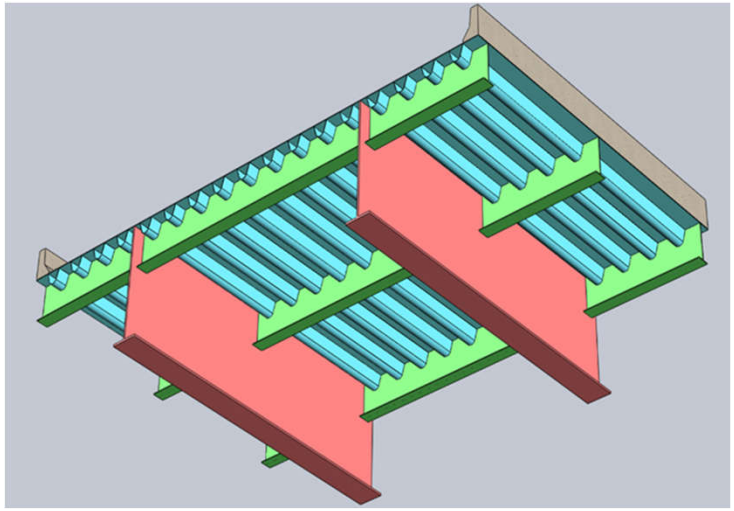
Challenges to US Bridge Infrastructure

- Time-dependent deterioration due to
  - elements of weather
  - winter maintenance
  - live loading
- Concrete decks are inherently susceptible to corrosion damage
  - Repeated repair or replacement
  - Increased life cycle cost
- Aging bridge inventory inadequate for operational rating
  - need lighter and efficient bridge deck

from: FHWA TechBrief FHWA-HIF-18-028

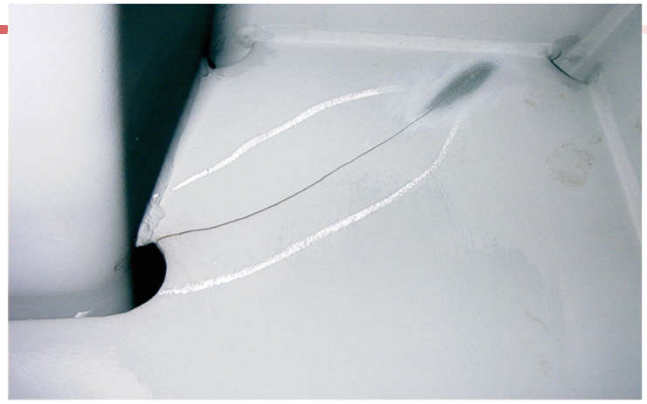
Steel Orthotropic Bridge Decks



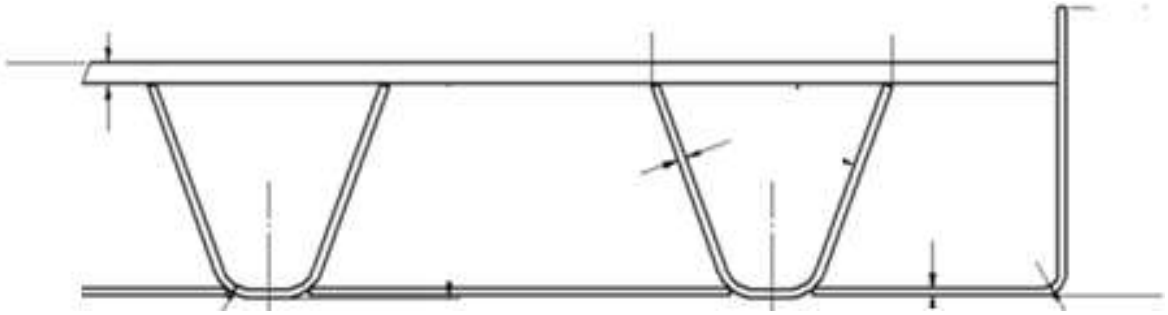
- Light weight, redundant form – structurally efficient
- Modular form — effective for accelerated construction
- Only deck form that can provide 100 years life (?)
- Improved life cycle performance and cost benefit

