Western Bridge Engineers' Seminar
September 24 – 26, 2007
Boise, Idaho

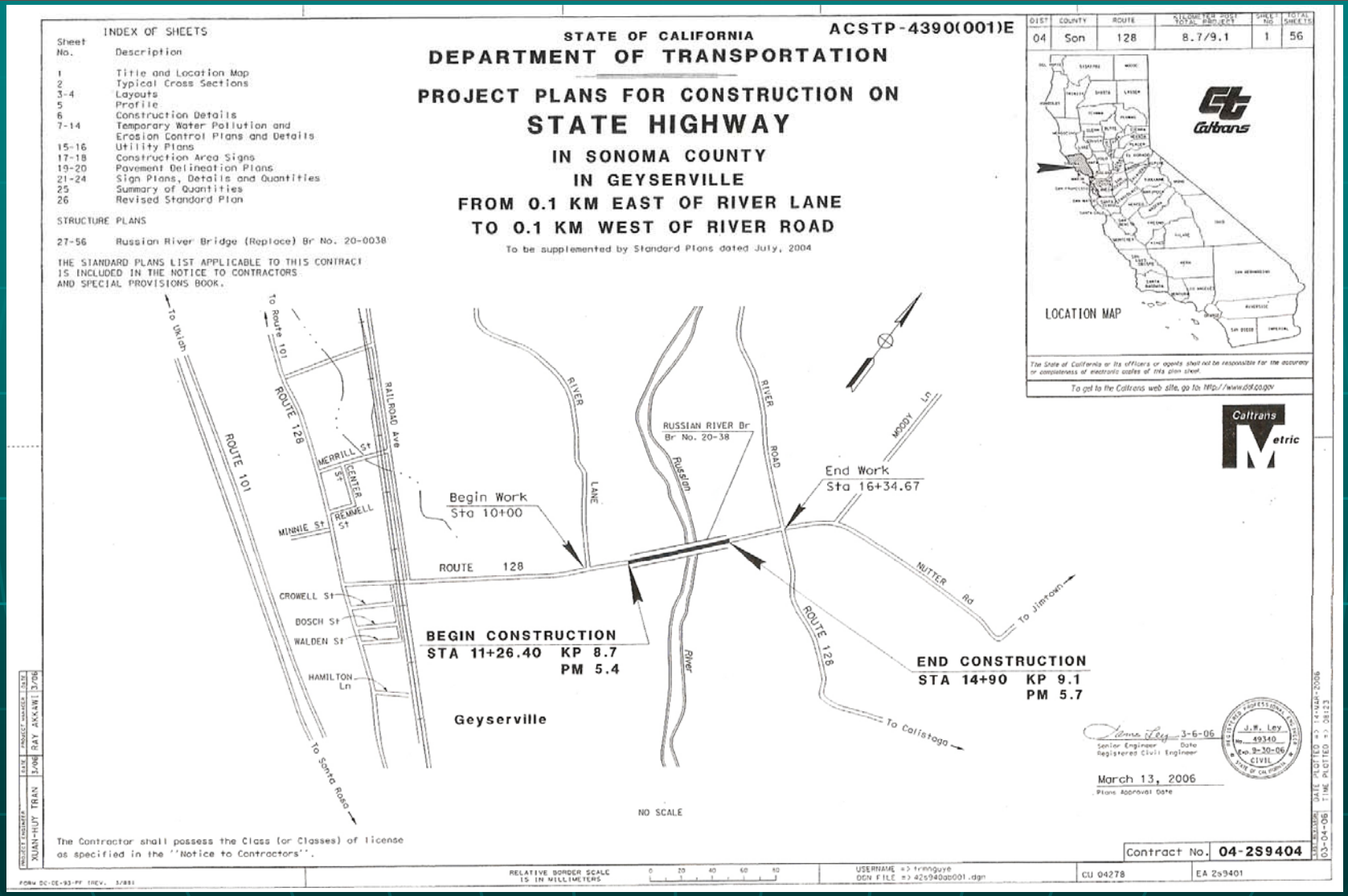
Emergency Replacement of the Russian River Bridge

on Hwy 128 in Geyserville

ENGINEERING SERVICES - STRUCTURE CONSTRUCTION
S C
SAFETY FIRST

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Project Location

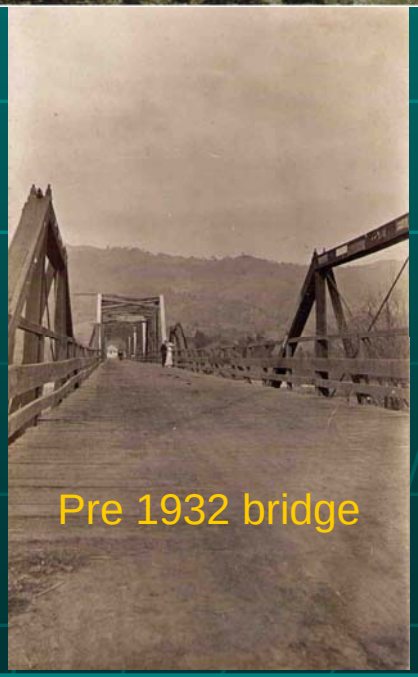


Key Facts

- 297 meter bridge closed to traffic on January 1, 2006
- Governor Arnold Schwarzenegger issues State of Emergency Proclamation for Sonoma County on January 4
- $10.5M emergency contract issued on January 15 to repair bridge
- Sonoma County declared a disaster area by FEMA on February 03
- Emergency contract amended for removal of existing bridge
- Second emergency contract advertised in March for replacement bridge contract
- $14.3M contract awarded to low bidder on April 11, 2006
- Contractor submits Cost Reduction Incentive Proposal (CRIP) requesting to change superstructure type
- CRIP approved and new bridge construction started in May
- New 300 meter bridge opened to traffic August 17, 2006
- Contract accepted on March 12, 2007

Presentation Outline

- Introduction
- Project Scope
  - Creating Access
  - Bridge Removal
  - Replacement Bridge Design
  - Replacement Bridge Construction
  - Permit Mitigation
- Lessons Learned

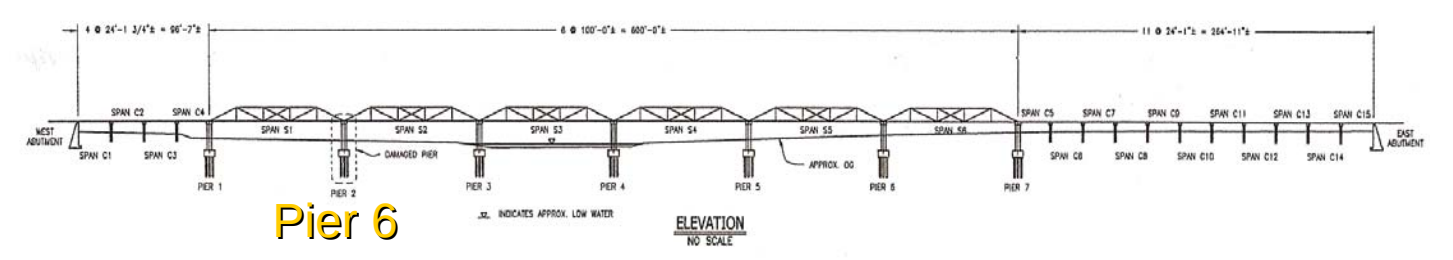


Introduction

- Major damage resulting from series of storms during last week of December 2005
- Bridge closed to traffic after local authorities observe deck sag and shift
- Structure Maintenance and Investigations on January 2 observes:
  - 0.2-m settlement at right gutter above Pier 6
  - Longitudinal misalignment of superstructure
  - Diagonal break in web wall
  - Tilted rocker bearings
- Closure creates hardship to the community
  - 15 mile detour
  - Public schools, residences and businesses divided by river

