American Concrete Institute

Use of Heavy Equipment on Existing Bridges During Construction

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Agenda

- About Kiewit
- Risk Mitigation
- Design Criteria
- Loading
- Methods
- Design Best Practices

ABOUT KIEWIT

- The Kiewit Difference

  People

  Integrity

  Excellence

  Stewardship

RISK MITIGATION

RISK MITIGATION

- We Have Risk and we must take risk mitigation measures to keep the public and workers safe

"It is the Company's policy to properly and systematically address the design and construction of temporary structures and other construction devices used in our operations. When the design is not provided by the owner, the liability assumed by the Company requires even greater attention to minimize the risk of failure. The design and construction of temporary structures and other construction devices requires thoughtful risk analysis and risk mitigation measures that begin with appropriate selection of designers, an independent review of the resultant design, and proper inspection during construction.

Districts are to follow the Design and Construction of Temporary Structures and Construction Devices Manual."

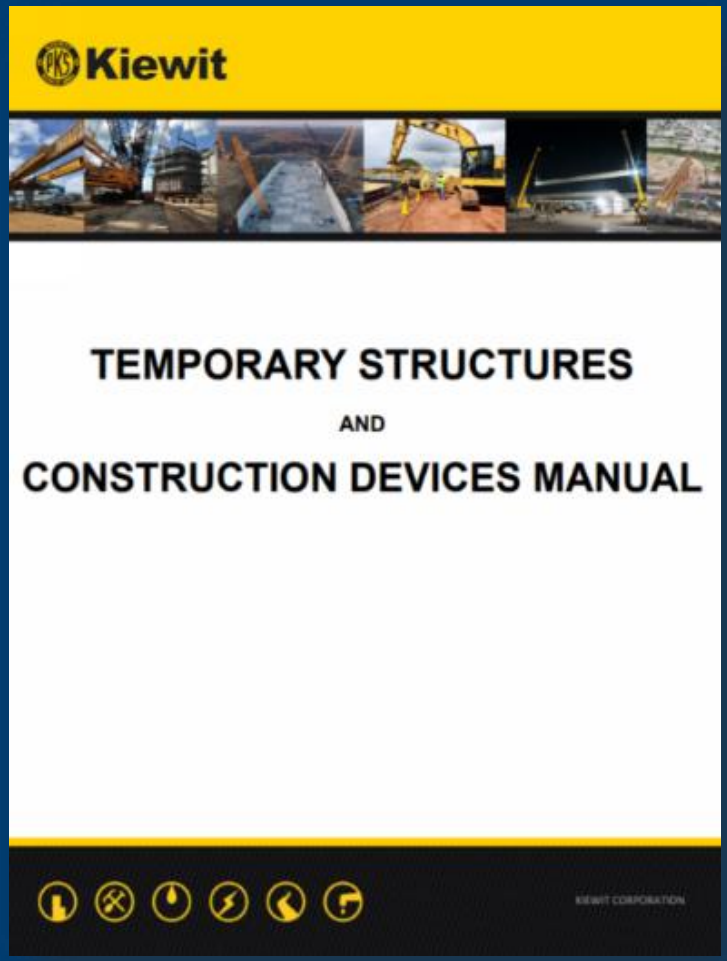
RISK MITIGATION

- TSCD

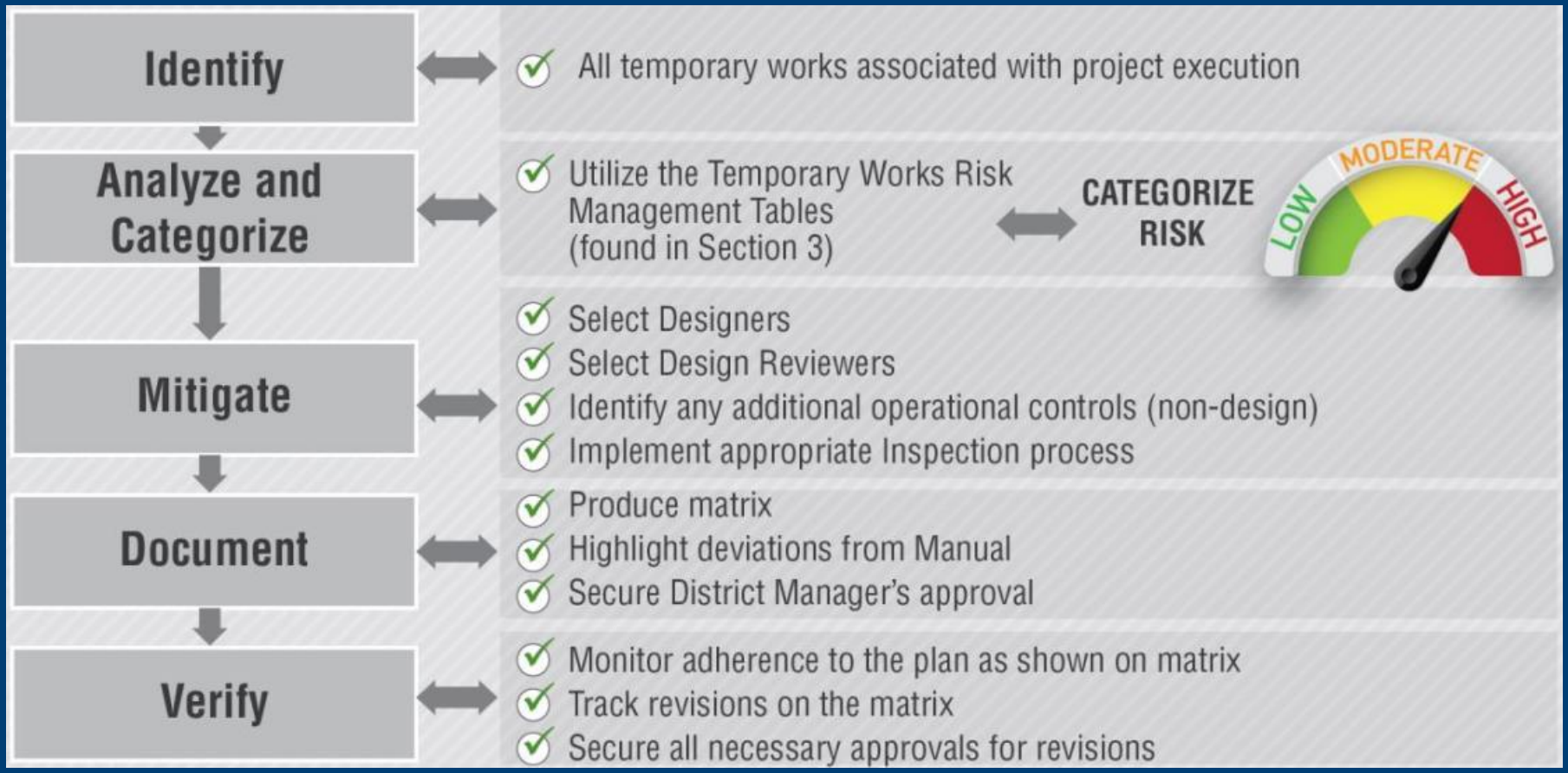
  Temporary Structures and Construction Devices – elements that are designed, developed, and constructed for the sole purpose of aiding in the construction of permanent works.

RISK MITIGATION

- CONSEPTUALIZE
- DESIGN
- DESIGN REVIEW
  INSPECT and VERIFY



RISK MITIGATION



RISK MITIGATION

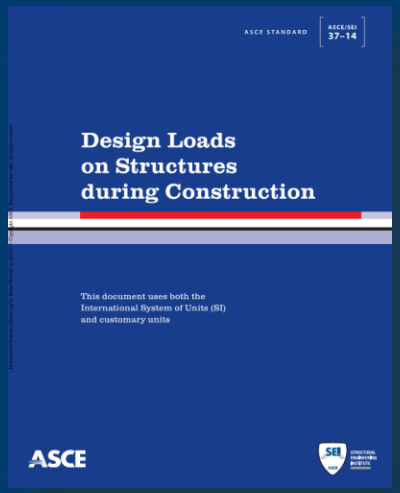
KIEWIT CORPORATION
TEMPORARY STRUCTURES AND CONSTRUCTION DEVICES MANUAL | REV 10.0

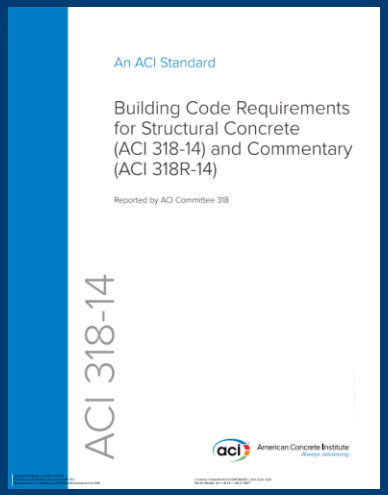