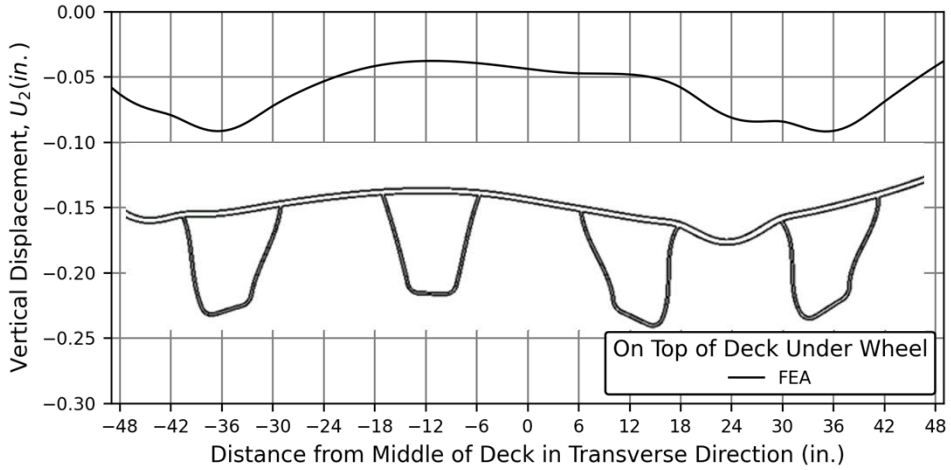
Challenges

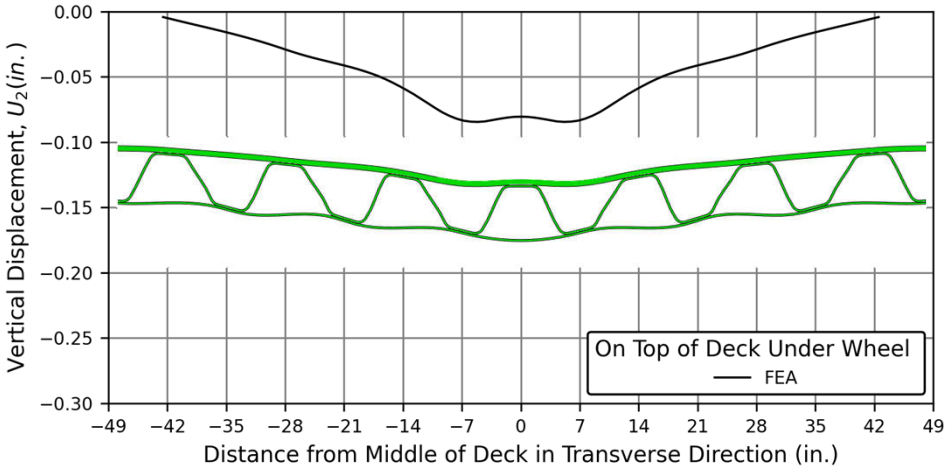
- Possibility of in-service fatigue cracking
- Wearing surface durability
- High initial cost due to intensive fabrication
- Rational design and fabrication of decks for durability
- Most importantly deck depth is not comparable to a conventional concrete deck



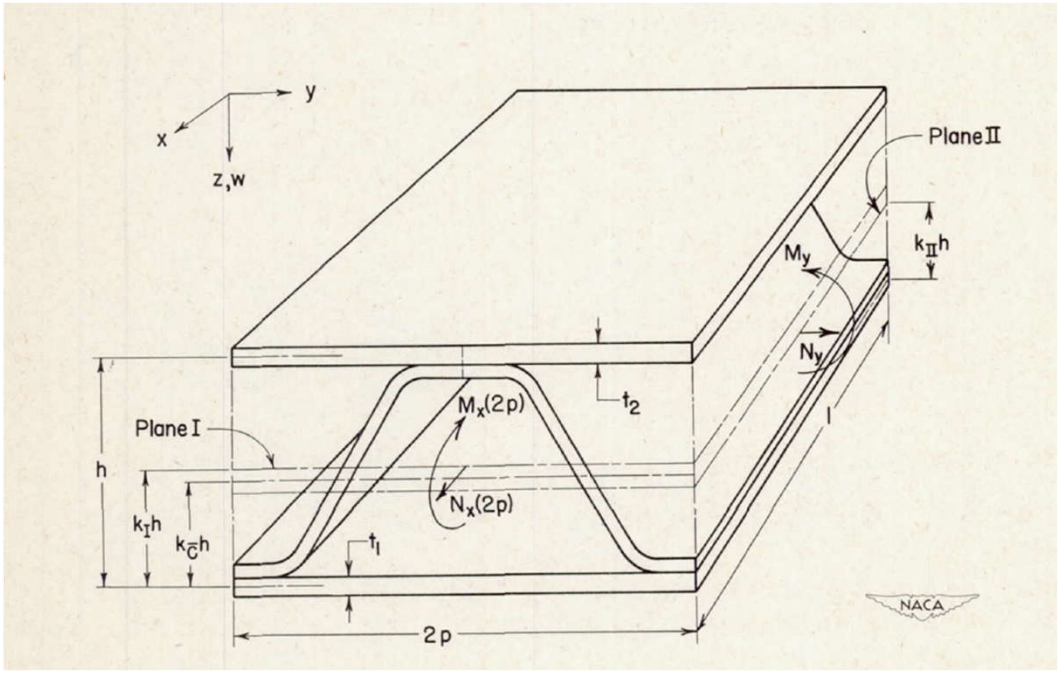
Evolution of Corrugated Core Sandwich Deck