Introduction

Existing Bridge As-built Conditions



Pier 6

- 6 – 30.5m riveted pony truss spans on RC columns with curtain wall piers with west and east approach T beam spans on RC column bents
- Bridge built in 1932 carries 2400 ADT
- Piers supported on estimated 7.6m long timber piles
- Prior to event structure in fair to poor condition
- Low load carrying capacity and narrow roadway

Introduction

Existing Bridge As-built Conditions

- Local scour
- Channel degradation
- Hydraulic skew of 30 – 45 degrees
- Annual debris accumulation at piers
- Channel consist of gravel and sand at existing foundation depth

Introduction
Decision Made

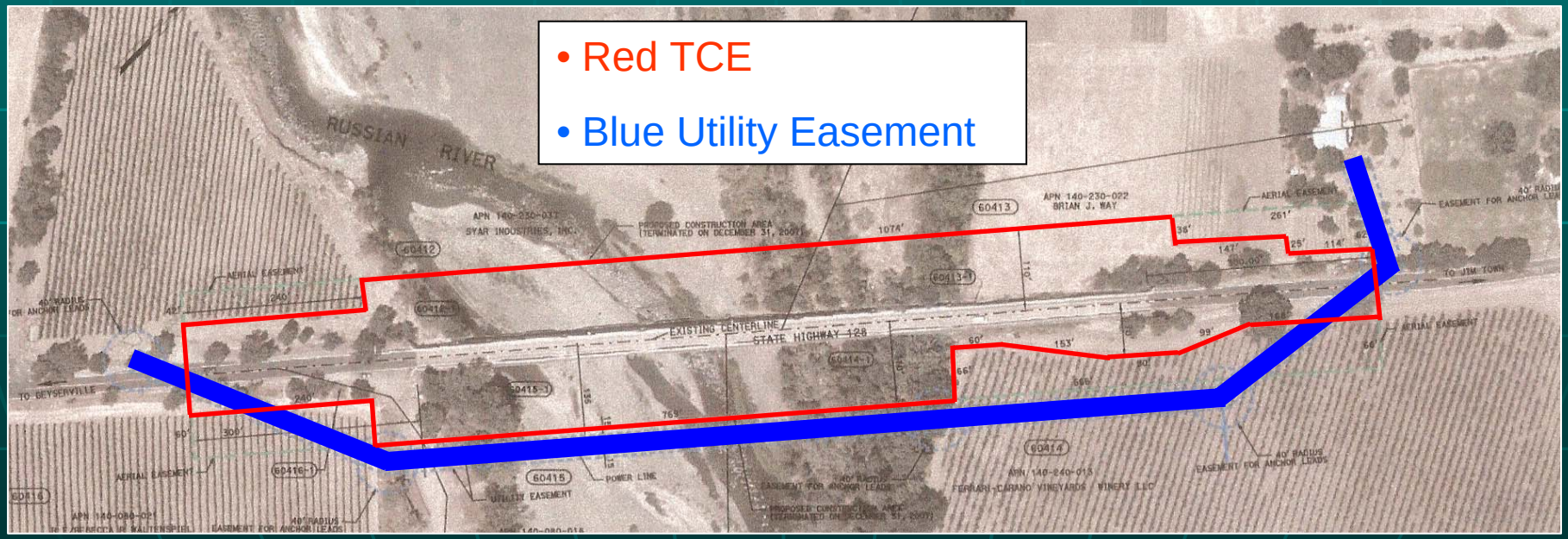
- Caltrans Management - Chief Engineer - Rick Land, District Director - Bijan Sartipi, Bridge Maintenance Engineer – Barton Newton made decision to replace bridge in late January:
  - New bridge to open to traffic within one year, possibly sooner
  - Prudent use of tax dollars to replace vs. repair
  - New structure built to latest safety standards
  - 100% Federal Funding reimbursement
  - Project to be in-house design

Creating Access
Many Obstacles

- Right of Way Agreements
  - 4 property owners
- Utility Relocation Required
  - Above Ground: Existing overhead power & cable
  - On Bridge: Existing natural gas line
- Access to Bridge
  - Construct work trestle upstream of damaged bridge
  - All season access

Creating Access
Right of Way

- Minimize construction foot print
- Obtain easement for work trestle & ultimate replacement project
- Obtain easement for utility relocation



Creating Access
Utility Relocation

- Overhead lines relocated from adjacent to upstream EOD to downstream utility easement

Creating Access
Utility Relocation

- PG&E Contractor bored 1000’ long 8” dia. hole up to 65’ deep under river
- Placed 4” permanent gas line
- Trestle pile work stopped due to vibration while boring pipe

Creating Access
Trestle Construction

- Provide all weather access & durability
- Width to accommodate bridge repair, removal & meet all future contract needs
- Minimize environmental impacts
- Minimize installation time

Creating Access
Trestle Construction

CC MYERS INC.