TABLE 3.18: PERMANENT STRUCTURES – TEMPORARY CONDITION DURING CONSTRUCTION / ERECTION

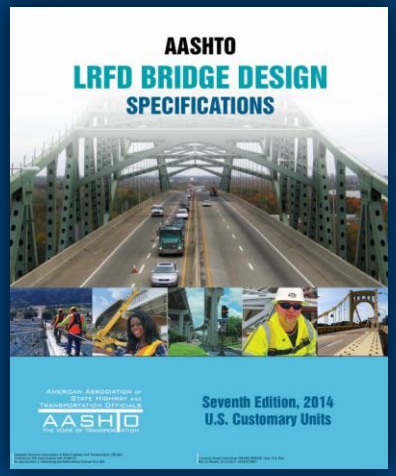
Risk Level	Attributes	Designer	Design Reviewer	Inspector(s)
Low (See Note 1)	✓ Stresses and loading during construction of permanent works may impact structure differently from final loading conditions. ✓ Overhang brackets on deck pours need to have anchorages and overturning forces on girders reviewed.	Project Personnel to confirm with client that temporary conditions will not adversely affect structure Documentation required	Not required	No review of design process required in field. Erection checking covered elsewhere.
Moderate	✓ Structures where stability of individual members during construction needs to be reviewed, but overall structure stability is not at risk. ✓ Handling of long pre-cast or steel plate girders. Stability and external bracing require Design and Design Review. ✓ Erection of structural steel buildings, frames before final bracing is installed.	KIE	Not required	Experienced District Personnel to review construction designs for completeness and constructability
		District PE **OR** Consultant A	KIE **OR** Consultant B	
High	✓ Any structure that is unstable in a global manner until final erection is complete. ✓ Steel truss cantilever bridge erection ✓ Segmental pre-cast and CIP bridge structures ✓ Box girder bridges requiring cast in place deck for stability ✓ Long-span bridge girders or trusses ✓ Exposure to public in partially erected condition	Erection procedures designed by KIE	Consultant	Experienced District Personnel to review construction designs for completeness and constructability
		Erection procedures designed by Consultant A	KIE **OR** Consultant B	

