State-of-the Art and Practices in Integral Abutment Bridges in the United States

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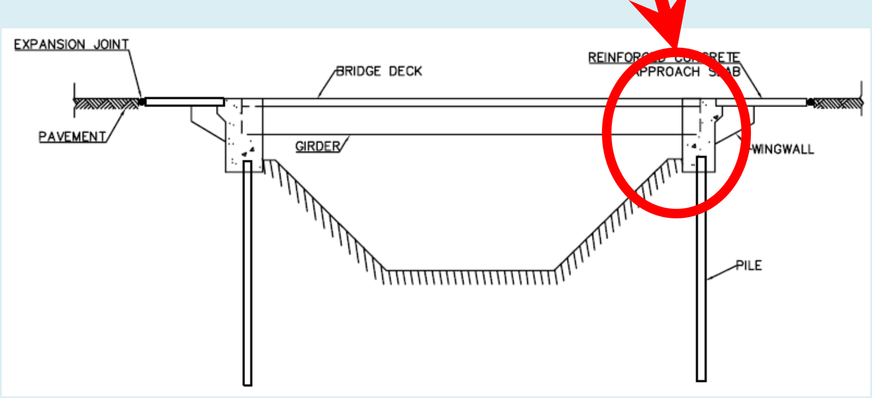
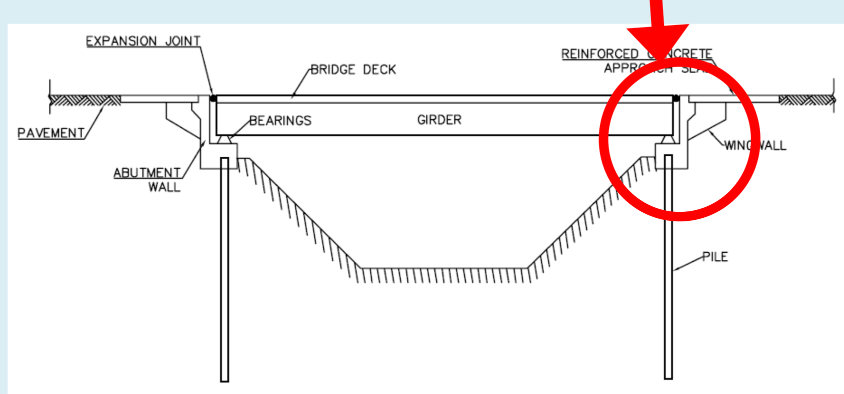
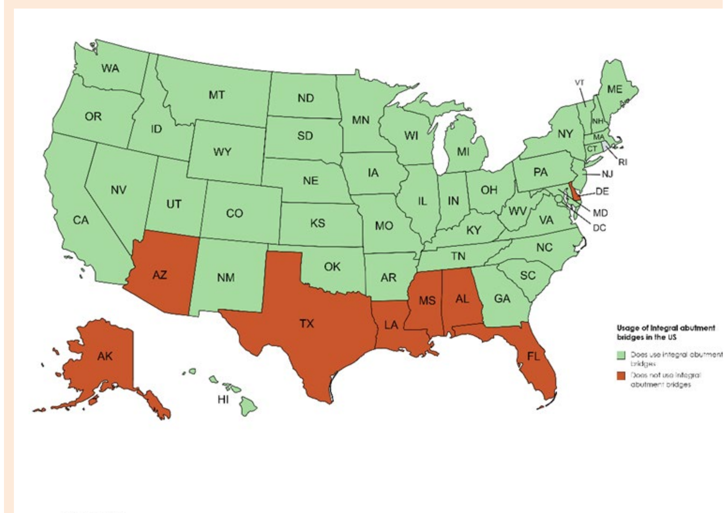
Integral Abutment Bridge vs. Conventional Bridge





Integral Abutment Bridge Usage in the US

- ***42 States: Yes.***
- ***8 States: No.***



State	Reason(s) Not Using Integral Abutment Bridges
Alabama	The predominant soil type is high-volume change clay. Expansion joints are critical to accommodate the shrinkage and swelling of the soil.
Alaska	Frozen soil restraints the movement of the fully integral abutment.
Arizona	Costly repairs due to the longitudinal movements causing approach slab settlements
Delaware	Never used.
Florida	The elimination of joints between the superstructure and back wall is important for using deicing salts.. In Florida, where road salts are not used, there is no need for a joint-less system.
Louisiana	Poor soft soil condition
Mississippi	The predominant soil type is expansive clay, and expansion joints are critical to accommodate the shrinkage and swelling of the soil.
Texas	Concrete piles are too stiff to move. Large pile movements will cause cracking. Integral abutment bridges are also not economical to build or repair due to the poor soil conditions.

