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Unconventional Reinforced Concrete Bridge Columns

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Perched Pier Design for the Sellwood Bridge

by

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American Concrete Institute
Spring Convention
March 2014

Unconventional Reinforced Concrete Bridge Columns:

Perched Pier Design for the Sellwood Bridge over the Willamette River, Portland, Oregon

Presented by Mike Lopez, PE, SE
T.Y. Lin International

Sellwood Bridge Pier Design

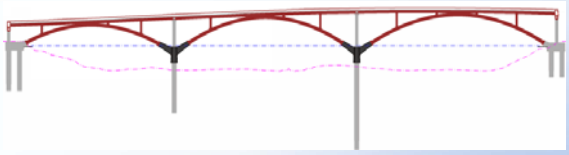
- Project owner: Multnomah County, Oregon
- Prime consultant and main span bridge engineering: T.Y. Lin International
- Main span bridge checking, approach engineering: CH2M Hill
- The project is being delivered under the Construction Manager/General Contractor procurement method.

Sellwood Bridge Pier Design
Unique Design Aspects

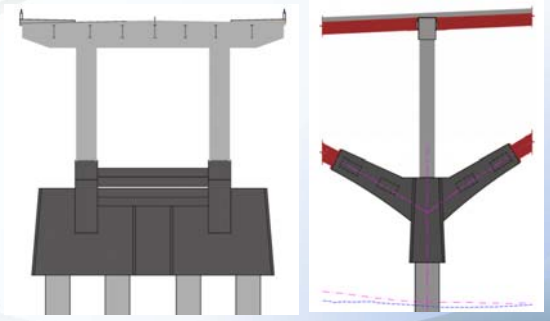
- Pier design follows a strut-and-tie methodology.
- Layout and interaction of column, shaft, arch, pier reinforcing – reinforcing follows force transfer models.
- Contractor's construction methods recognize requirements for the pier design.

Main Span Elevation

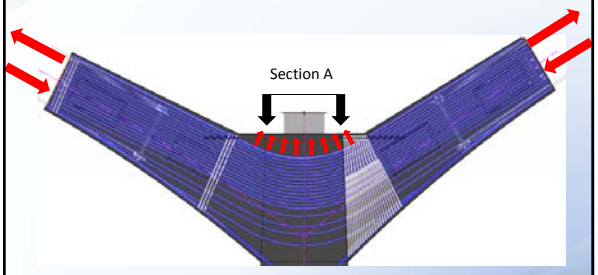
Span lengths of 365', 425', 465'



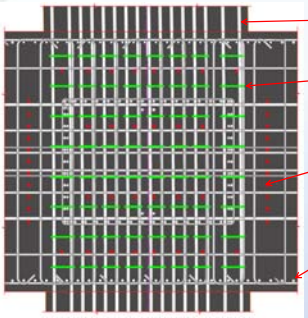
River Pier



Springing/Wall/Column/Strut Interface



Arch springing/column/pier joint



- Radially bent bars
- U-bars (vertical hairpins) shown in green
- Supplemental vertical bars shown in red
- Pier face bars follow wall batter

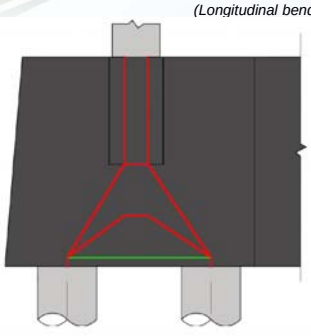
Section A

Sample force transfer models

- Multiple force transfer models are required.
- The following slides illustrate some sample force models used in design for controlling longitudinal and transverse load cases.

Compressive resultant force flow

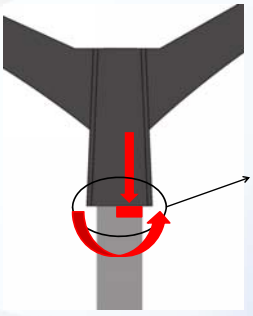
(Longitudinal bending)

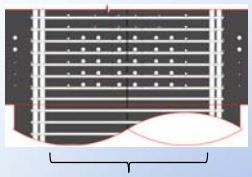


- Compressive resultants in the columns and arches take the paths shown in red.
- The tie shown in green equilibrates the lateral force components.
- Strut thicknesses into the page are determined by load conditions at the shaft heads.

Compressive resultant force flow

(Longitudinal bending)

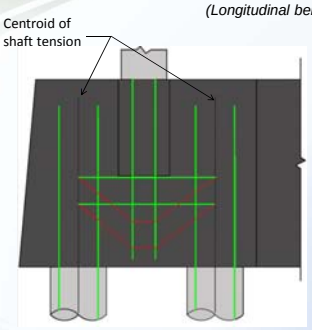




The zone of compression at the shaft head defines the extent of the tie reinforcing available to resist a given loading.

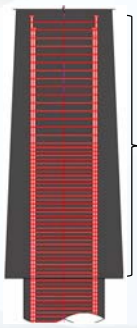
Tensile resultant force flow

(Longitudinal bending)



- Tensile resultants in the columns and arches strut to the pier verticals and drilled shaft bars.
- Layers of horizontal bars throughout the pier resolve the lateral force components shown.

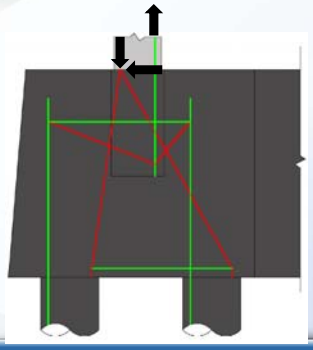
Drilled shaft cage length



- Column bars are deeply embedded for the same purpose.
- Drilled shaft casing within the river channel accounted for in analysis.

Transverse Loading:

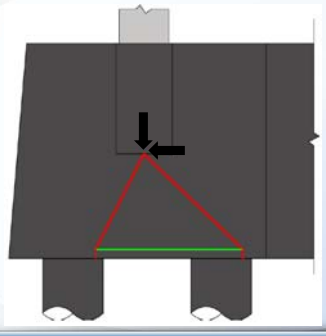
Column force transfer



- Column force resultants from pushover and moment-curvature analyses take the paths shown.
- Layers of horizontal reinforcing distributed throughout pier provide required tie forces.

Transverse Loading:

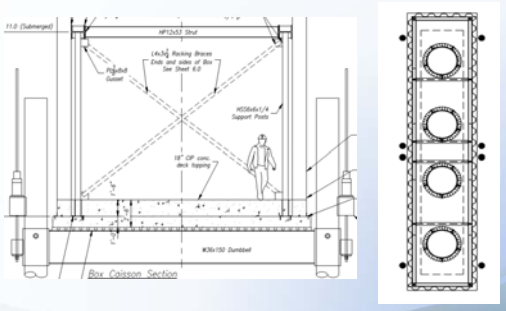
Arch springing force transfer



- Forces delivered at the arch springings take the paths shown.
- Tie force demands are directly added to those required by column load path.
- Strut demands are combined vectorially with those required by column load path.

Perched cofferdam

(courtesy of McGee Engineering)



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