

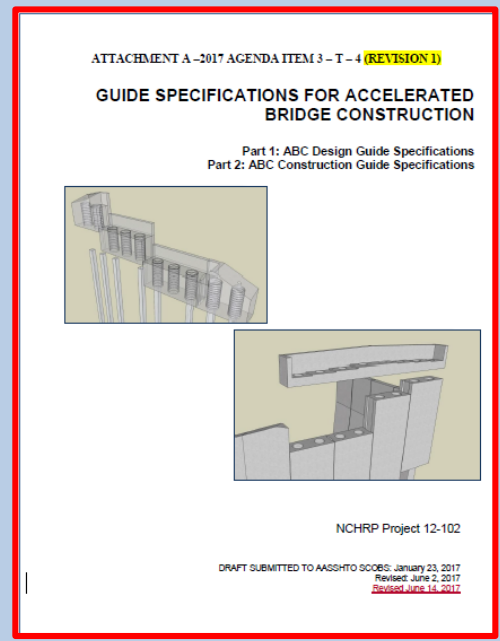
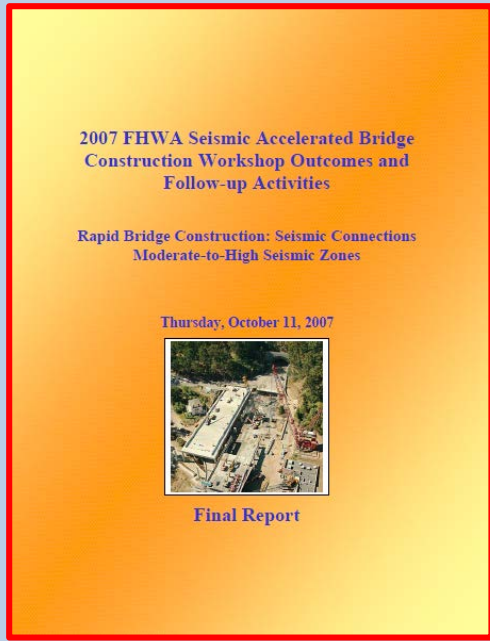
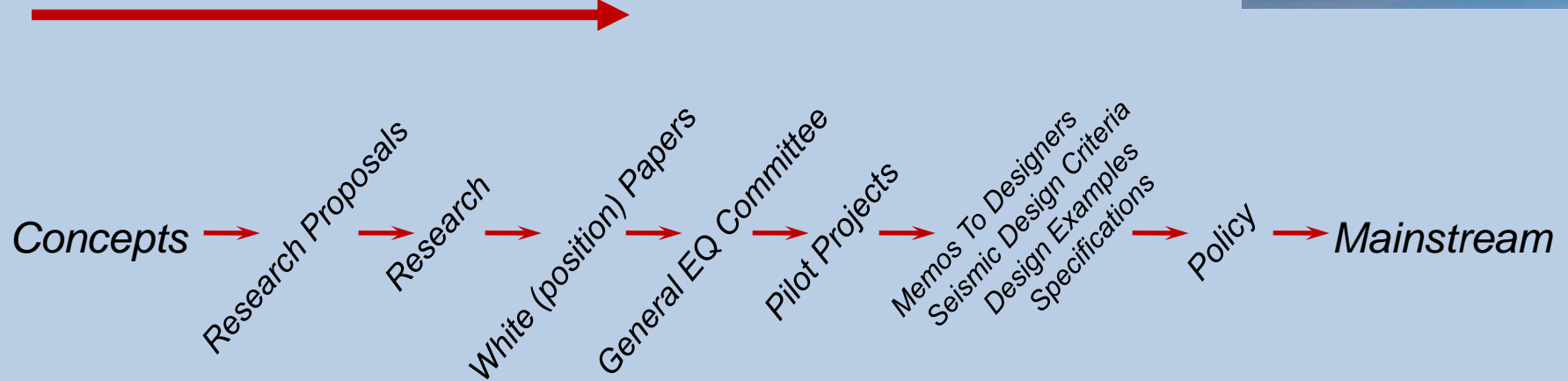


**RESEARCH, DESIGN, and CONSTRUCTION of CALIFORNIA ABC
COLUMN-TO-CAP and GIRDER-TO-CAP CONNECTIONS**

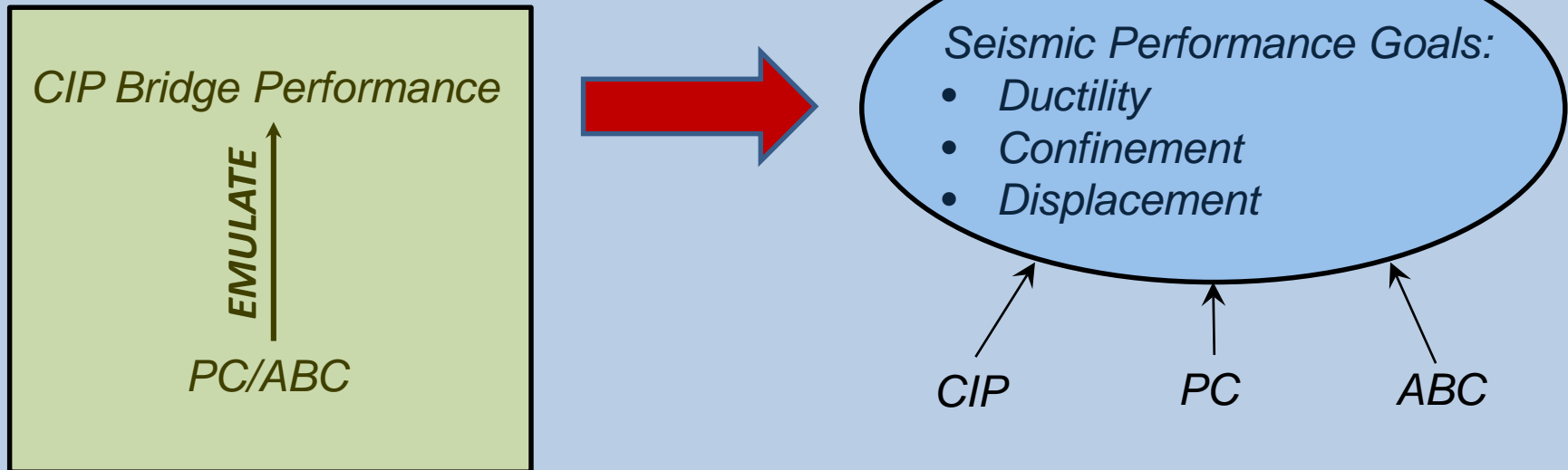
Tom Ostrom - State Bridge Engineer
Ron Bromenschenkel - Senior Bridge Engineer