Current Practices in Integral Abutment Bridges

Max # of Span	States
Not specified	CA,CT,GA,HI,ID,IL,IN,IA,KS,MD,MN,MO,MT,NE, NV,NH,NM, ND,OR, TN,UT,VT,VA,WV,WY
1 and 2 or more(up to 6)	AR,CO,KY,ME,MA,MI,NJ,NY,OH,OK,PA,RI,SD,WI

Max Span Length	States
≤150 ft	IN,MI,NH,PA,SD,WI
151 ft – 425 ft	IA,NJ,OH,VA,
800 ft	CO
Not specified	AR,CA,CT,GA,HI,ID,IL,KS,ME,MD,MA,MN,MO,MT,NE,NV,NM,NY, NC, ND,OK,OR,RI,SC,TN,UT,VT,WV,WY

Max Bridge Length	States
100 ft – 299 ft	AR,ME,MA,NY,
300 ft – 600 ft	CA,ID,IL,IN,IA,KS,MI,MN,NV,NH,NJ,NC, ND,OH,OK,PA,RI,SD,TN,VA,
600 ft – 800 ft	KY,
800 ft – 1000 ft	CO,
Not specified	CT,GA,HI,MD,MI,MO,MT,NE,OR,SC,UT,VT,WV,WI,WY

Straight VS Curved Bridges	States
Straight bridge only	IL,IN,MI,OH,RI,VT
Curved bridge allowed	AR,CA,CO,ID,IA,KS,KY,ME,MN,NV,NH,NJ,NY,NC,OR, PA,SD,VA,WV,WI

Max Curvature	States
1°-5°	AR,CO,MA,WV
6°-15°	CA,NV
Not specified	CT,GA,HI,ID,IL,IN,KYME,MD,MI,MN,MO,MN,NE,NM,NY,NC,ND,OH,OK,RI,SC, TN, UT,VT,VA,WY

Max Skew	States
1°-10°	OK
11°-20°	CA,IN,ME,MN,NH,VT, NC, PA
21°-45°	AR,CO,CT,ID,IL,IA,MA,MI,NE,NV,NJ,NY, ND,OH,OR,RI,SD,UT,VA,WV,
Not specified	GA,HI,MD,MO,MT,TN,WY

Typical Foundation Types:

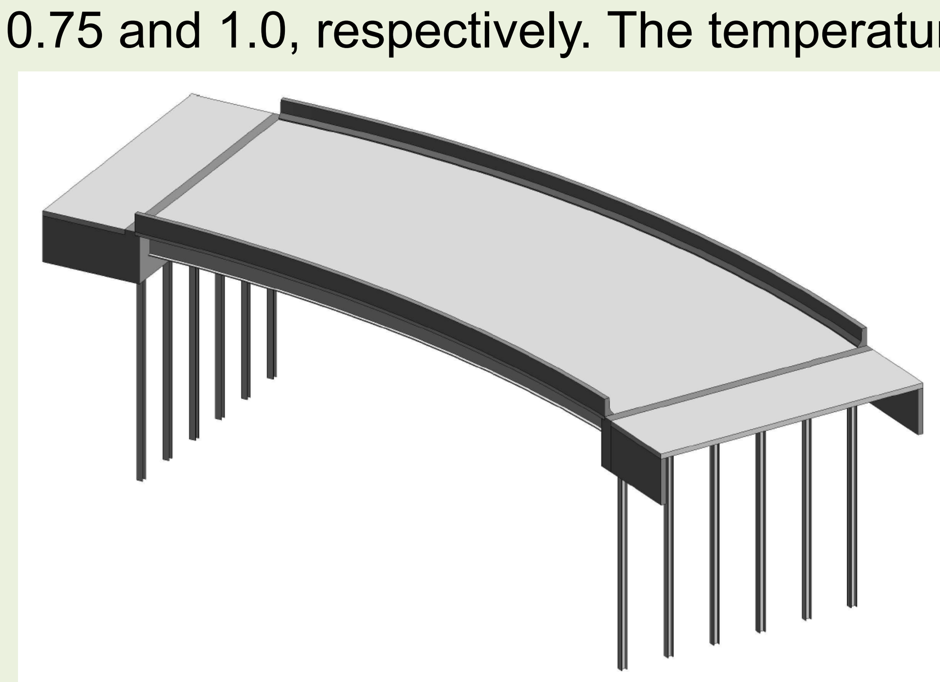
- ***HP Driven Piles***
- *Steel Pipes*
- *Drilled Shafts*