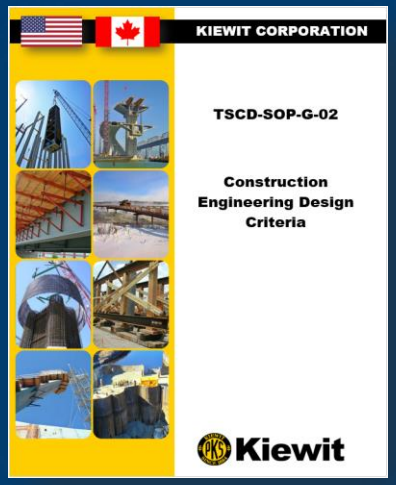
DESIGN CRITERIA

- ASCE 37-14
- ACI 318
- AASHTO LRFD Bridge Construction Spec.
- AASHTO Guide Design Spec. for Bridge Temp. Works
- Others: AREMA, Kiewit CEDC



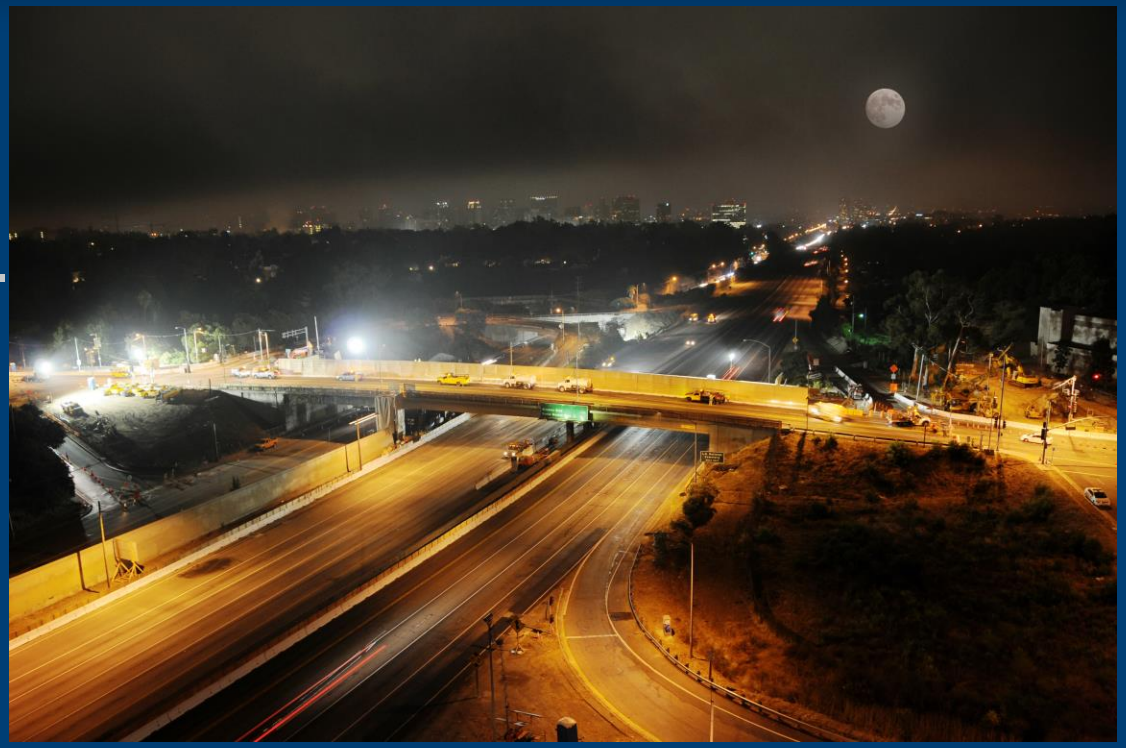






LOADING

- DEAD LOADS
  - Structure Self Wt.
  - Wearing Surface
  - Barriers
  - Utilities



AASHTO 3.4.2.1: DC = 1.25

Evaluation of Strength III for max. force effect during construction

LOADING

- LIVE LOADS

  Equipment Self Wt.