CONSTRUCTION TRESTLE

FOR THE

RUSSIAN RIVER BRIDGE AT GEYSERVILLE

DRAWING LIST

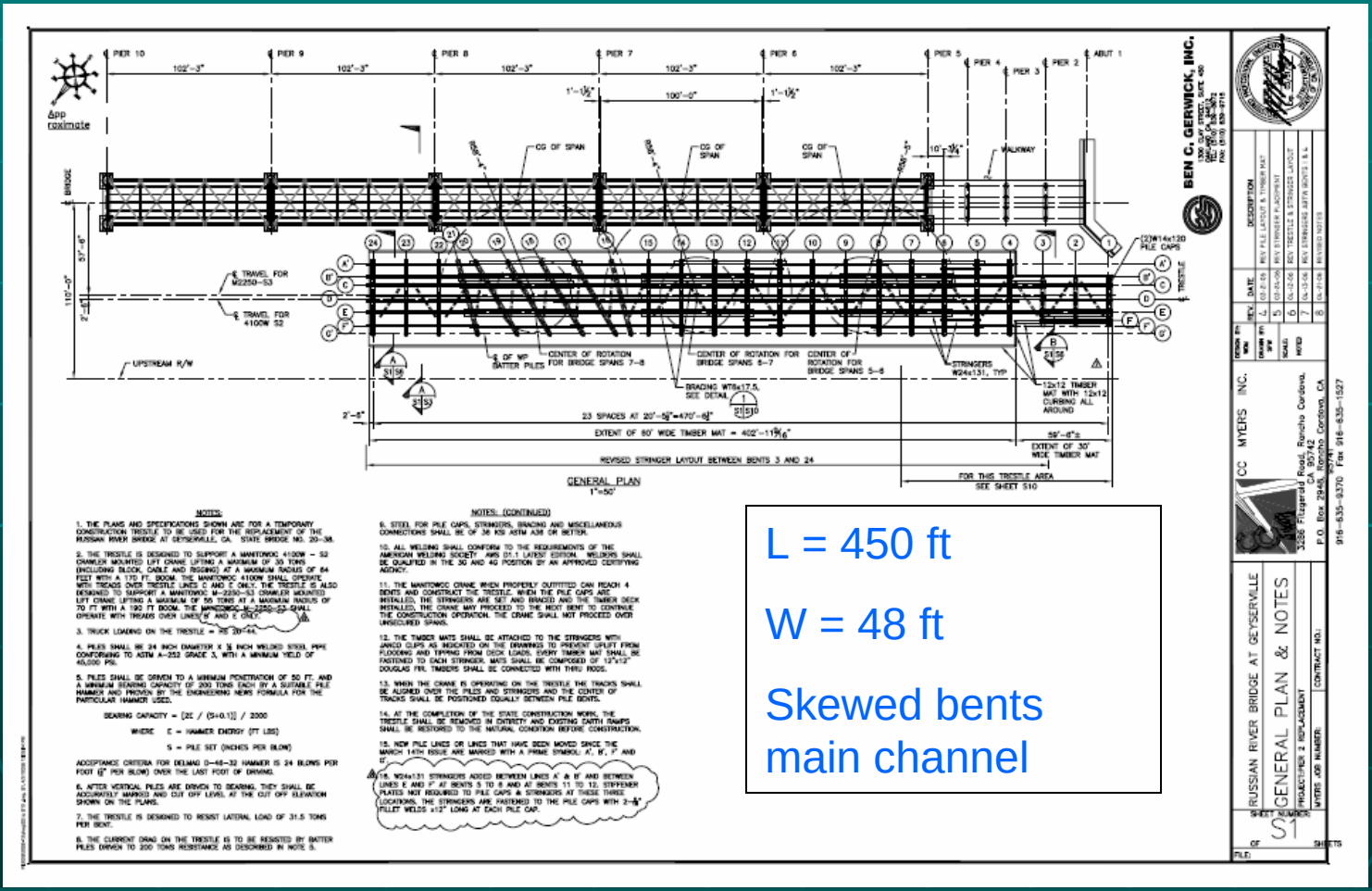
DRAWING NO.	REVISION	DATE	DRAWING DESCRIPTION
S0	8	APRIL 21, 2006	DRAWING LIST
S1	8	APRIL 21, 2006	GENERAL PLAN & NOTES
S2	5	APR 17, 2006	GENERAL PILE PLAN
S2A	1	MAR 21, 2006	PARTIAL PILE PLAN
S3	2	APR 17, 2006	SECTION A – 4100W CRANE
S3A	3	APR 21, 2006	SECTION A – M2250 CRANE
S4	1	APR 17, 2006	CONSTR 1 – 4100W CRANE
S4A	1	APR 17, 2006	CONSTR 1 – M2250 CRANE
S5	1	APR 17, 2006	CONSTR 2 – 4100W CRANE
S5A	2	APR 17, 2006	CONSTR 2 – M2250 CRANE
S6	3	APR 17, 2006	SECTIONS
S7	3	APR 17, 2006	SECTIONS & DETAILS – SHT 1
S8	3	APRIL 4, 2006	SECTIONS & DETAILS – SHT 2
S9	2	APR 17, 2006	SECTIONS & DETAILS – SHT 3
S10	5	APRIL 13, 2006	TYPICAL BRACING DETAILS
S11	2	MAR 24, 2006	PILE CAP DETAILS – SHT 1
S12	4	APRIL 20, 2006	PILE CAP DETAILS – SHT 2
S13	1	APRIL 20, 2006	PILE CAP DETAILS – SHT 3
S14	1	APRIL 20, 2006	PILE CAP DETAILS – SHT 4
S15	1	APRIL 20, 2006	PILE CAP DETAILS – SHT 5
S16	1	APRIL 20, 2006	PILE CAP DETAILS – SHT 6