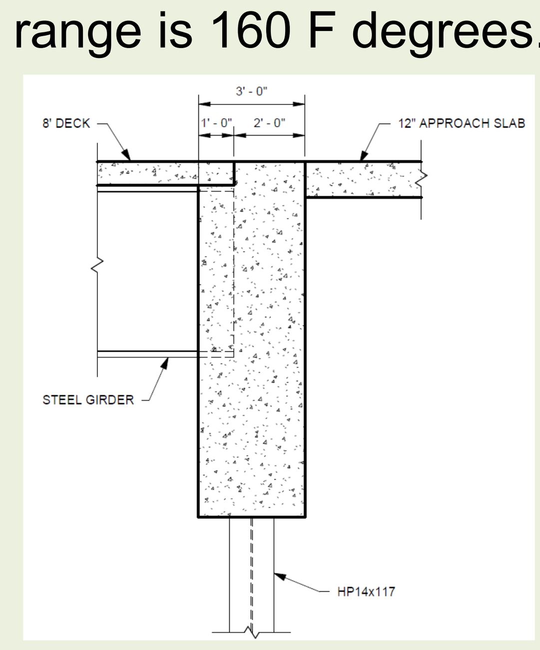
Substructure Layout Requirement:

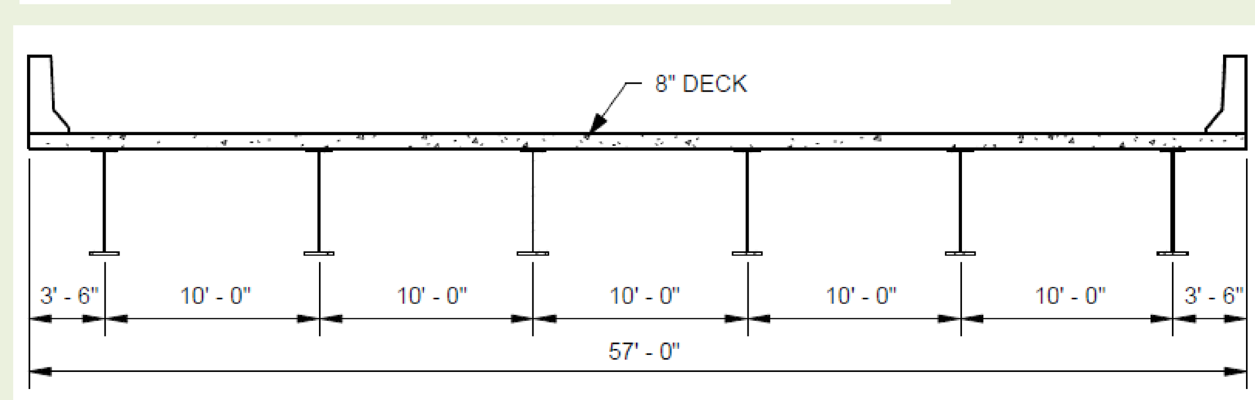
- *Abutment and Piers should be parallel.*

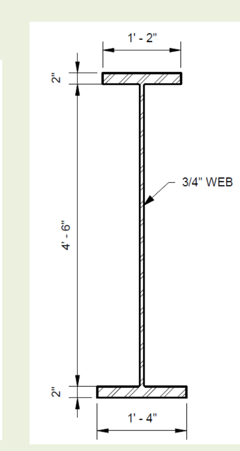
Horizontally Curved Integral Abutment Bridges

Finite Element Modeling: A simple span curved bridge has a span length of 130 ft, the bridge width is 57 ft, and it has 6 I-plate girders with 10 ft spacing. The curvatures are 0 (straight), 0.25, 0.50, 0.75 and 1.0, respectively. The temperature range is 160 F degrees.