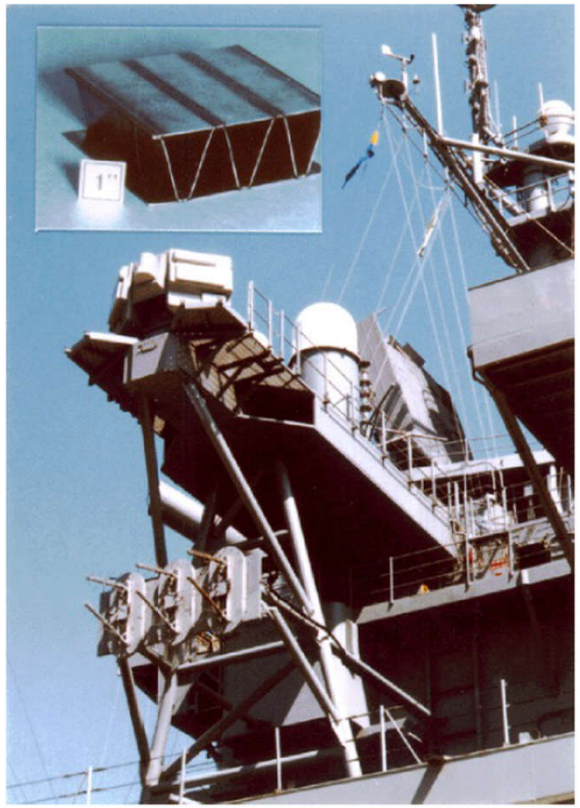




History of Corrugated Core Sandwich Panel

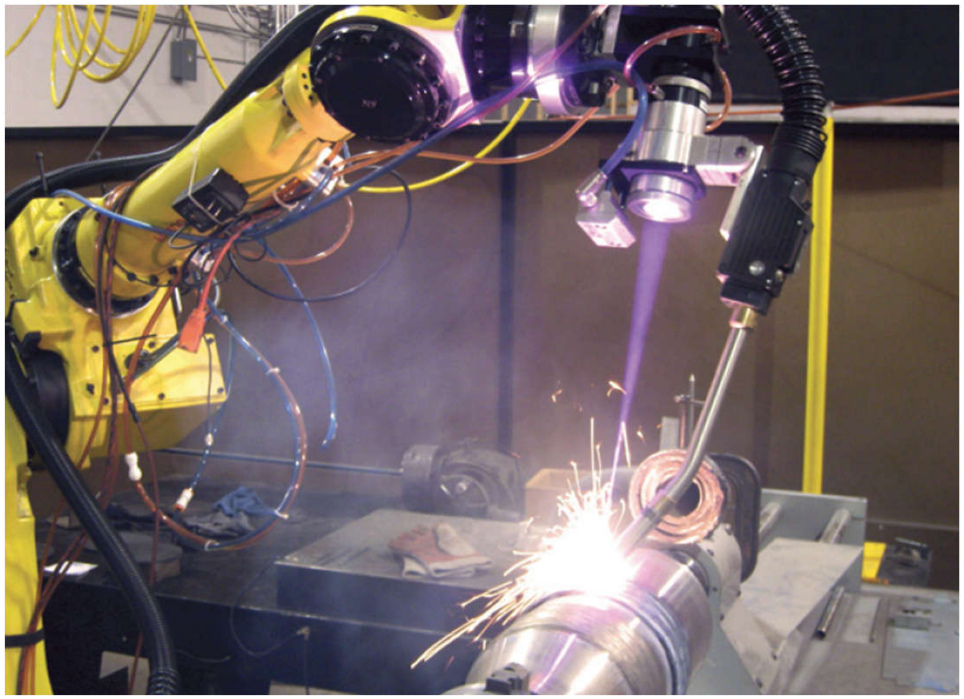


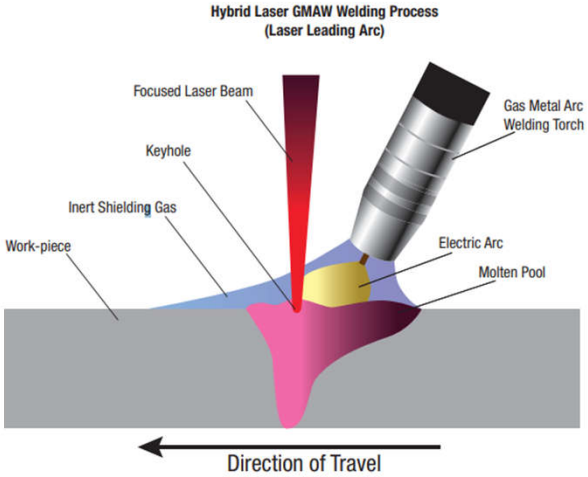
Libove and Hubka (1951)

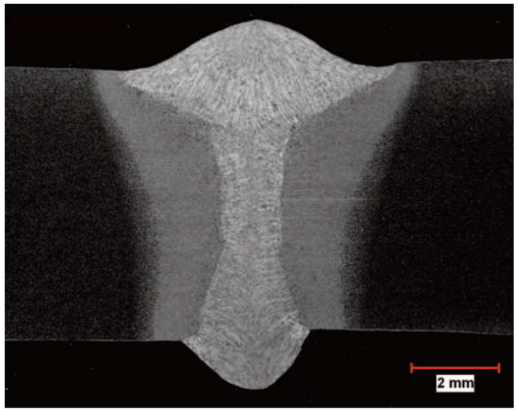


LASCOR for USS Mt. Whitney (1994)
from Abbott et al. (2007)

Hybrid Laser Arc Welding (HLAW)