Design Build

21 sheets

8 major rev

Creating Access
Trestle Construction

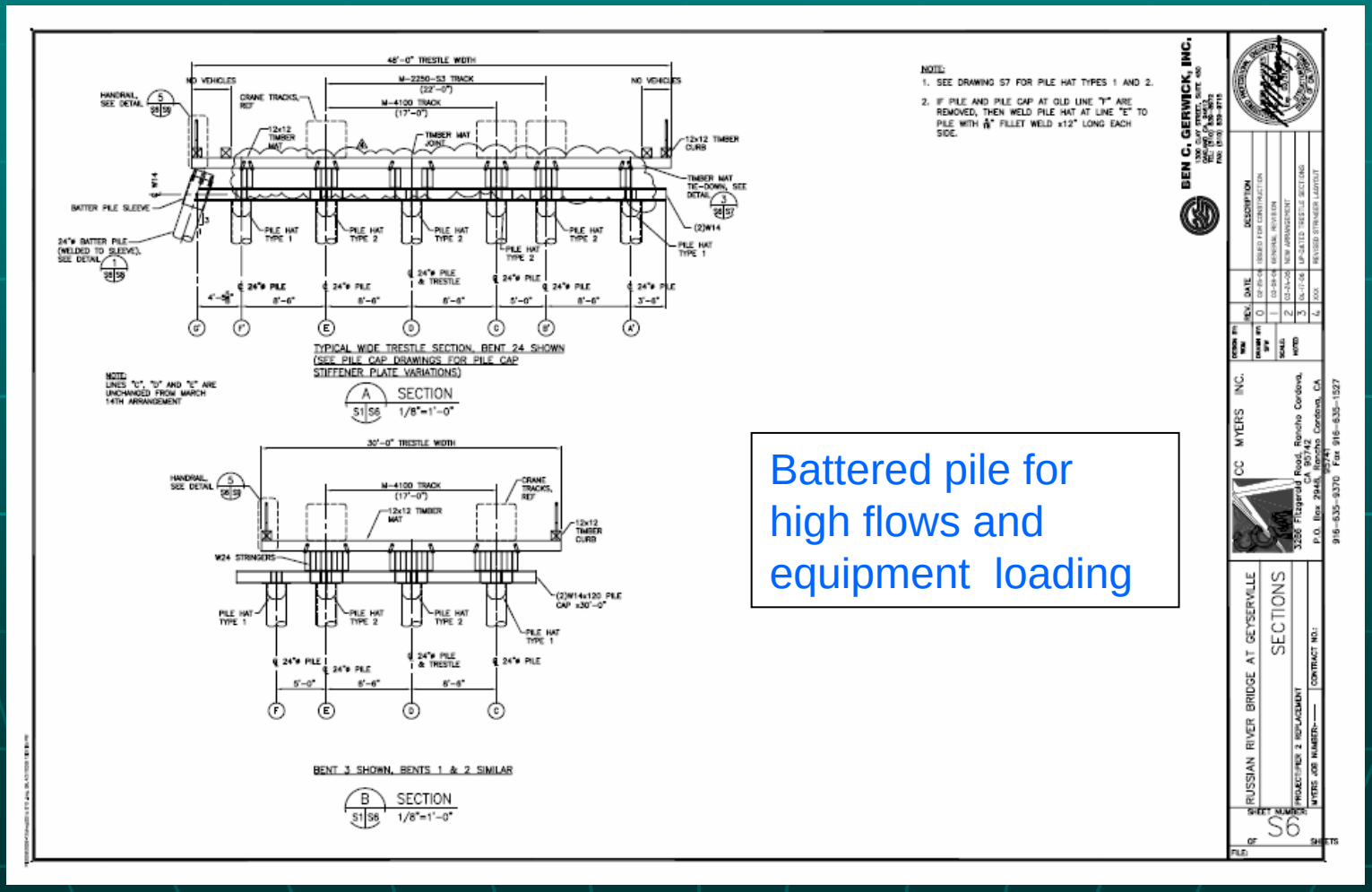


L = 450 ft

W = 48 ft

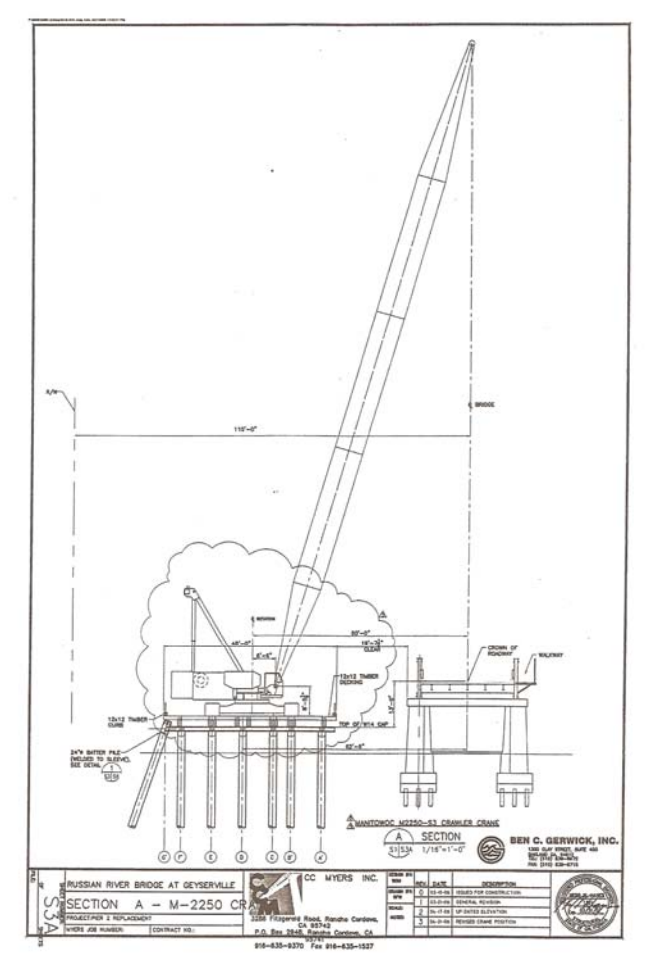
Skewed bents main channel

Creating Access
Trestle Construction



Battered pile for high flows and equipment loading

Creating Access
Trestle Construction



Creating Access
Trestle Construction

- Trestle installation started from west bank using Manitowoc 4100W
- Template installed to support 48” isolation casings
- Isolation casing required by agencies to minimize sound vibration from driving 24” trestle pipe piles due to presence of endangered Coho Salmon and threatened Coastal Steelhead
- Hydroacoustic monitoring performed

Creating Access
Trestle Construction

- Trestle started from east bank to accelerate progress using Manitowoc M2250
- East bank crane provided greater reach & all weather production
- High water in mid-April threatens access & slows trestle progress

Creating Access
Trestle Construction

- Setting trestle battered pile collar
- Installing east side trestle piles through isolation casing
- Piles installed using diesel hammer, vibratory hammer & hydraulic hammer
- Pile driving records maintained
- PDA performed to reduce ENR bearing requirement on 200 ton trestle piles

Creating Access
Trestle Construction

- Trestle construction completed early May after major bridge removal started

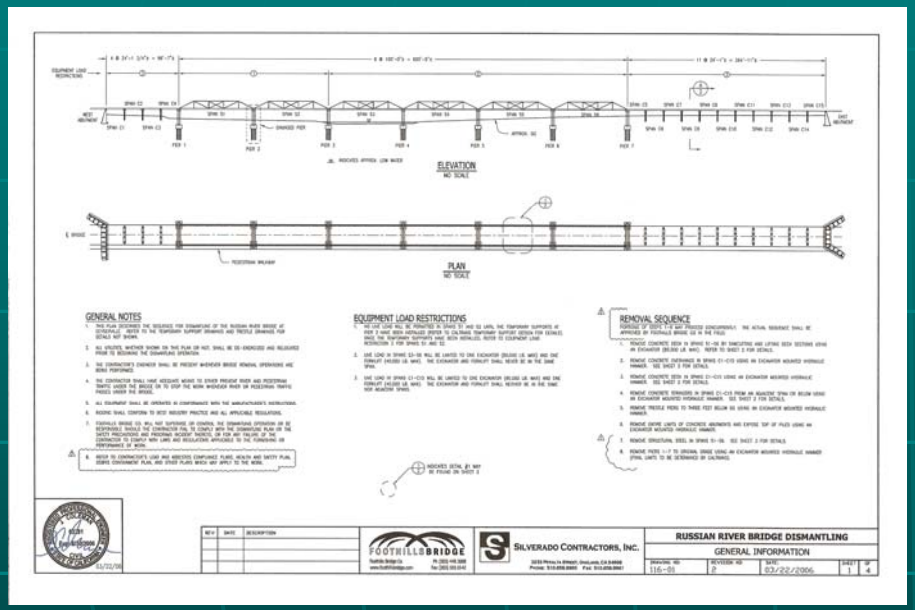
Bridge Removal

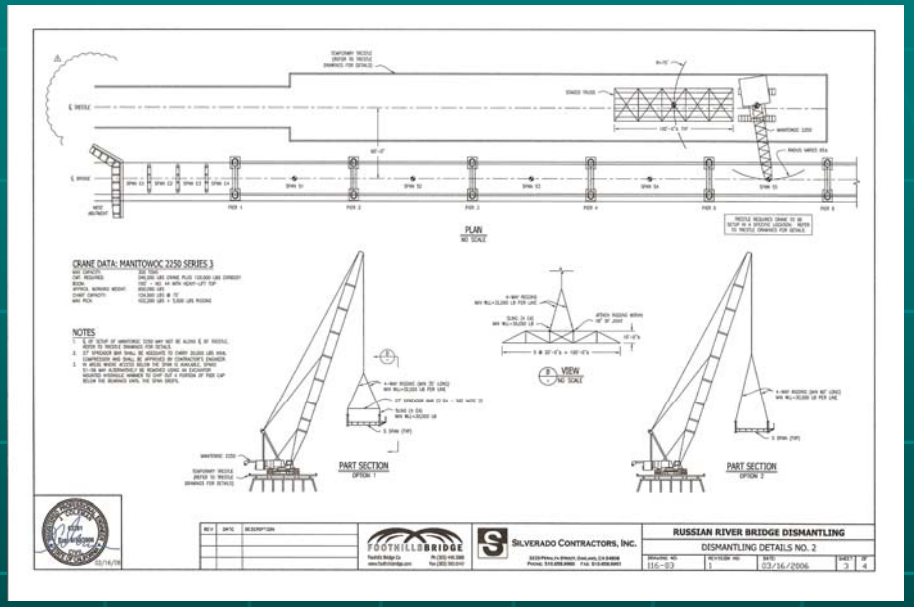
- Red Lead & Asbestos Surveys
- Bridge Removal Plan
- Bridge Removal CCO
- Superstructure Removal
- Foundation Removal