  Dynamic Impact

AASHTO 3.4.2.1: LL = 1.50, IM = 1.33

Evaluation of Strength III for max. force effect during construction

LOADING

- EQUIPMENT

  -Excavators on Superstructure (If necessary)

  -Haul Trucks

  -Ground Based Excavators

  -Ground Based Cranes

LOADING

- EQUIPMENT
  - Excavators ~ 40 to 100+ kip (Larger yields more economical operation)
  - Compare to AASHTO Truck 72 kip (Greater need for engineering)
  - Consider both uniform track and concentrated point loading

METHODS

- DECK REMOVAL
  - CORE HOLES (INITIAL)
  - DECK SLOTTING (LEAVE ENOUGH FOR GIRDER STABILITY)
  - HYDRAULIC HAMMER ATTACHMENTS
  - DIAMOND BLADE SAWS (LIMITED)
  - DIAMOND WIRE SAWS (PREFERRED)

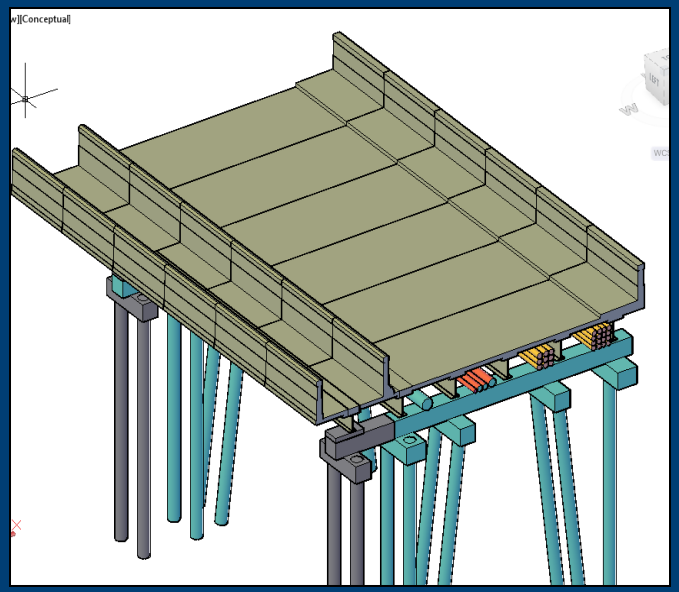
METHODS

METHODS

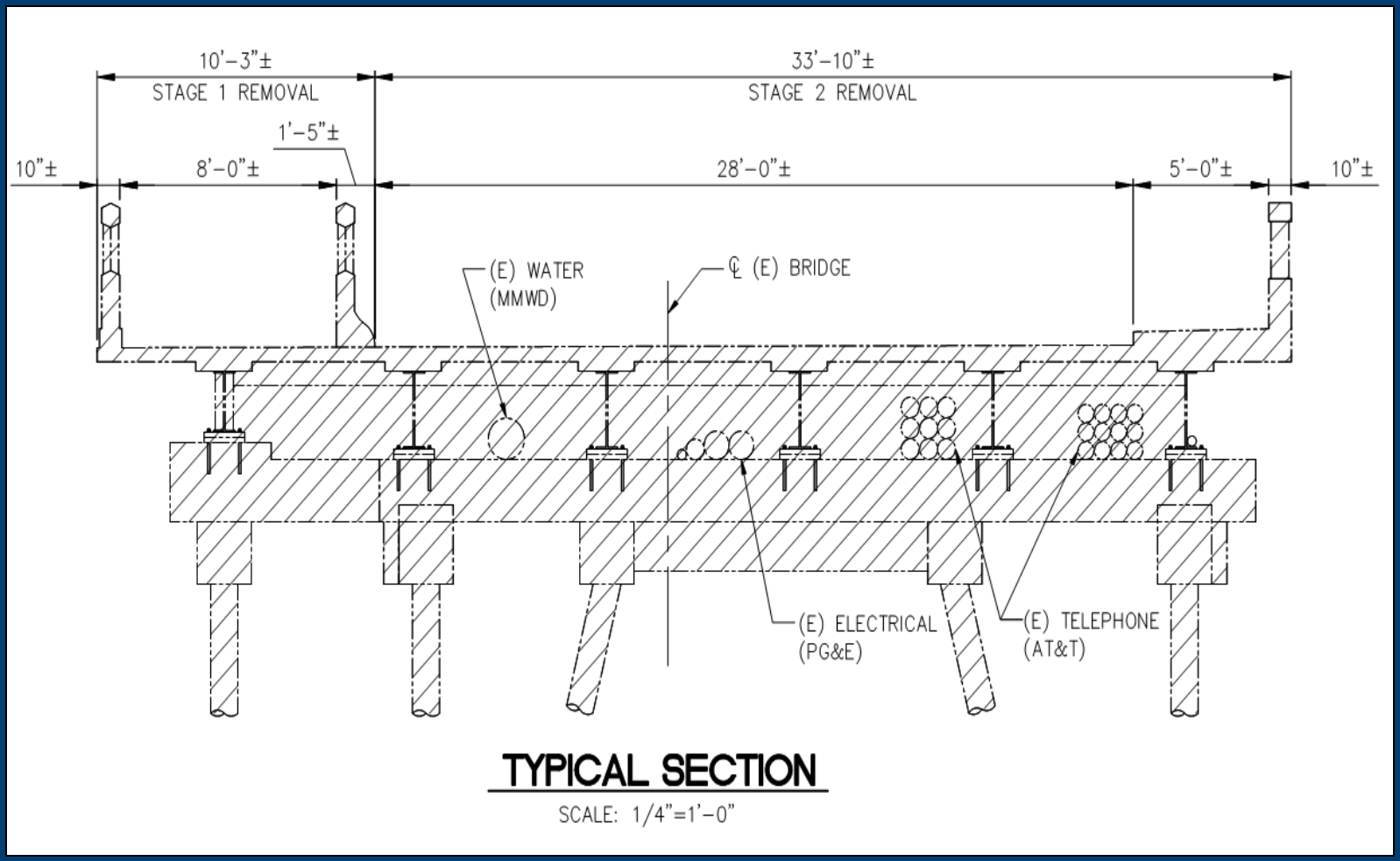
METHODS

METHODS

- STAGE SEQUENCES
  - EVALUATE EVERY STEP
  - REDUCED WIND EXPOSURE
  - EXAMPLE SHOWING A TYPICAL STAGE DEMO

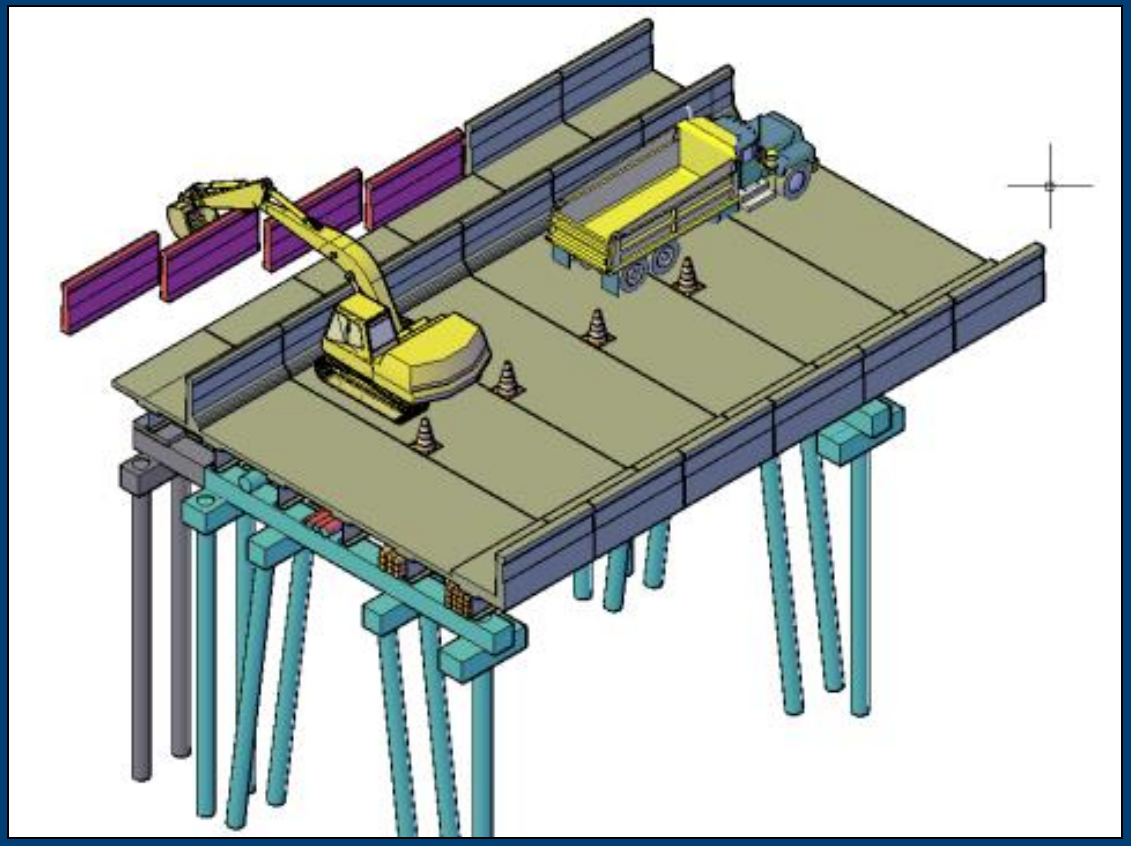


METHODS


10'–3"±
STAGE 1 REMOVAL
33'–10"±
STAGE 2 REMOVAL
1'–5"±
10"±
8'–0"±
28'–0"±
5'–0"±
10"±
(E) WATER
(MMWD)
℄ (E) BRIDGE
(E) ELECTRICAL
(PG&E)
(E) TELEPHONE
(AT&T)
TYPICAL SECTION
SCALE: 1/4"=1'–0"