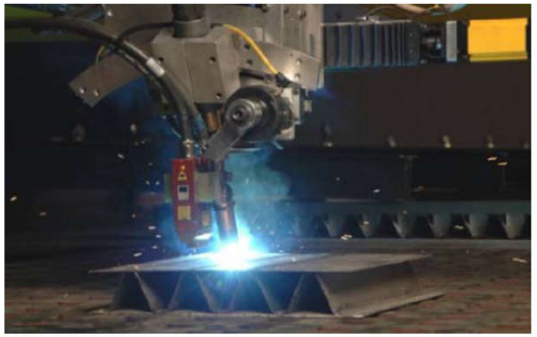


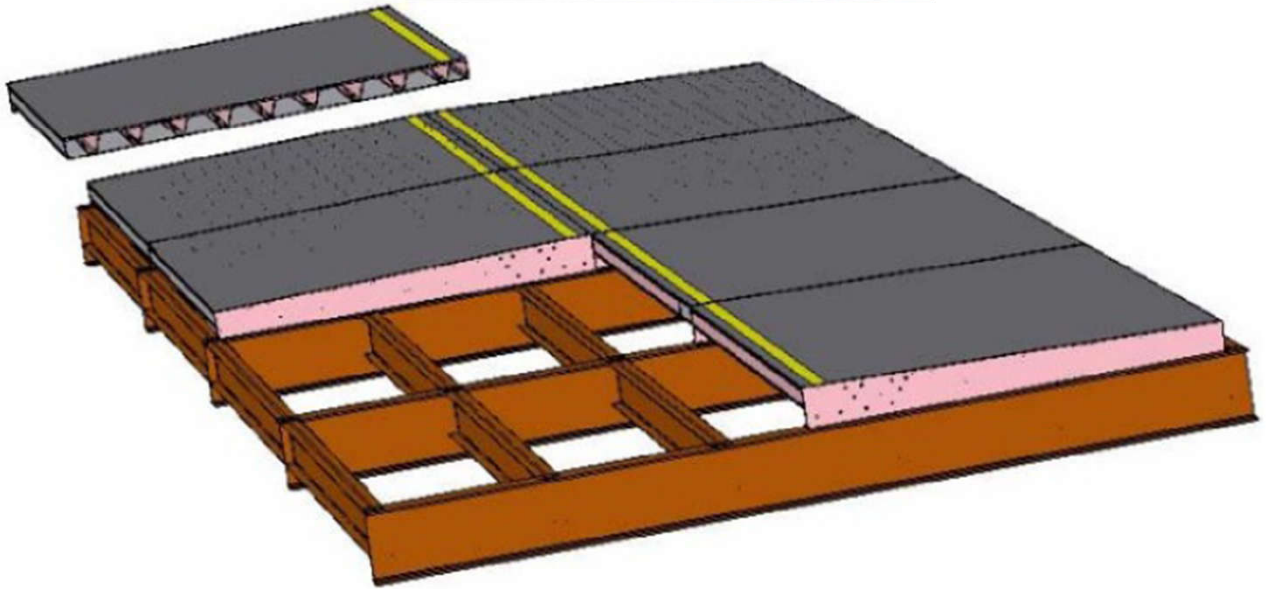
Very high penetration and deposition rate

Photographs from Lincoln Electric

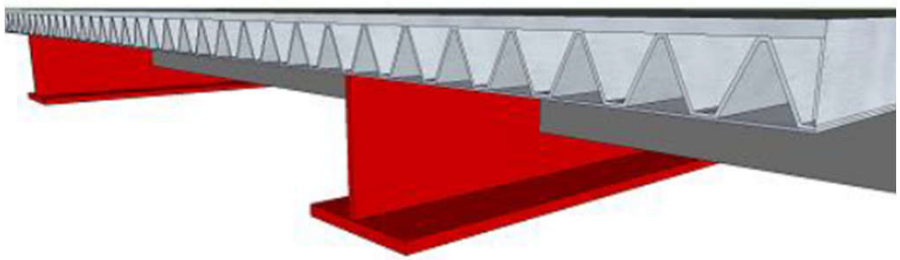
FHWA IBRC Grant (Abbot et al. 2007)

- Maine DOT and PLS Systems, Maine
- Applied Thermal Sciences (ATS), Maine
- University of Maine