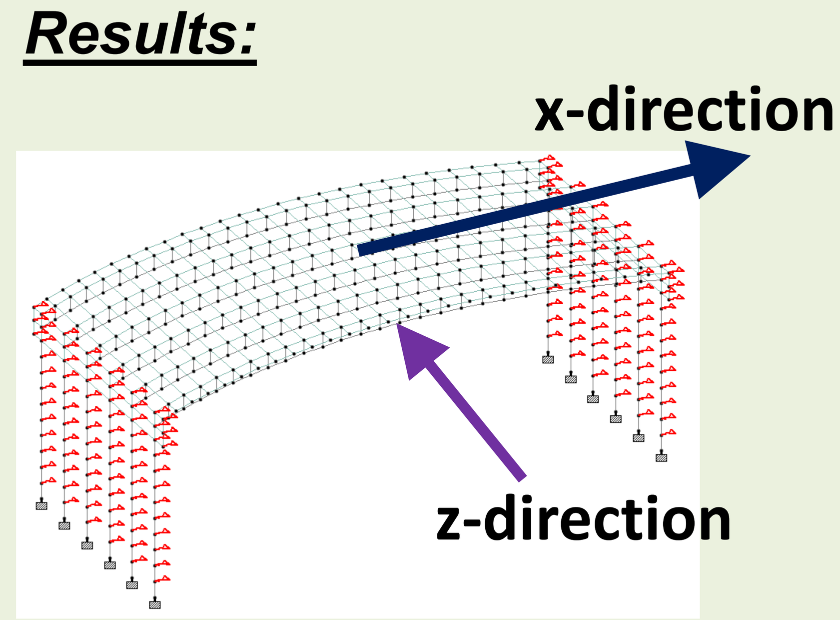


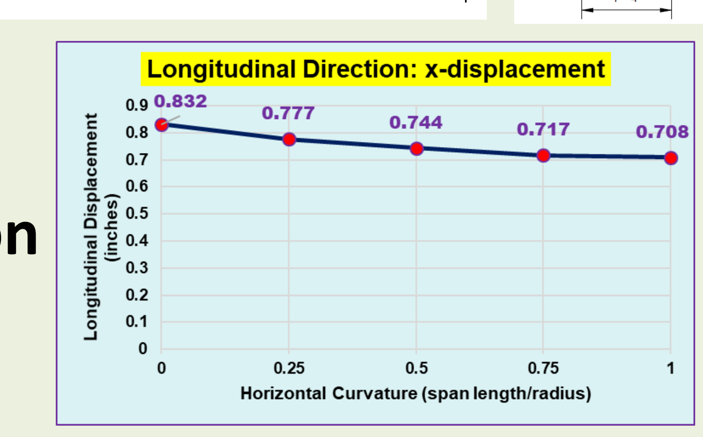


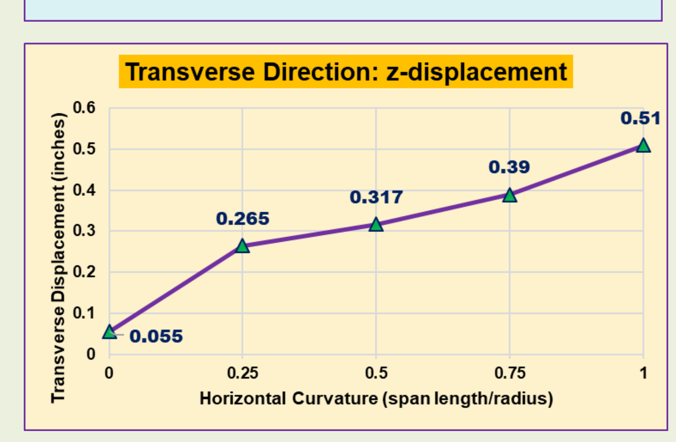




Results:







Conclusions

- ***Due to lower construction and maintenance costs and longer service life, integral abutment bridges are the excellent alternative to conventional bridges.***
- ***Geographical location plays an important role in integral abutment bridge adoption due to weather and soil conditions.***
- ***Some states still do not use integral abutment bridges due to uncertainties about expansive soil conditions and structural behaviors of piles.***
- ***Better understanding the behaviors of curved bridges will facilitate further use of integral abutment bridges.***
- ***The radial displacement is important to analyze curved integral bridges under thermal loads.***

The 39th International Bridge Conference

Design Session: Tue, July 19th, 2022, Pittsburgh, PA