Bridge Removal
Red Lead & Asbestos

- Trace (<1%) amounts of asbestos found in concrete aggregate
- Required Asbestos Safety and Health Plan and contractor certification
- Required Lead Compliance Plan

Bridge Removal
Bridge Removal Plan





- Crane to lift 100’ truss spans

Bridge Removal
Bridge Removal CCO

Extra Work at Agreed Lump Sum:

- The contractor agrees to accept and receive the sum of **$1,354,500.00** as full compensation for furnishing and mobilizing all labor, equipment, materials, and obtaining all permits necessary to remove the Russian River Bridge Br. No. 20-0038, on Rte 128 in Geyserville to the limits as stated within this Contract Change Order and dispose of the debris outside the State Right of Way, as approved by the Engineer. This sum constitutes full compensation for all direct and indirect costs, including all markups, and all incidentals and consumables for this work. All work shall be performed in accordance with all applicable sections of the Standard Specifications, contract service documents, approved demolition plan, debris containment plans, Lead Compliance Plans, Asbestos Health and Safety Plan and this Contract Change Order. Additional terms of this Contract Change Order include the following:

- No additional compensation shall be made for any impact due to the loss of production and delays resulting from the construction of the temporary trestle. Both the Contractor and the Subcontractor shall coordinate all work necessary to complete the bridge removal work within the time of **25 calendar days**. All costs of overtime hours necessary to complete the demolition work within 25 calendar days from the start date are included in the agreed price of this Contract Change Order. For each day past the allotted 25 calendar days, **the Contractor shall receive $32,000 less** in total payment for this work. The area between the existing bridge pier 11 and the most easterly abutment shall be completed as the first order of bridge removal work. Any demolition work activities remaining after May 01, 2006, on the east river bank shall be coordinated with the new bridge replacement contractor.

Bridge Removal
Superstructure

Bridge Removal
Superstructure

- Hydraulic shears minimize torching

Bridge Removal
Foundation

Bridge Removal

Pier 5 Removal (Video)

Replacement Bridge Design

- Project Constraints
- Design
- State Furnished Material
- Advertisement & Bid Opening

Replacement Bridge Design
Project Constraints

- Environmental
  - no falsework in channel
- Tight schedule
  - Bridge to re-open before schools open - August
  - 5 weeks to PS&E, bid emergency contract
  - Availability of US steel for large diameter pipe piles
- Bridge to match existing profile, span lengths & vertical clearance

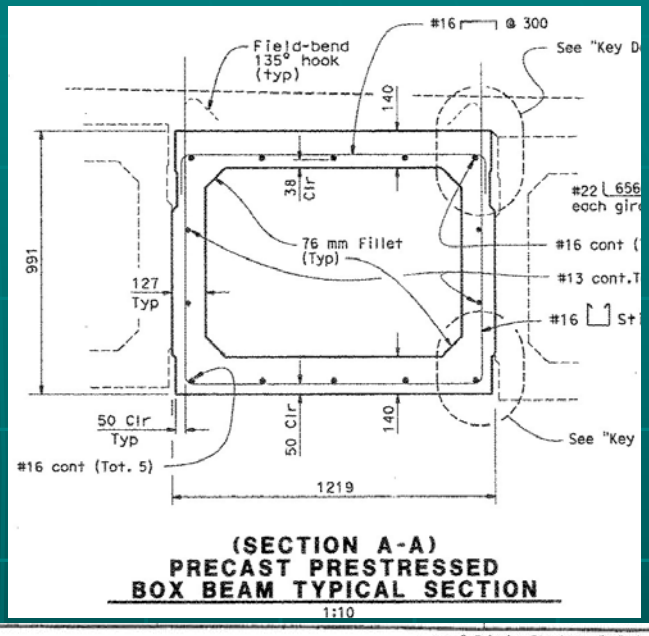
Led to **Precast Superstructure as** most suitable type

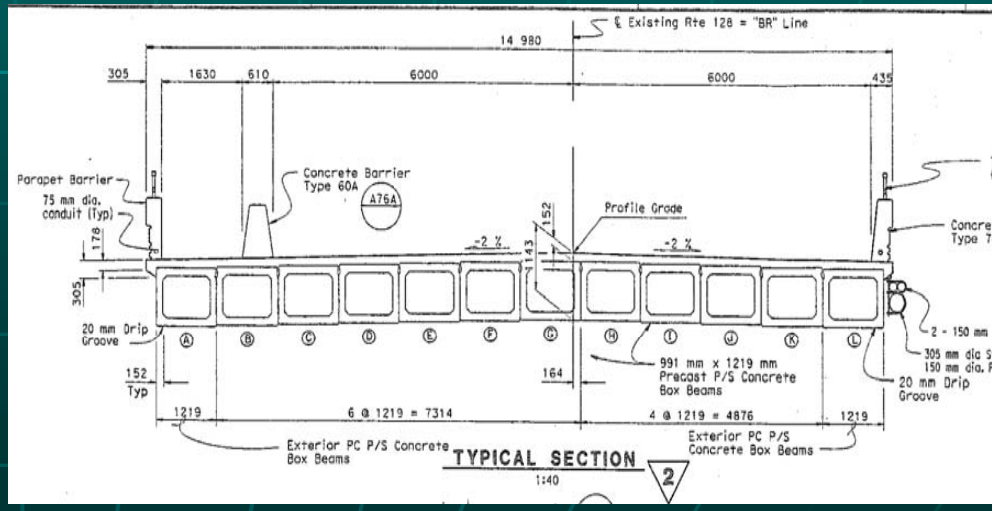
Replacement Bridge Design
Design

- New Bridge design started first week of February, 2006
- New structure with 8 – 31.242m and 2- 24.387m spans; overall length of 298.71m
- Type Selection
  - Main issue tight span to depth ratio of 0.037
  - No falsework in channel
  - Availability of pipe piles
- Effort made to produce a biddable design
  - Standard sections
  - State furnished 1219mm diameter pipe piles