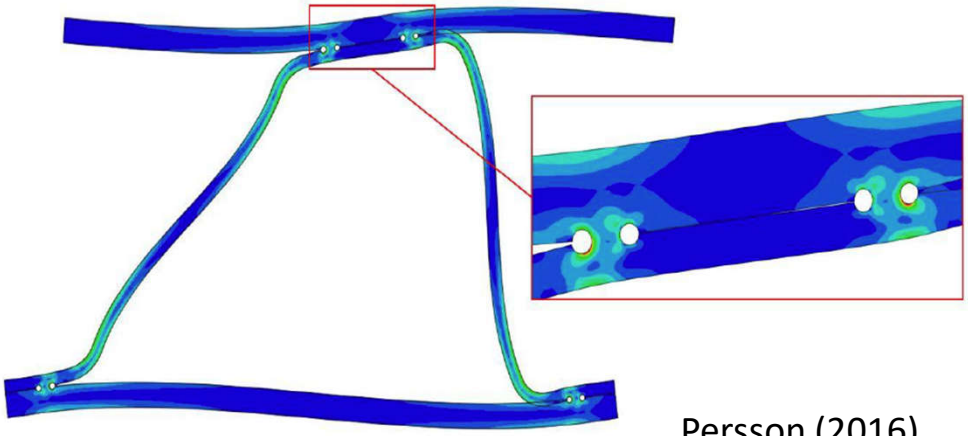




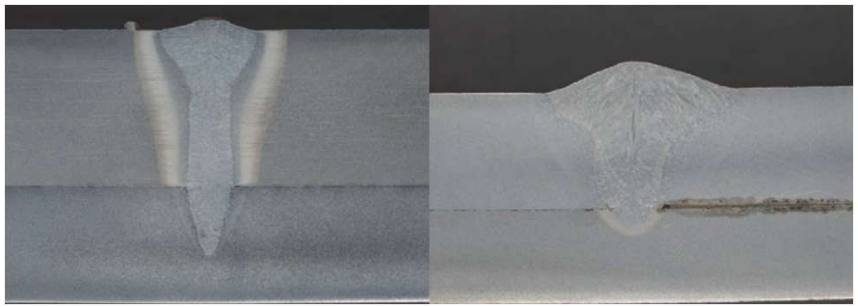
Research at Chalmers, Sweden



Beneus and Koc (2014)

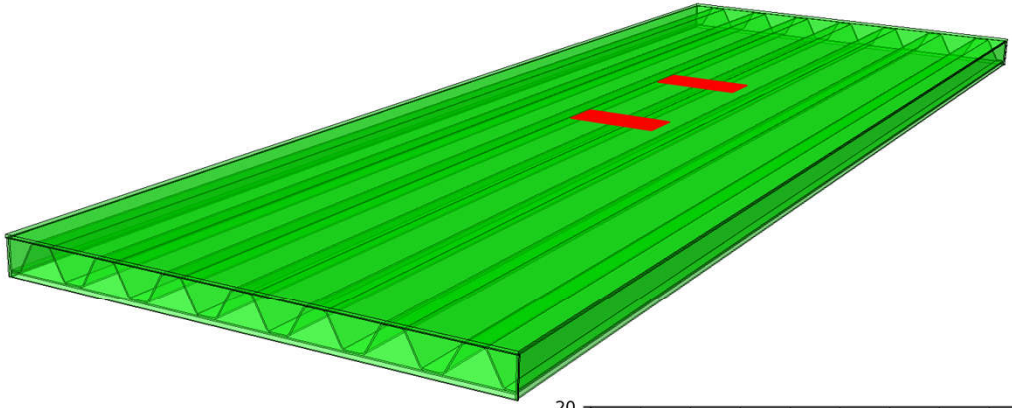


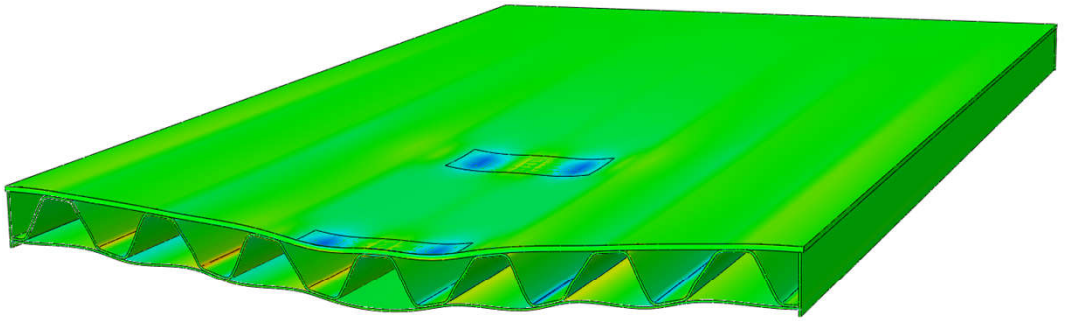
Persson (2016)