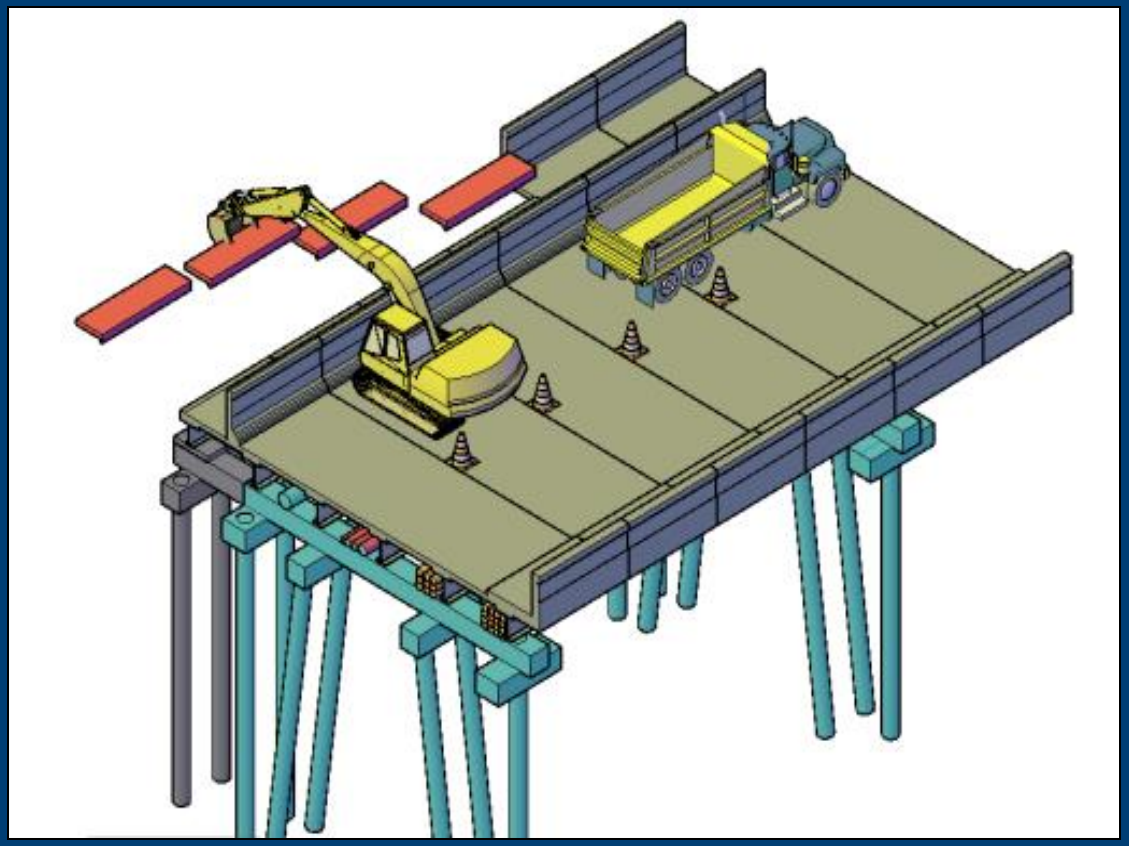
METHODS

Stage 1 – remove outer bike lane rail – Saw cut in ~10’ pieces – pick with Excavator through existing railing holes and load directly into truck



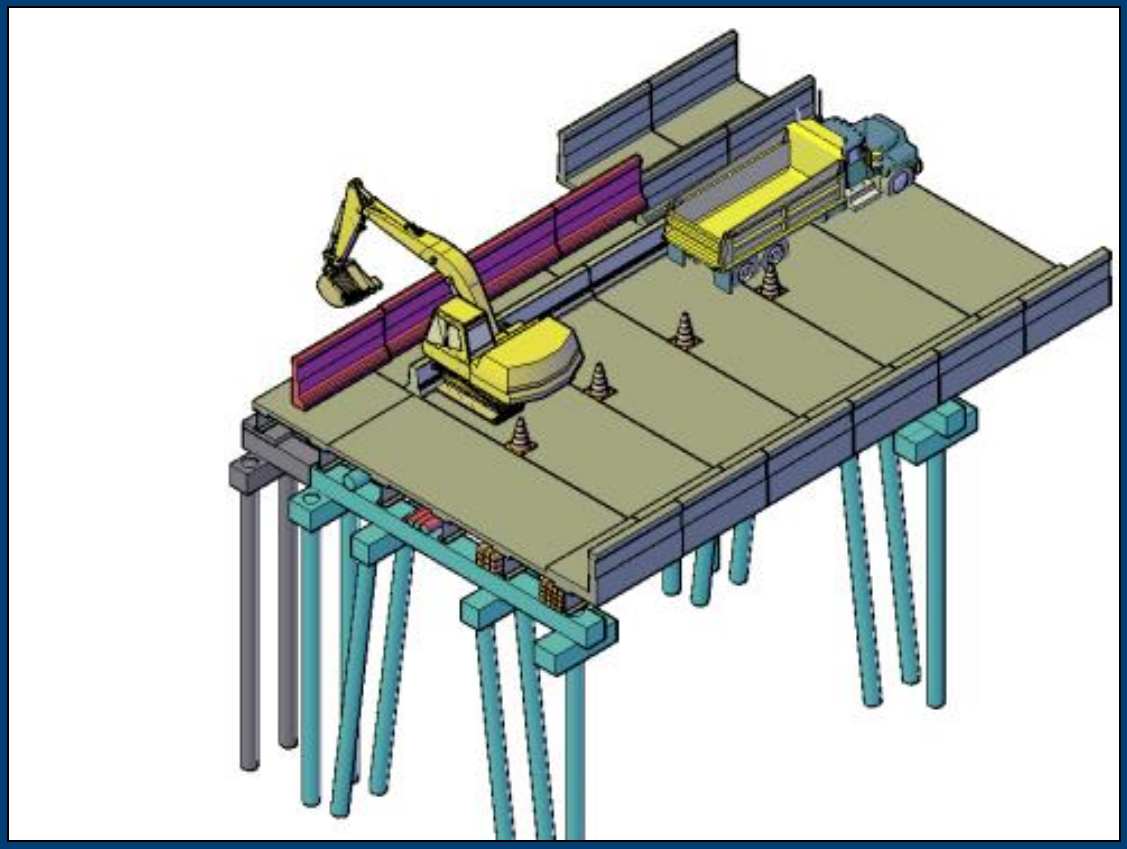
METHODS

Stage 2 – remove outer bike lane deck – Saw cut into ~10’ long pieces – pick with excavator and load directly into truck