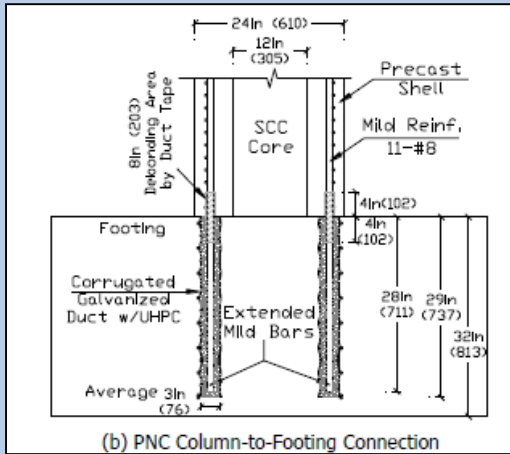
California Department of Transportation

Caltrans ABC Timeline



A Better Model...



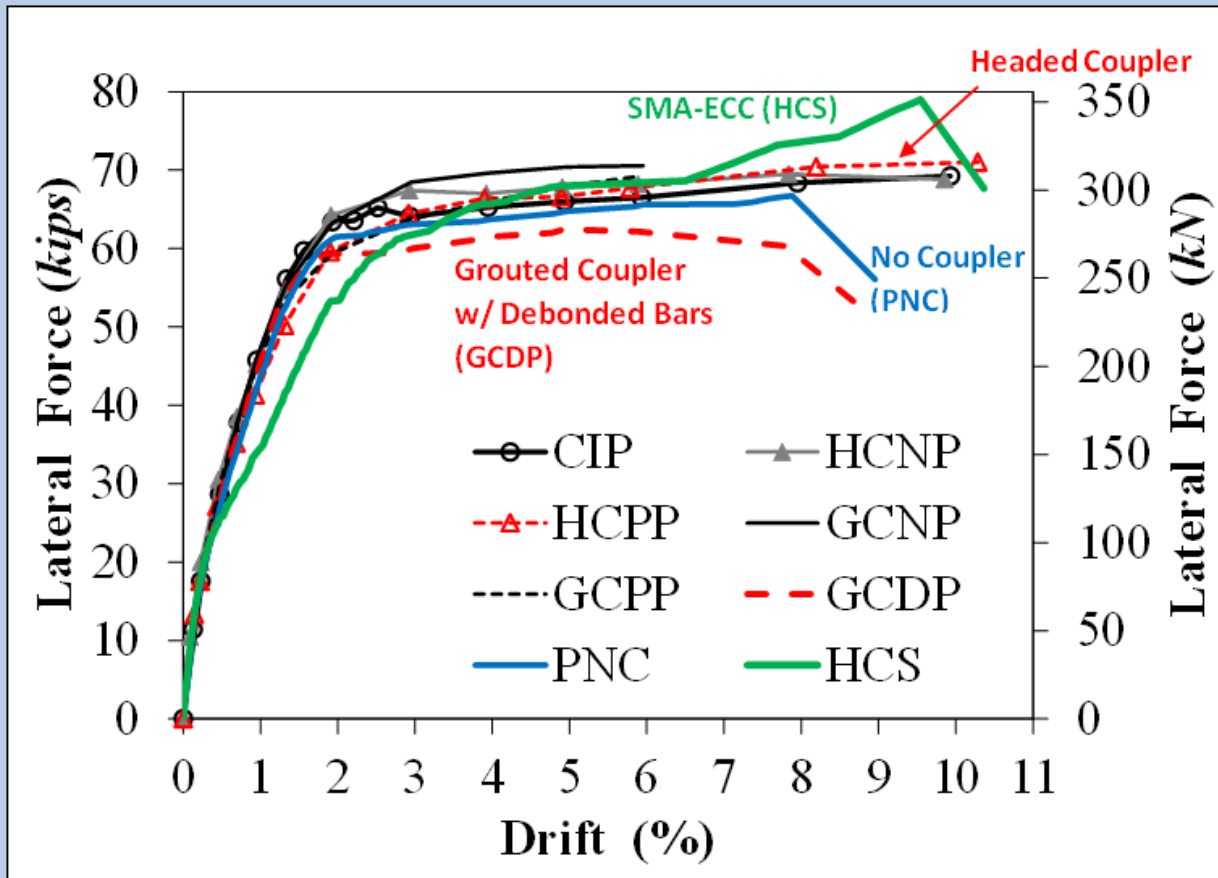


ABC full-moment PC Column connections into bent cap and footings feature CIP construction or grouted ducts with either HS grout or UHPC.

PC Column with Sleeve Connection as tested at UNR



PC Column-to-Footing Connection Test Results



Bar and duct development into footings and PC caps is based on a review of Caltrans research at the University of Nevada, Reno. Couplers are not used in plastic hinge zones to connect columns to other elements.



Caltrans SDC 2.0

8.2.2 Reinforcement Splices in Seismic Critical Members

8.2.2.1 No-Splice Zones

The “No-Splice Zones” for SCMs shall correspond to the plastic hinge regions specified in Section 5.3.2. No-Splice Zones shall be clearly identified on the plans.

Except as specified herein, splicing of main flexural reinforcement shall not be permitted in No-Splice Zones.

C8.2.2.1

The No-Splice Zone in seismic critical members may be shown on plans either as a fixed dimension or as a fraction of the height or length of the member.

The “No-splice” requirement for seismic critical members is applicable to both cast-in-place and precast construction.