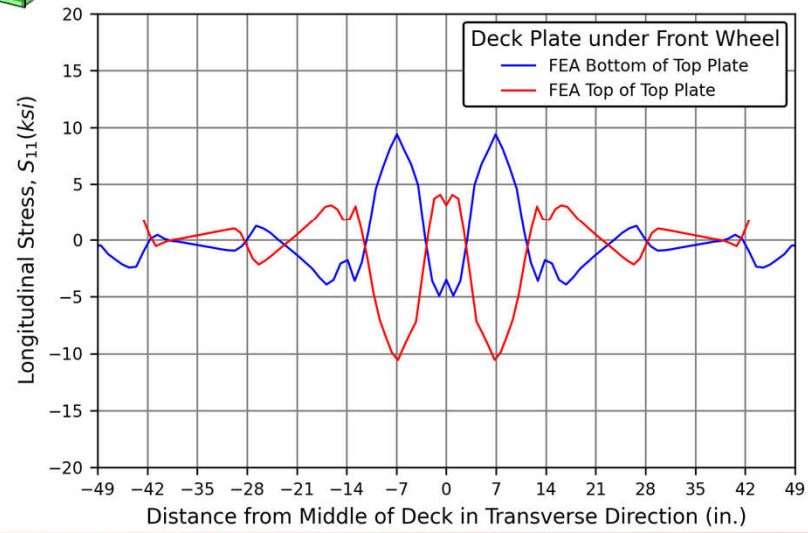


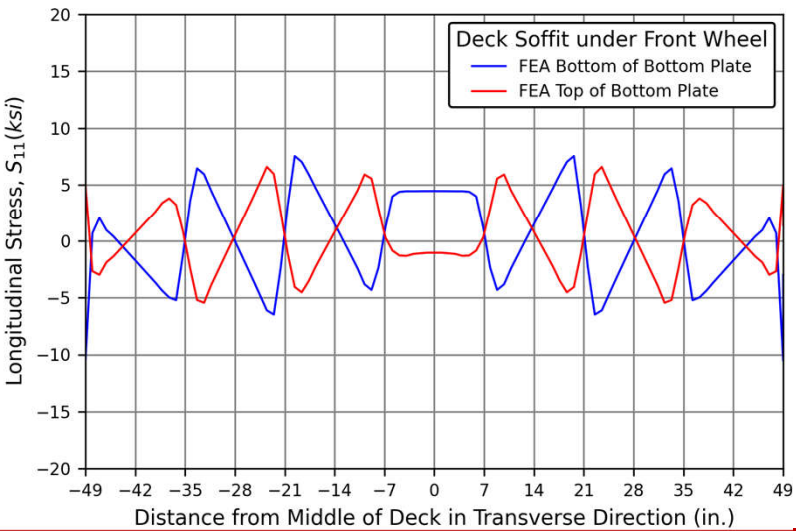
Nilsson (2017)