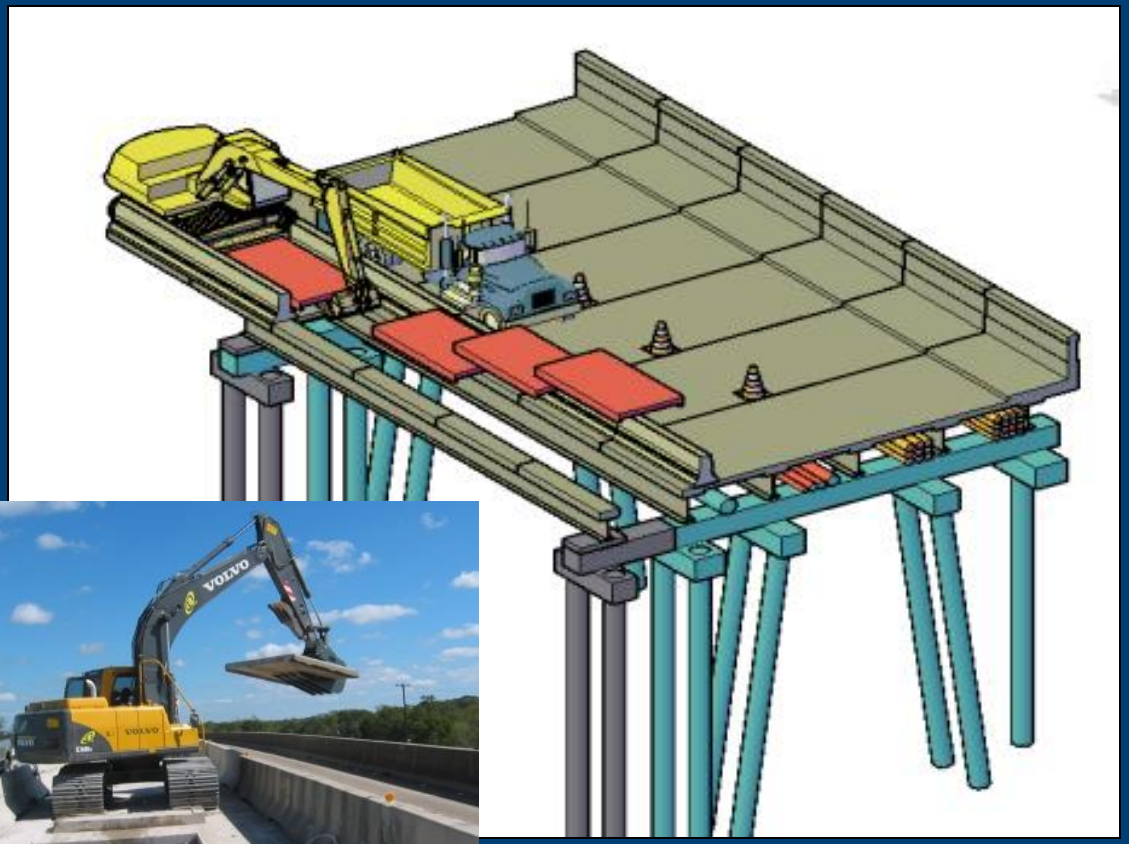
METHODS

Stage 3 – remove inner Barrier Rail – Hoe ram excavator demo



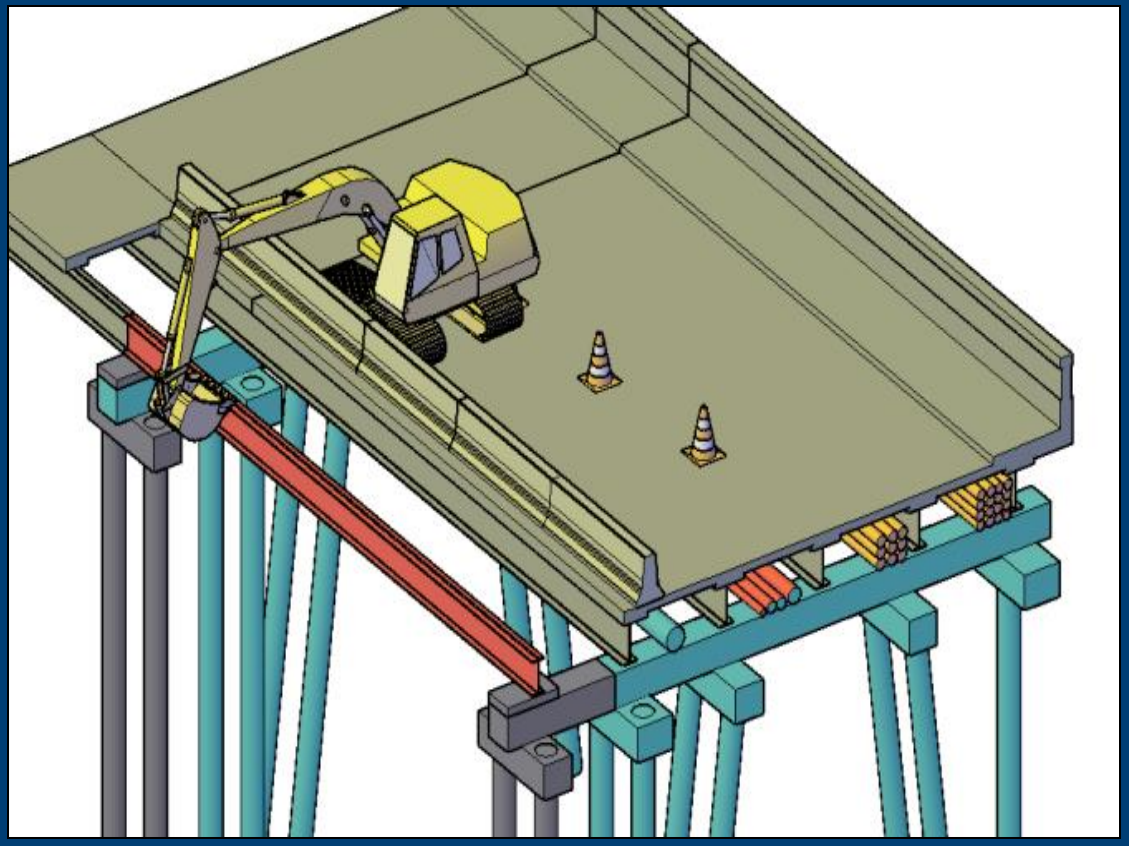
METHODS

Stage 4 – remove Inner bike lane deck – saw cut into ~10 long pieces and pick