8-2

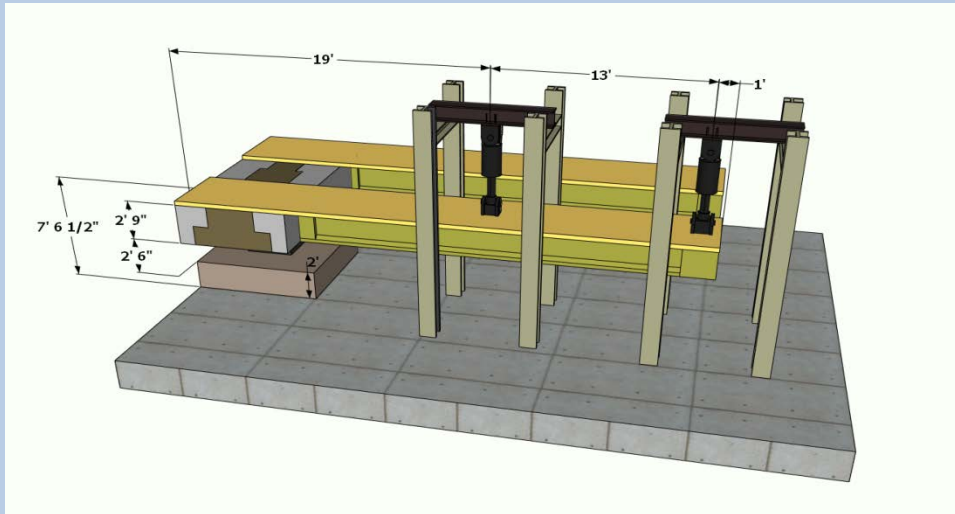


SEISMIC DESIGN CRITERIA VERSION 2.0 OCTOBER 2017

Table 8.2.1-1 Splice Requirements for Longitudinal Reinforcement

Member	Location	Splice Type
All SCMs	Inside plastic hinge region	Not allowed, except as specified in Section 8.2.2.1
	Outside plastic hinge region	Ultimate butt

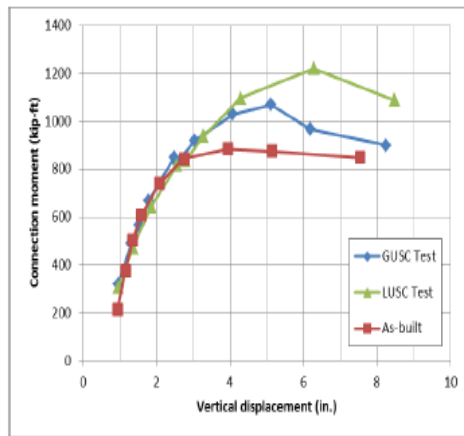
PC Girder-to-Cap Tests



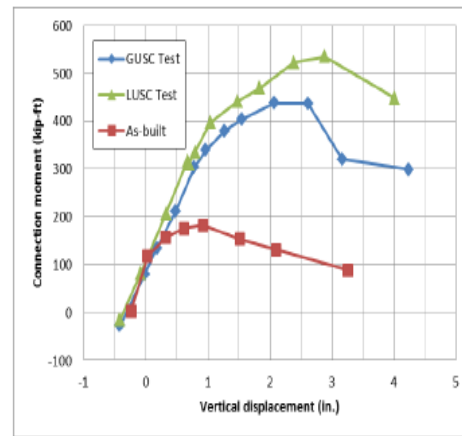
Iowa State University investigated existing PC girder-to-cap connections. Six improved connection alternatives were then proof-tested.

FEM was also used to quantify bar and strand strain in connections through a follow-on consultant contract.

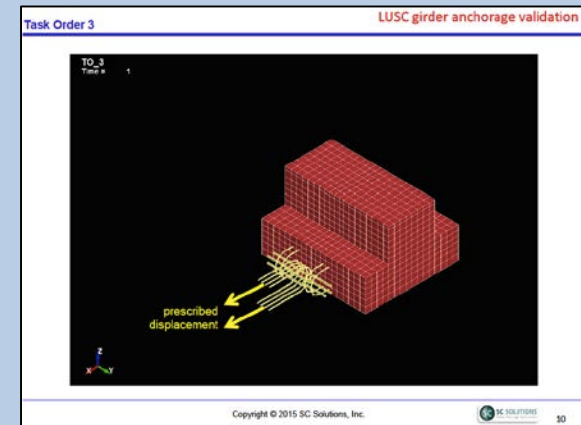
PC girder continuity through bent caps will be a requirement in Caltrans SDC 2.0.