Research at Rutgers University

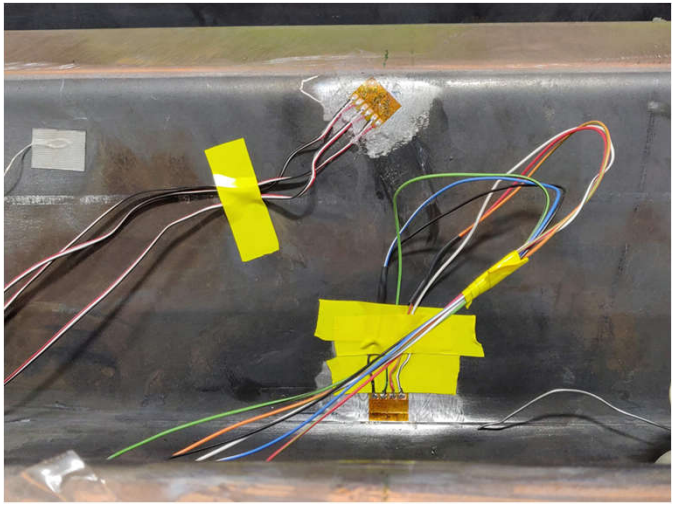


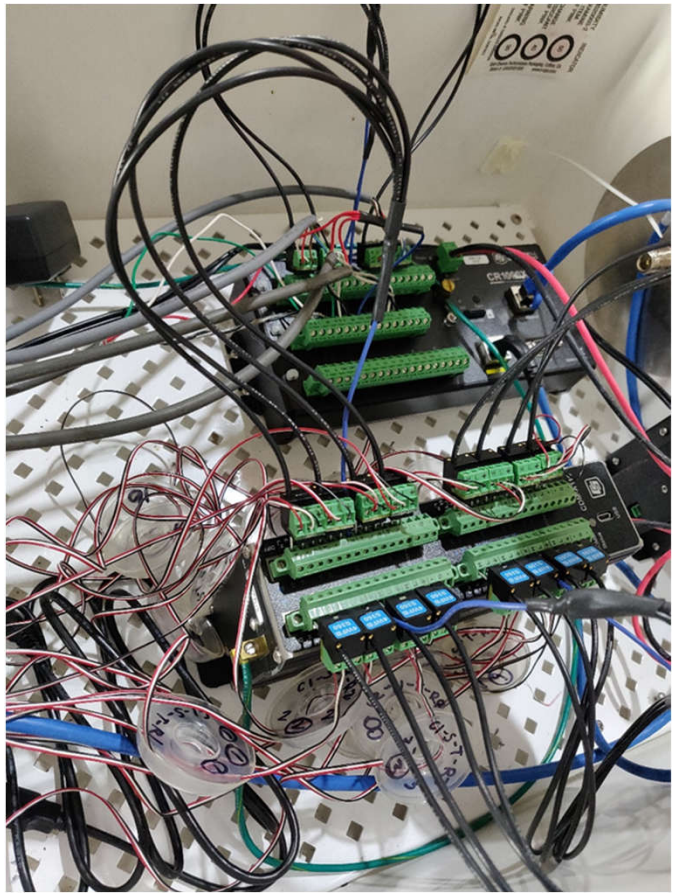




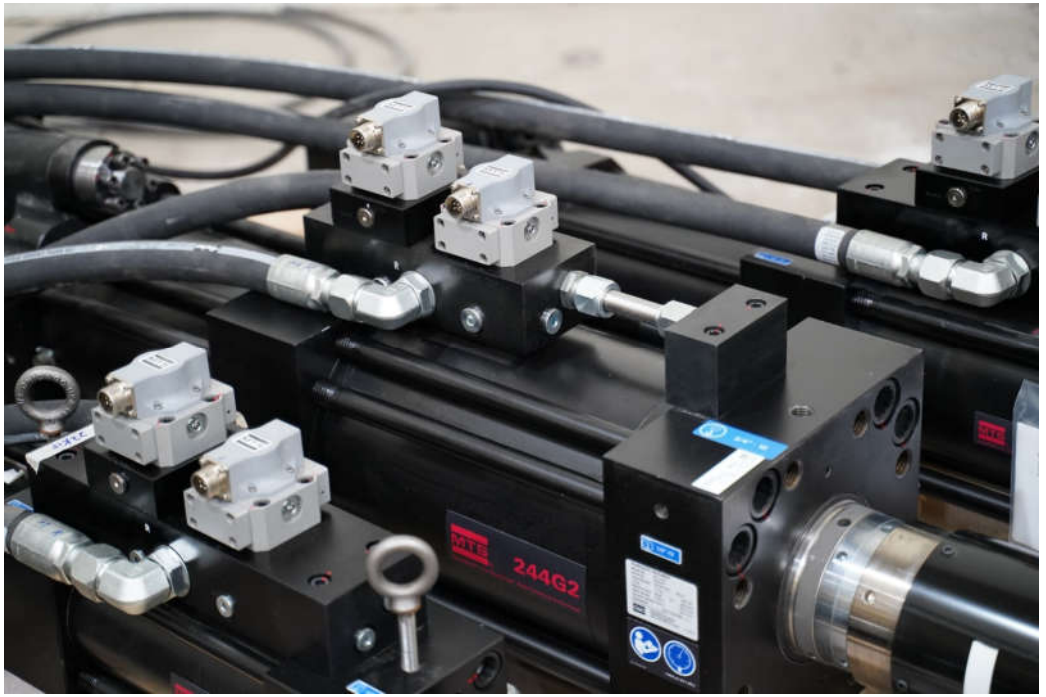


Laboratory Testing of Bridge Deck

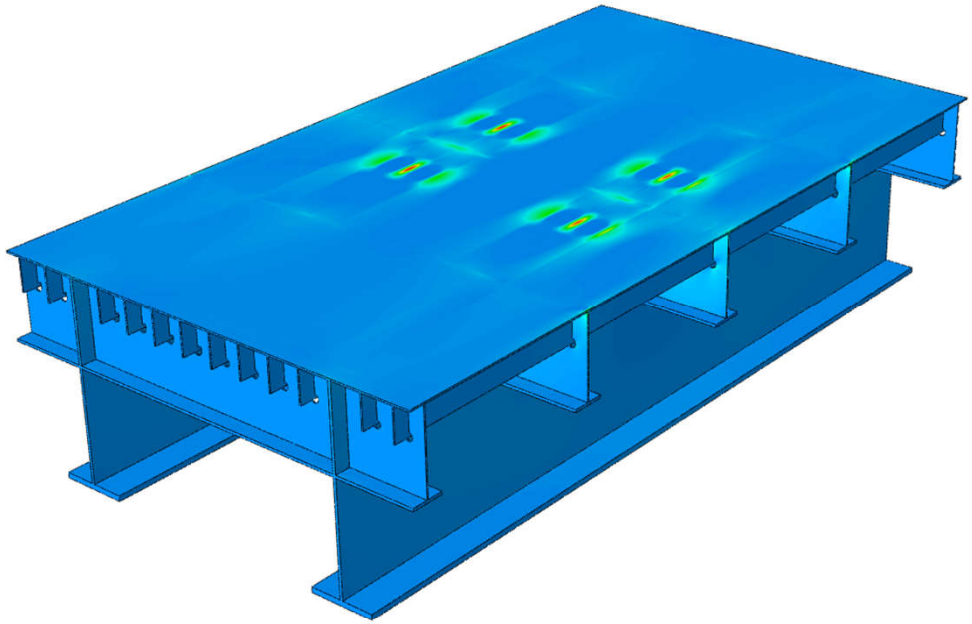


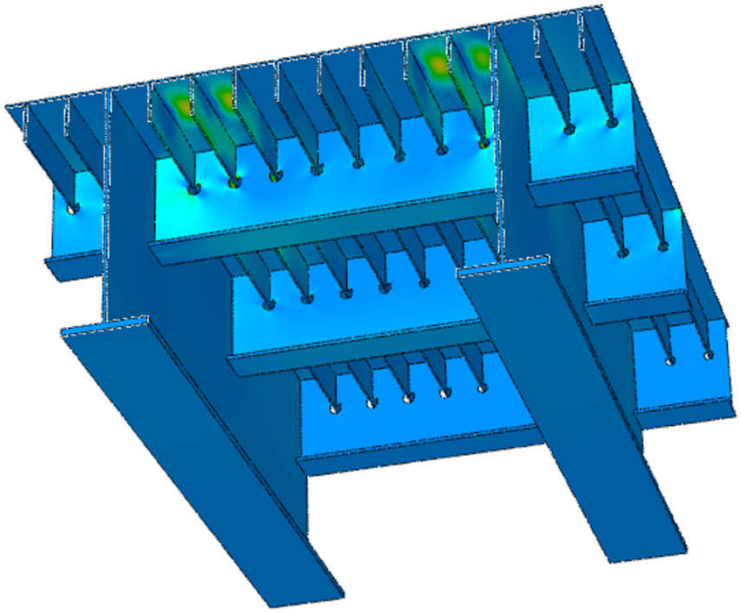


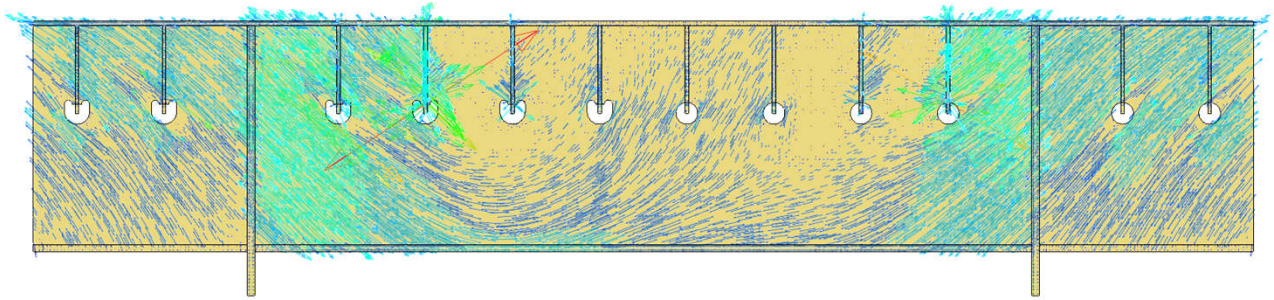
Rutgers CAIT Civil Engineering Laboratory