Replacement Bridge Design
Design - Superstructure

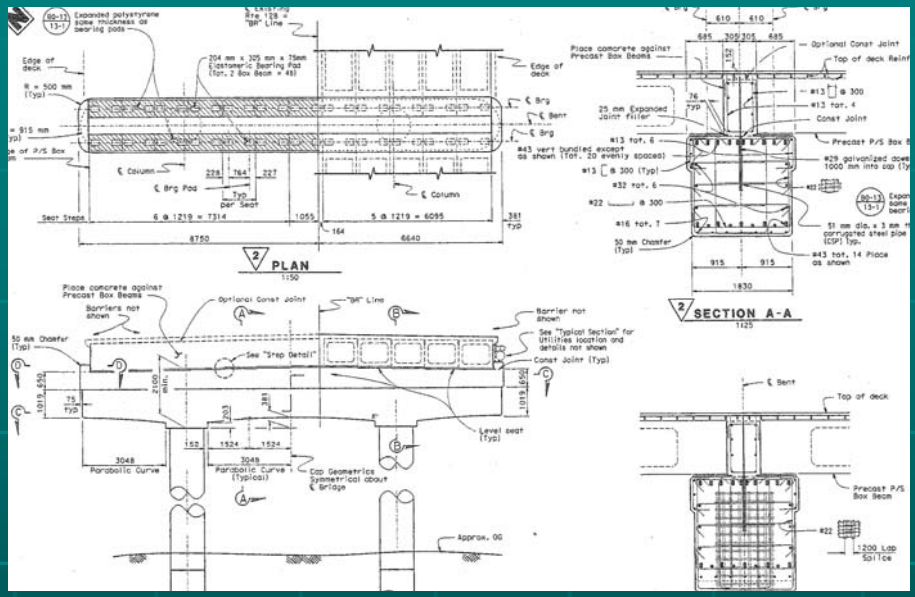
- Adjacent standard **1.219m wide** precast AASHTO box girder section - depth of 991 mm - 152mm CIP RC deck selected
- Total of 12 precast box girders per span

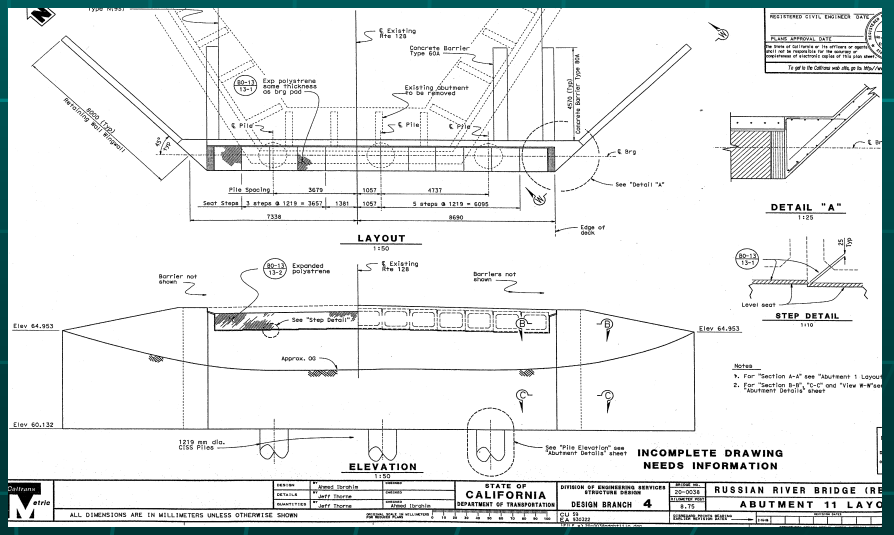




Replacement Bridge Design
Design - Substructure

- Two – 1220mm diameter column with drop bent cap
- CISS Piles
- High scour conditions –scour depth varies from 7m – 12m
- High seismic area with peak ARS of 1.6g
- Superstructure pinned at bents
- Abutment designed as “stand alone”

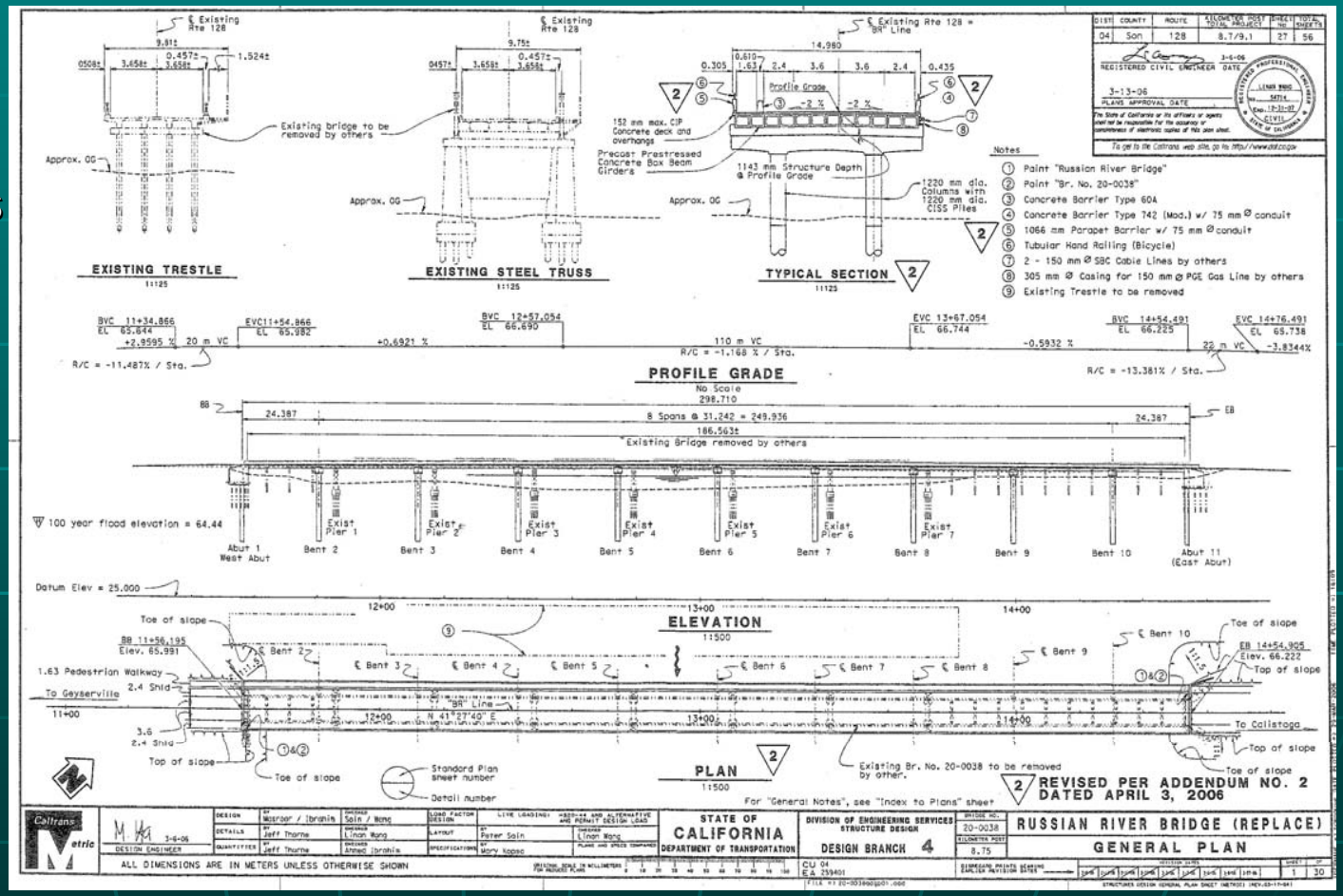




Replacement Bridge Design

Highlights:

- PS&E in 5 weeks
- Mid-March biddable design package RTL
- State furnished pipe piles
- A+B Contract



Offices of Structure Construction

Replacement Bridge Design
State Furnished Materials

- Per contract SP 1220mm pipe pile to be State furnished
- XKT Engineering, Inc Mare Island
- All pile to be available by June 20th
- 1100m of pile to be provided

Replacement Bridge Design
Advertisement & Bid Opening

- Contract advertised March 17
- Total contract 225 days
- Three Phase Contract
  - Phase 1: Mobilization, submittal review, material procurement
  - Phase 2: Completing replacement bridge – B portion of bid max. 134 days
  - Phase 3: All remaining work
- Bids open April 11 to low bid contractor
  Total A+B = $14.3 million
- Contractor bids 80 days for phase 2

Replacement Bridge Construction

- Superstructure CRIP
- Work Progress Timeline
  - May
  - June
  - July
  - August
  - Opening day

Replacement Bridge Construction Superstructure CRIP

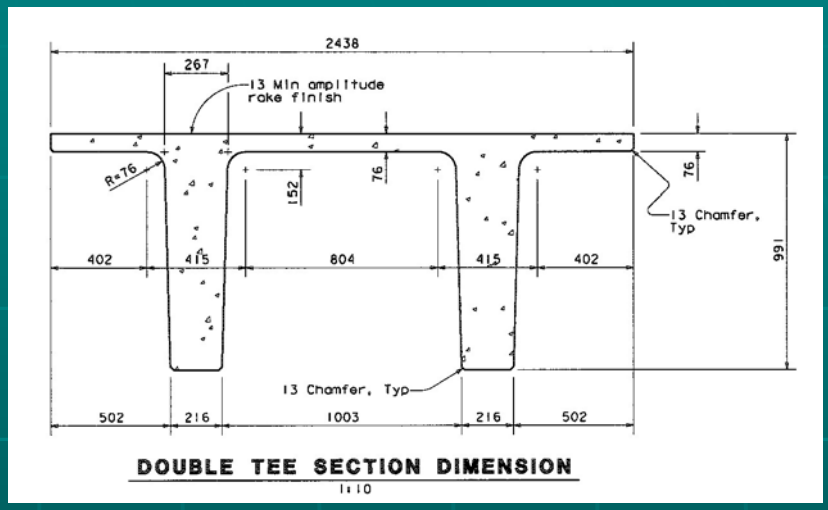
- April 12, Contractor's team submits design change CRIP
- Initial CRIP meeting held one day after BOD
- Proposed to use different type of superstructure:
  - 2.438m wide precast double -T prestressed concrete girders
  - Non-standard double -T section
  - **Twice** as wide & half as many girders, 6 per span
  - Use of two stage post-tensioning to maintain continuity under CIP RC deck load & live loads

Replacement Bridge Construction
Superstructure CRIP

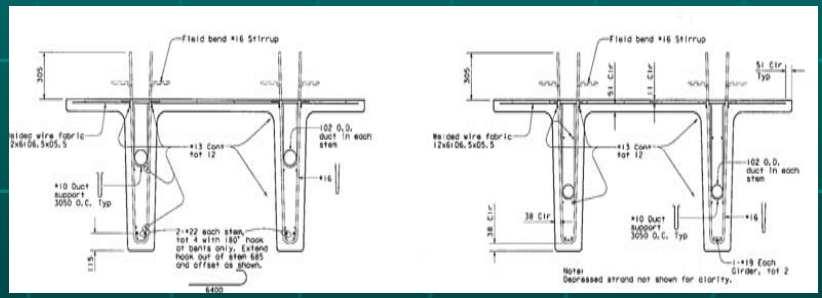
- Total CRIP savings $641.5K

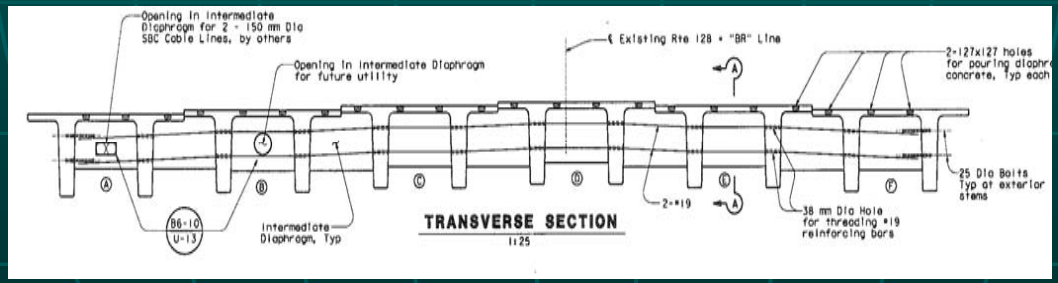
Russian River Bridge Replacement
Contract 04-2S9404
Box Beam/Double-Tee CRIP Proposal

DESCRIPTION	ORIGINAL Box Beams	PROPOSED Double-Tees	SAVINGS
Pre-Cast Girders	$2,340,000	$1,493,430	$846,570
Post-Tensioning	$35,000	$180,400	-$145,400
Rebar	$926,000	$926,000	$0
Joint Seal	$22,500	$59,114	-$36,614
Int diaphragms (308 each)	$0	$89,028	-$89,028
Girder Erection	$156,000	$50,370	$105,630
Structure Concrete Bridge	$3,096,000	$3,135,600	-$39,600
	$6,575,500	$5,933,942	$641,558
Difference		-$641,558	
Credit to Caltrans		-$320,779	
Credit to CCM		-$320,779	