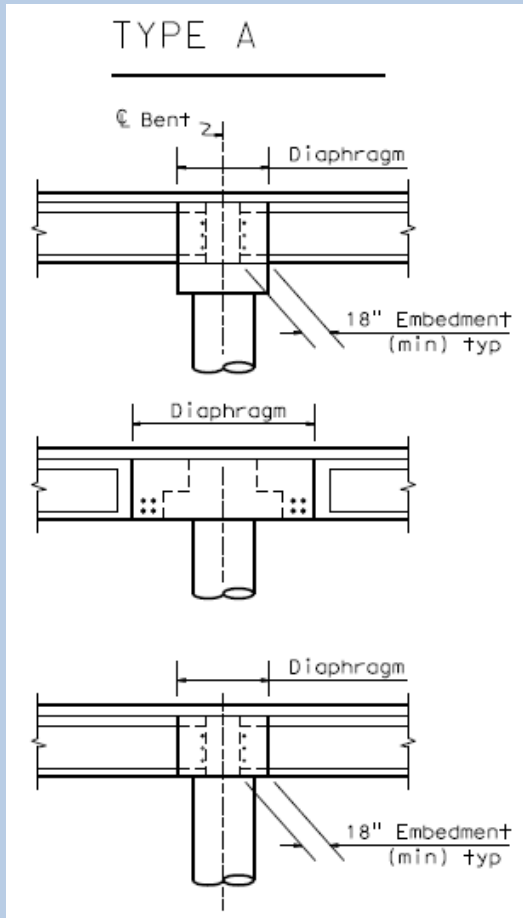
(a) Negative moment



(b) Positive moment



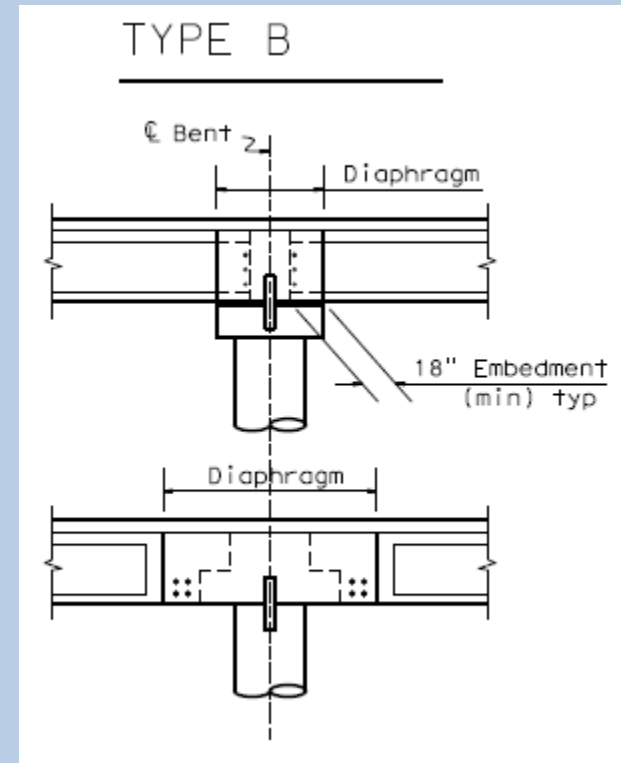
PC Girder-to-Cap Integral Connection



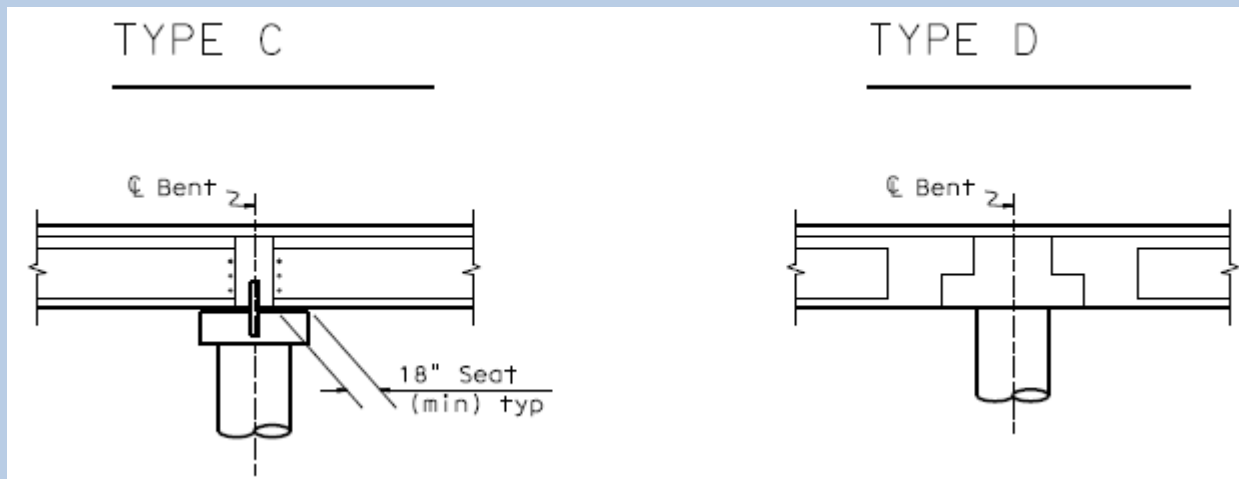
PC girders with positive and negative moment continuity having full column moment fixity using drop-caps or flush soffit situation are classified as Type 'A' connections in SDC 2.0.

PC girders with positive and negative moment continuity having no column moment fixity using drop-caps or flush soffit situation are classified as Type 'B' connections in SDC 2.0.