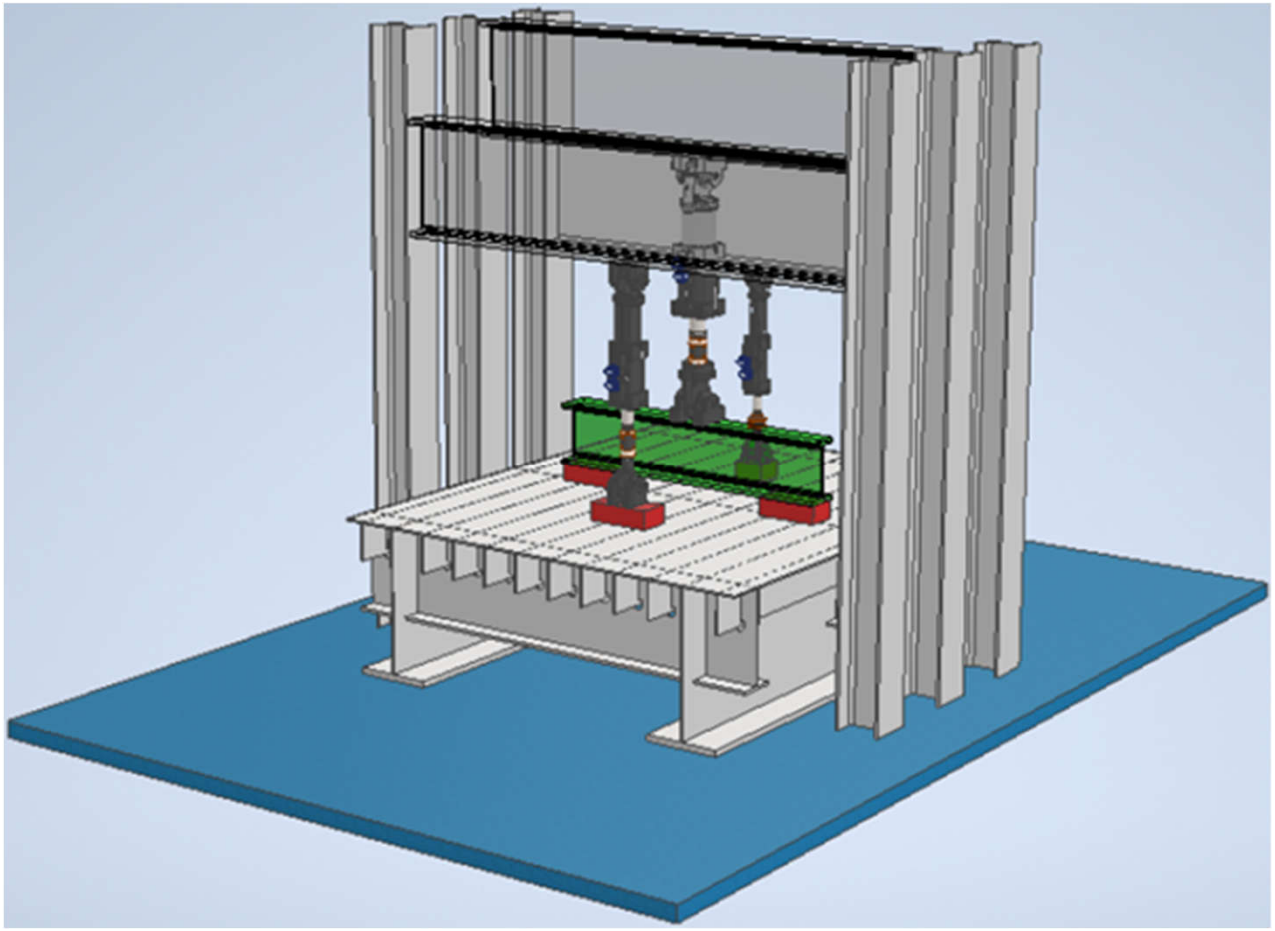
Standard Open Rib Orthotropic Deck







Full Scale Laboratory Testing



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- Rutgers CAIT

References

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6. Roy, S. Steel Orthotropic Deck Systems – Ideal Solution for 200 Year Bridges. IABSE Congress, New York City, 2019.

Thank You