DOUBLE TEE SECTION DIMENSION
1:10





TRANSVERSE SECTION
1:25

Replacement Bridge Construction Superstructure CRIP

Construction Stages

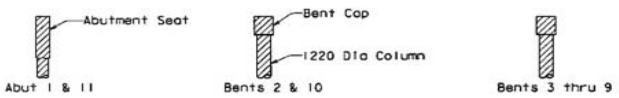


FIGURE 1

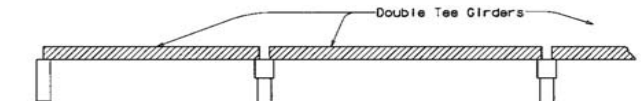


FIGURE 2

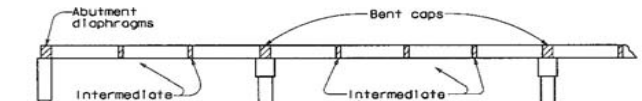


FIGURE 3

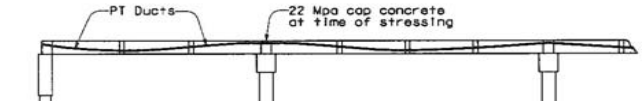


FIGURE 4

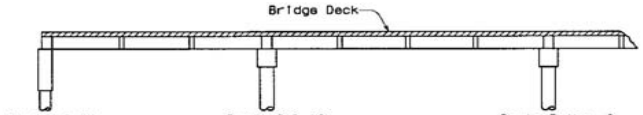


FIGURE 5

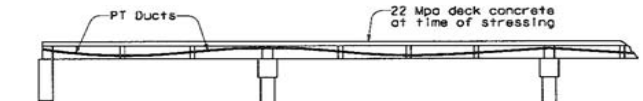


FIGURE 6

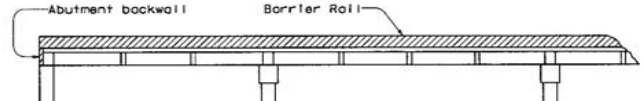


FIGURE 7

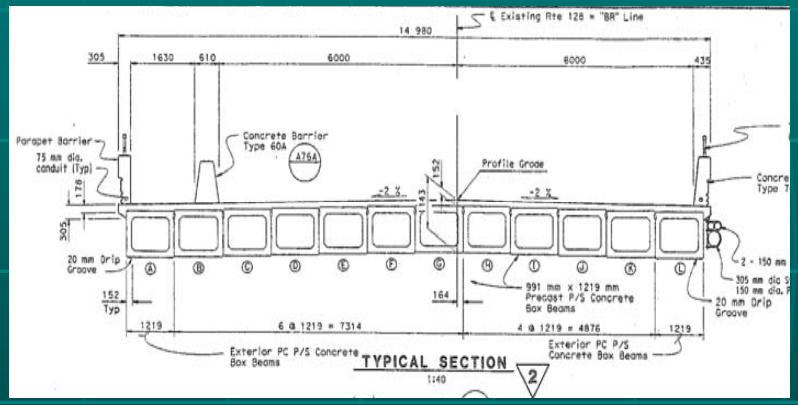
Two stage post-tensioning to maintain continuity

Replacement Bridge Construction Superstructure CRIP

Cons:

Extra time & cost due to:

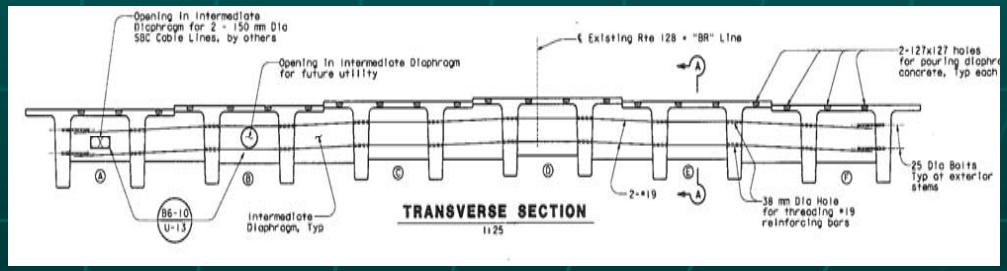
- Alternative Design – not typical design
- Build new forms for non-standard double T section
- Two stages of post-tensioning operations in field
- Grouting



Pros:

Reduced time & cost due to:

- Half as many girders
- Transportation
- Erection
- Less mild steel requirement over bents



Work Progress Timeline
May

- 13790 kn load test
- Passed with 23mm settlement
- D100 –13 hammer, piston weight = 22.1K

Work Progress Timeline
June

Work Progress Timeline
June

Work Progress Timeline
June

Work Progress Timeline
July

Work Progress Timeline
July

Work Progress Timeline
July

Work Progress Timeline
August

Work Progress Timeline
August – Opening Day

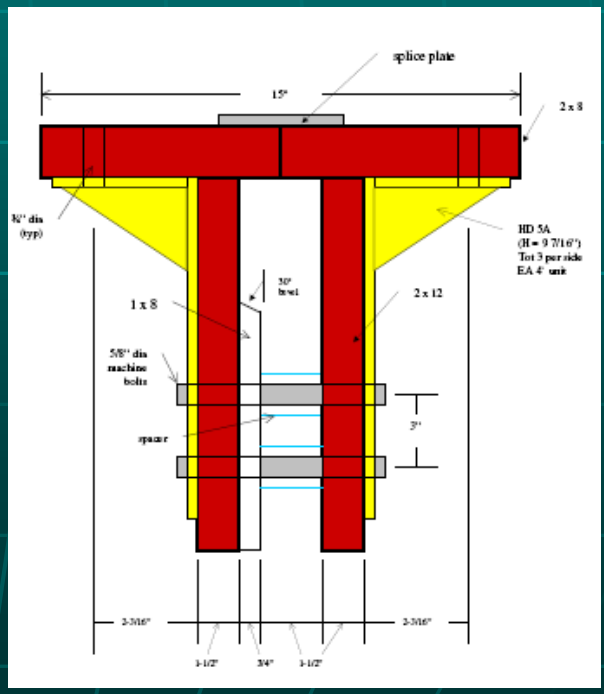
- August 17, 2006 bridge opens to traffic

Permit Mitigation

- Offsite stream mitigation for construction impacts
- Re-planting lost vegetation
- 40 redwood bat structures installed

Permit Mitigation

- Bat house design criteria
  - In house, original design
  - Lightweight
  - Placement in areas away from regular inspection zones
  - South side of bridge
  - 4’ long / 5 per bay



Lessons Learned

- CRIP approval process can be accelerated
- Partnering with contractors and stakeholders results in successful projects
- Site access can be achieved with good planning
- Site safety is number one priority

Lessons Learned

- CISS piling
  - June 15 subcontractor A drills out Pile 6R to depth of 95’ leaving 25’ soil plug. Bottom of hole appears dry. Water table near top of pile elevation.
  - 5’ seal course tailgated into hole
  - June 23 rebar cage set & pile concrete placed by subcontractor B
  - Pile concrete pumped into pile
  - Inspector & contractor observe water being displaced from pile top
  - subcontractor proceeds until “good” concrete observed being displaced
  - Pile acceptance withheld until full length core can prove “good” concrete
  - Subcontractor spends 2 weeks trying to verify competent concrete exist
  - Competent concrete not found after 20 feet
  - All concrete & rebar removed to seal course elevation
  - 2nd seal course placed, new pile placed in dry
- **Remaining piles charged with water prior to placing seal course**

Lessons Learned
Pile at Bent 6 R

Lessons Learned

- Settlement at approaches
  - Observe excessive settlement at east approach after first rain in December
  - Geotechnical recommends injecting lightweight fill
  - Hollow stem auger borings & penetrometer test show area within 10’ of abutment & retaining walls have voids & minimal density
  - Soil saturated & fines appear to have displaced into permeable material behind walls
  - Expanding polyurethane injected into approach fill

Lessons Learned
Approach Compaction

Lessons Learned

- Pre-cast girder deflection
  - No camber built into girders
  - Negative deflection remains
  - PT force increased after girders at site

Thank You!

FEB 12 2007

CALIFORNIA DEPARTMENT OF TRANSPORTATION