PC Girder-to-Cap Continuity Column Pin Connection

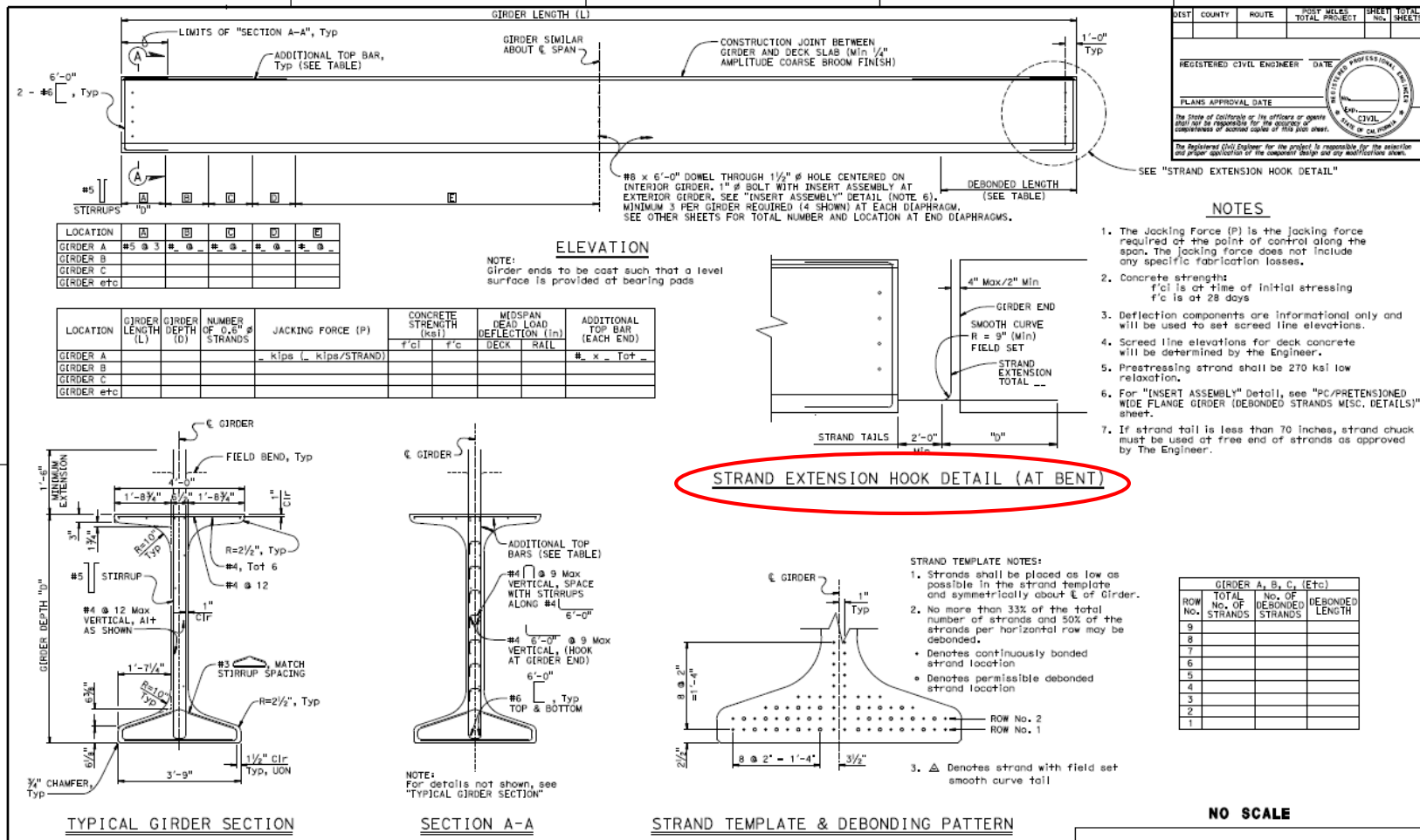


*PC Girder-to-Cap Detail
Negative Moment Continuity*



Type 'C' and 'D' connections feature negative moment continuity, and are allowed where $PGA < 0.6g$.

Proposed Design XS Sheet for PC Girder Continuity Details with strand



DEST COUNTY	ROUTE	TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
REGISTERED CIVIL ENGINEER		DATE		REGISTERED PROFESSIONAL ENGINEER
PLANS APPROVAL DATE				
<small>The State of California or its officers or agents shall not be responsible for the accuracy, completeness or correct copies of this and other.</small>				
<small>The Registered Civil Engineer for the project is responsible for the accuracy and proper application of the computer design and any modifications thereon.</small>				

LOCATION	A	B	C	D	E
GIRDER A	#5 @ 3'	#5 @ 3'	#5 @ 3'	#5 @ 3'	#5 @ 3'
GIRDER B					
GIRDER C					
GIRDER etc					

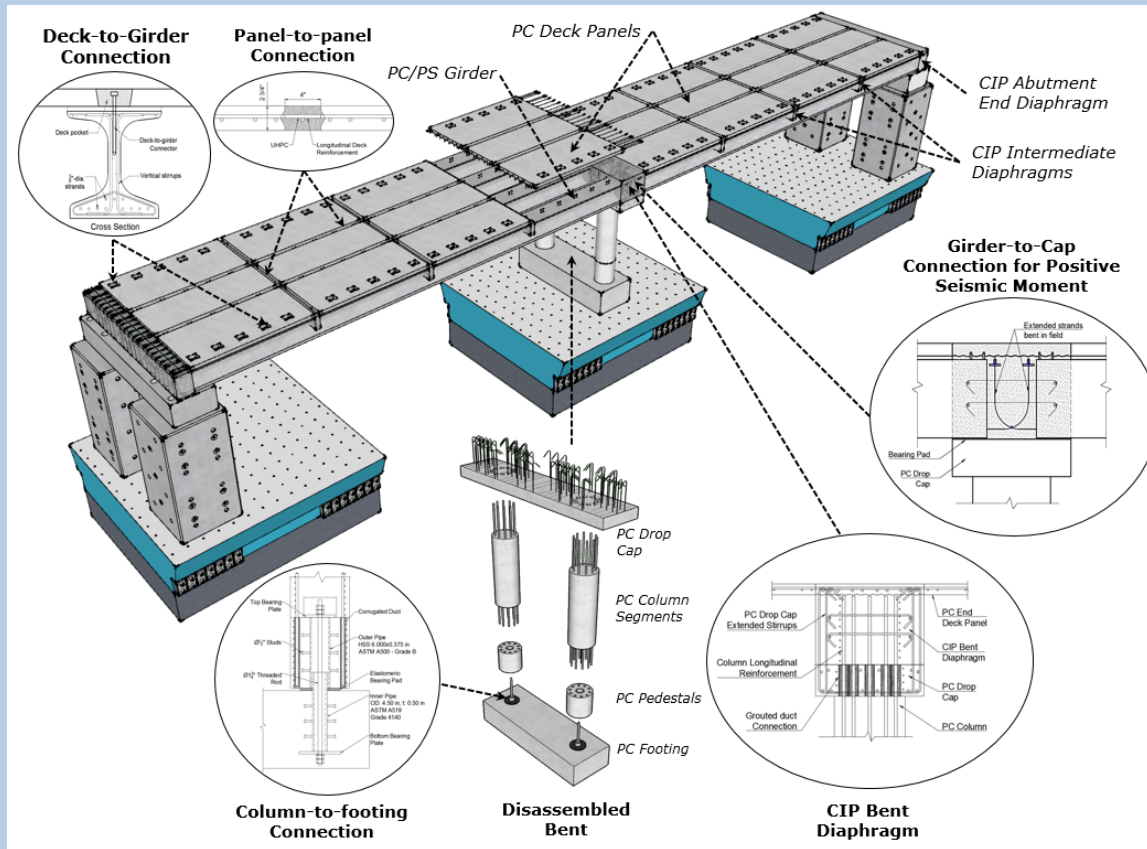
LOCATION	GIRDER LENGTH (L)	GIRDER DEPTH (D)	NUMBER OF 0.6" ϕ STRANDS	JACKING FORCE (P) - kips (kips/STRAND)	CONCRETE STRENGTH (ksi)		MIDSPAN DEAD LOAD DEFLECTION (in)		ADDITIONAL TOP BAR (EACH END) # x - Tot -
					f'_{ci}	f'_{cs}	DECK	RAIL	
GIRDER A									
GIRDER B									
GIRDER C									
GIRDER etc									

ROW NO.	GIRDER A, B, C, (Etc)	
	TOTAL No. OF STRANDS	No. OF DEBONDED STRANDS
9		
8		
7		
6		
5		
4		
3		
2		
1		

NO SCALE

BRIDGE STANDARD DETAILS X81-123-1 <small>FILE NO.</small>		<small>APPROVAL DATE</small> July 2017	<small>The components of the Bridge Standard derive from the original work of the responsible parties at the Technical Center, a registered civil engineer in the State of California.</small>	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES	BRIDGE NO. PROJECT MILE	PC/PRETENSIONED WIDE FLANGE GIRDER (DEBONDED STRANDS)
<small>DATE PLOTTED</small> 11/10 <small>DATE PLOTTED</small> 13-05-2017 <small>DESIGN SCALE</small> 1/8" = 1'-0" <small>FILE NO.</small> X81-123-1-00 <small>ISSUE NO.</small> 01/2009	<small>UNIT PROJECT NUMBER & PHASE</small>	<small>CONTRACT NO.</small>	<small>DESIGNER PRINTS BEARING</small> EXPLANATION SHEETS	<small>REVISION</small> 1 2 3 4	<small>DATE</small>	<small>BY</small>	<small>IF</small>

ABC System Bridge Research Component Compilation Tests



ABC System Bridge Research Component Compilation Tests



UNR Video at 1.75
Design EQ

ABC Bridge Construction Laurel Street Bridge replacement

[1]



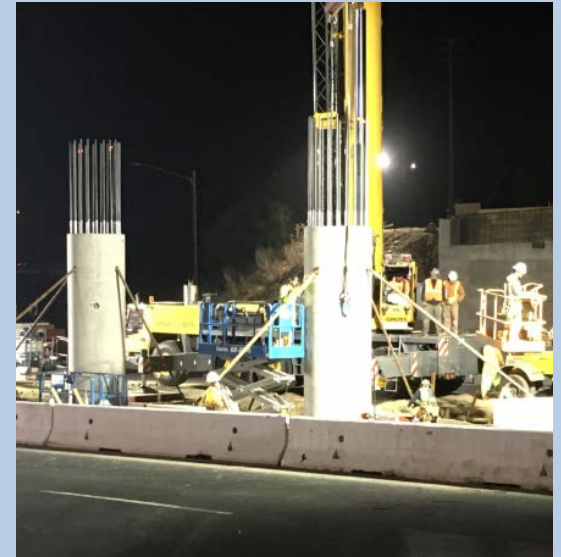
[2]



[7]



[5]



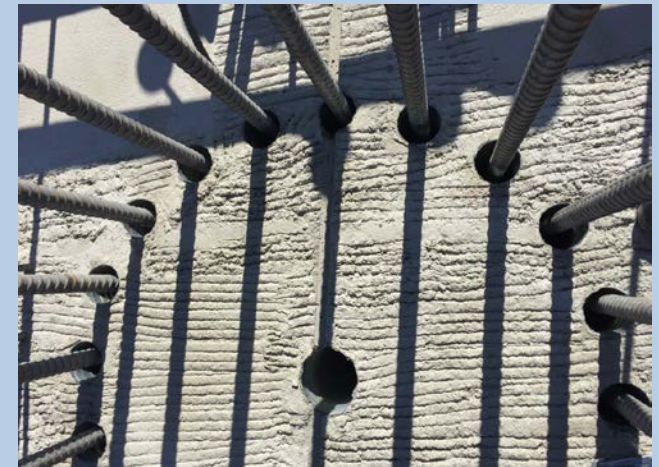
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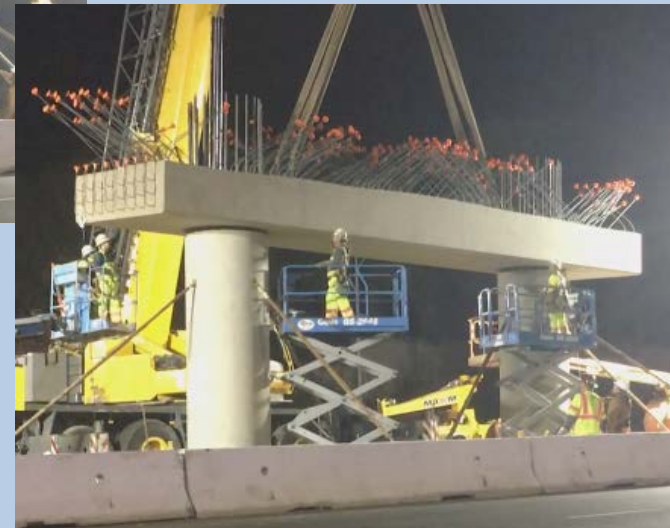
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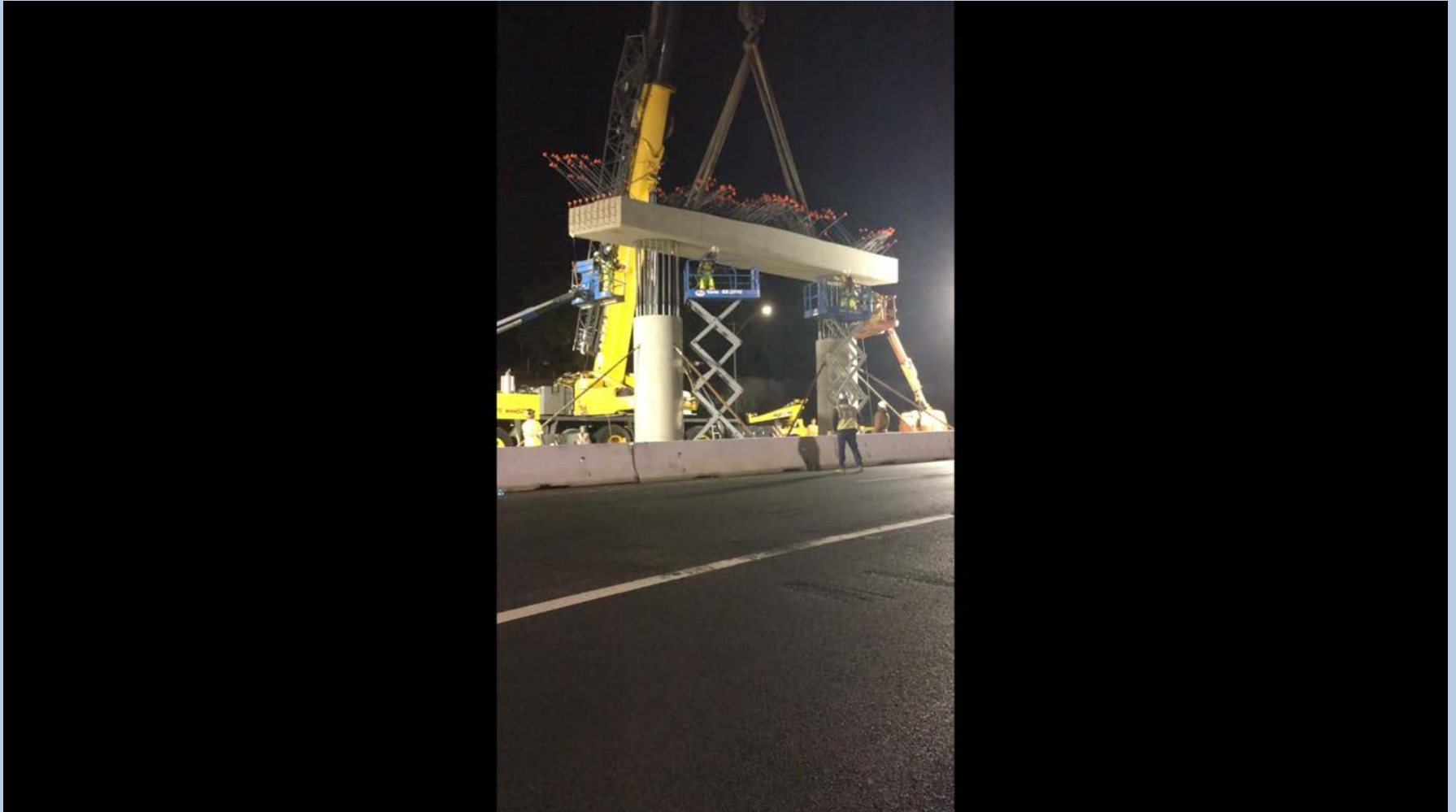
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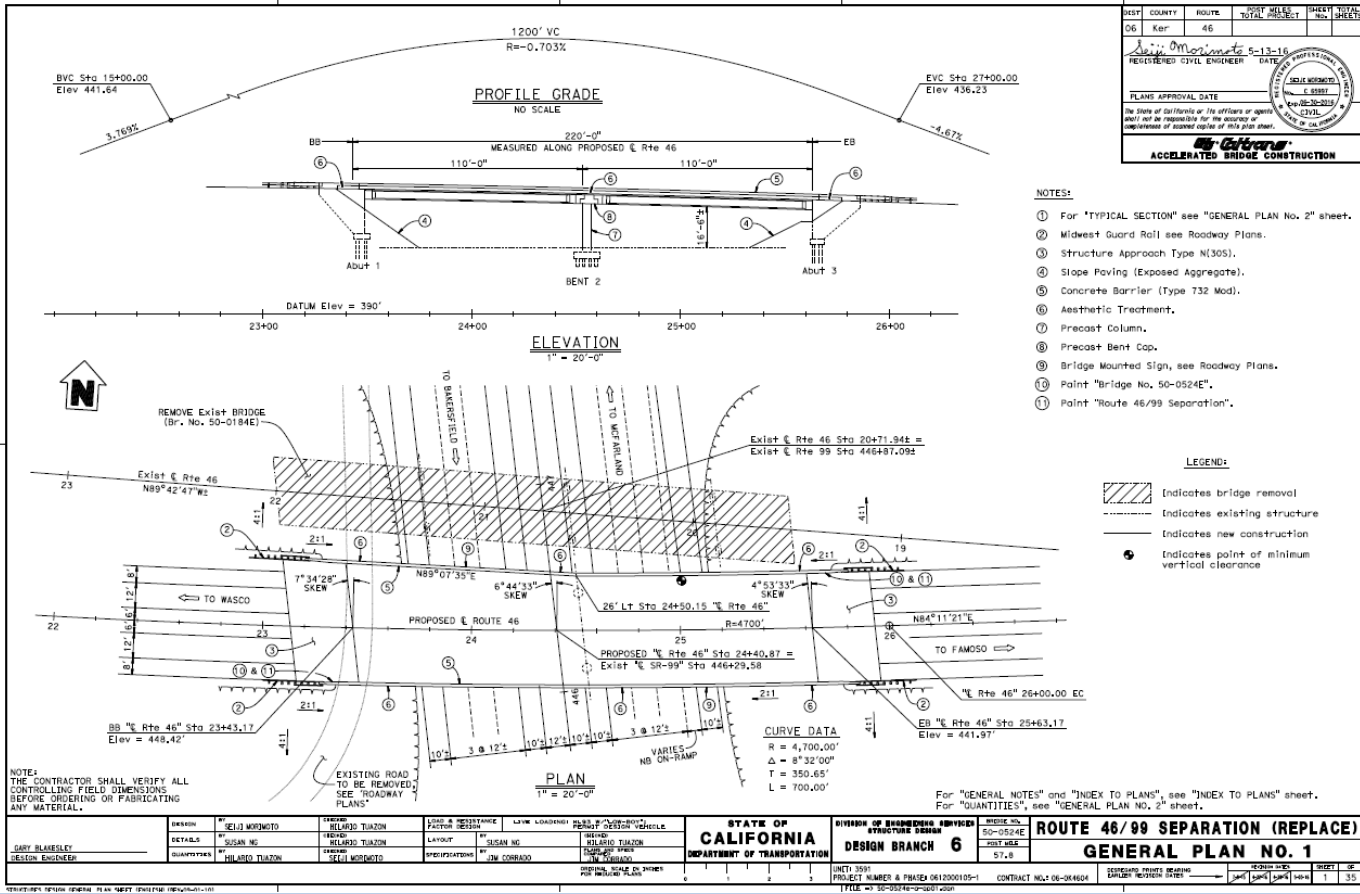
*ABC Bridge Construction
Laurel Street Bridge replacement*



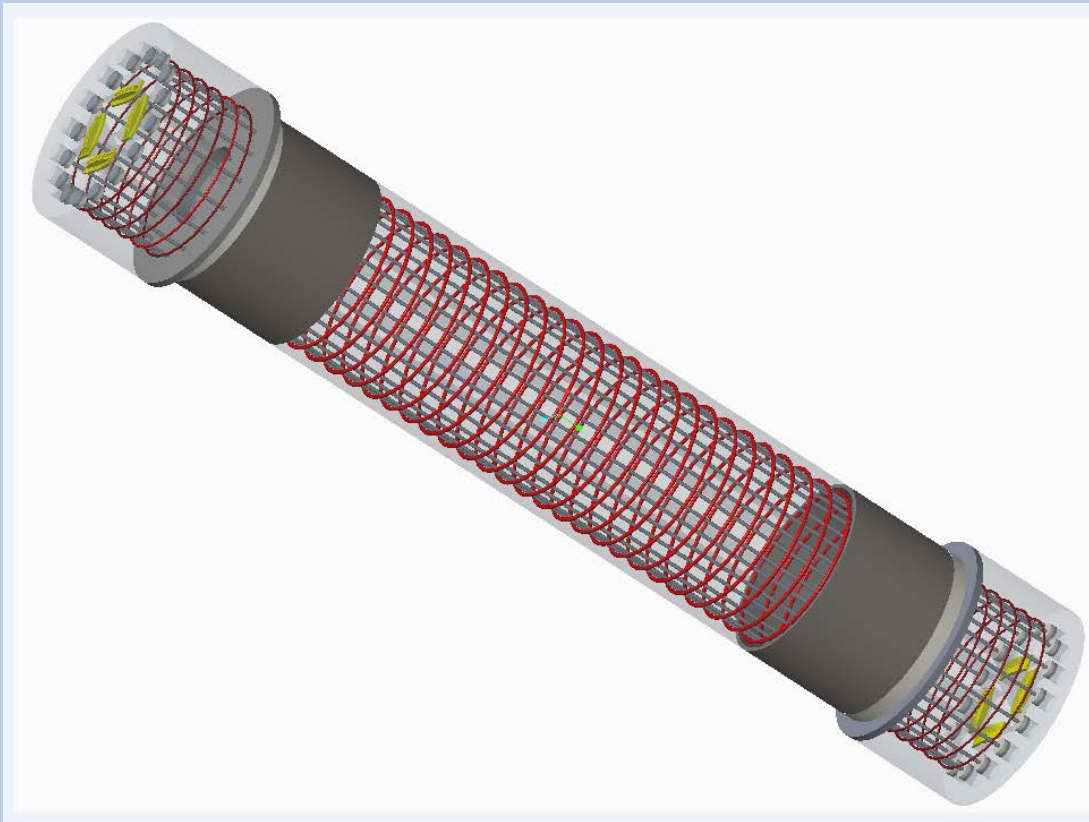
*ABC Bridge Construction
Laurel Street Bridge replacement*



Second two-span ABC Bridge Route 46/99 Separation [2018]

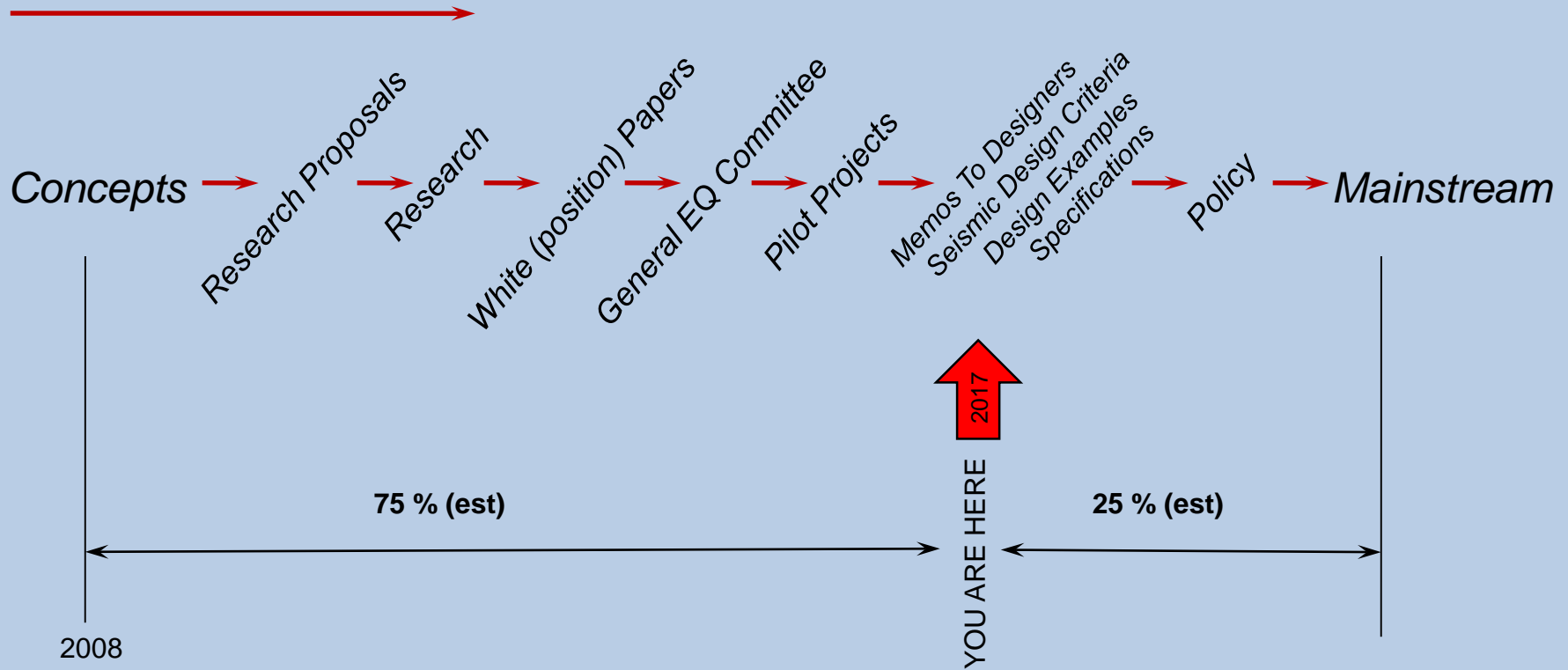


Future Column Design Concepts ABC/non-ABC 'Recovery Column'



- Prefabricated modular design-inserts into cap & footing
- Target 16% drift
- Re-centering capabilities
- Mild & PS steel
- 2012 Concept currently in research phase

Caltrans ABC Timeline



Questions?..... Comments?.....