with excavator and slab grab – load directly into truck



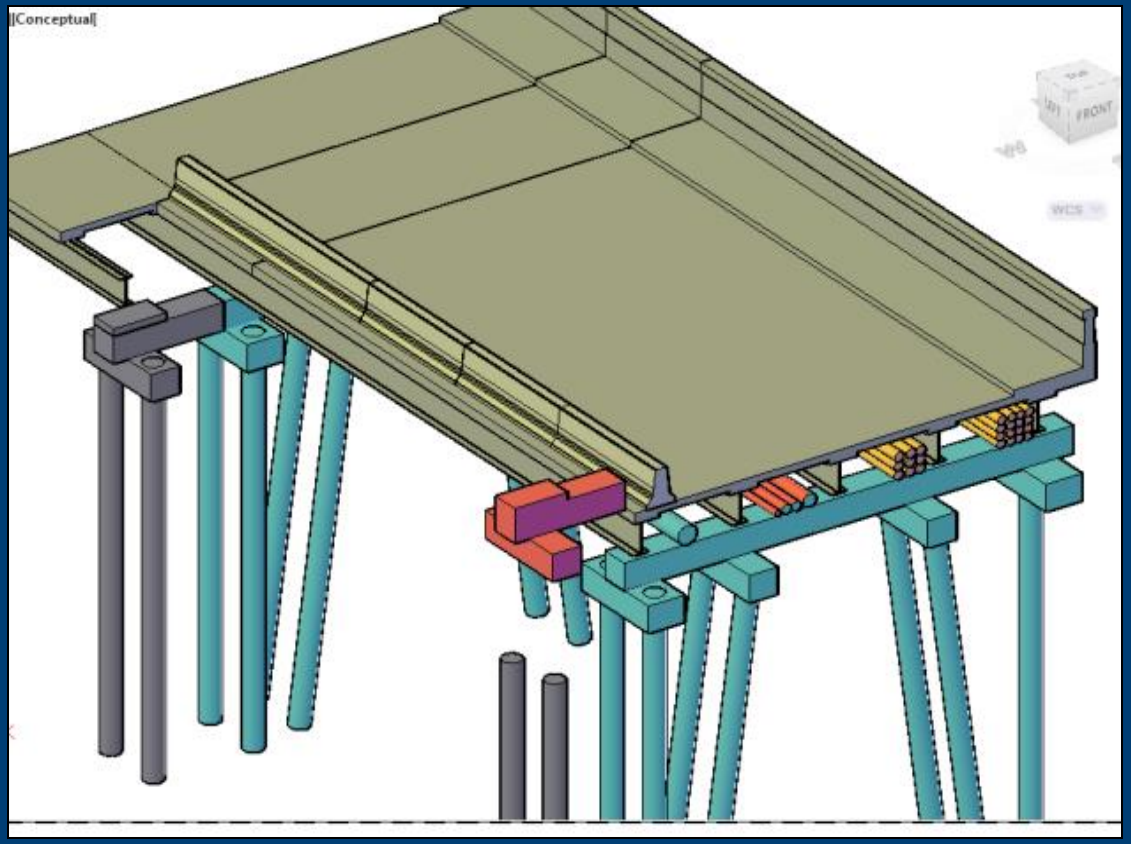
METHODS

Stage 5 – Use excavator W/ Shear to remove existing Girders and Stringers. Girders picked Full length (~42') with crane from Trestle



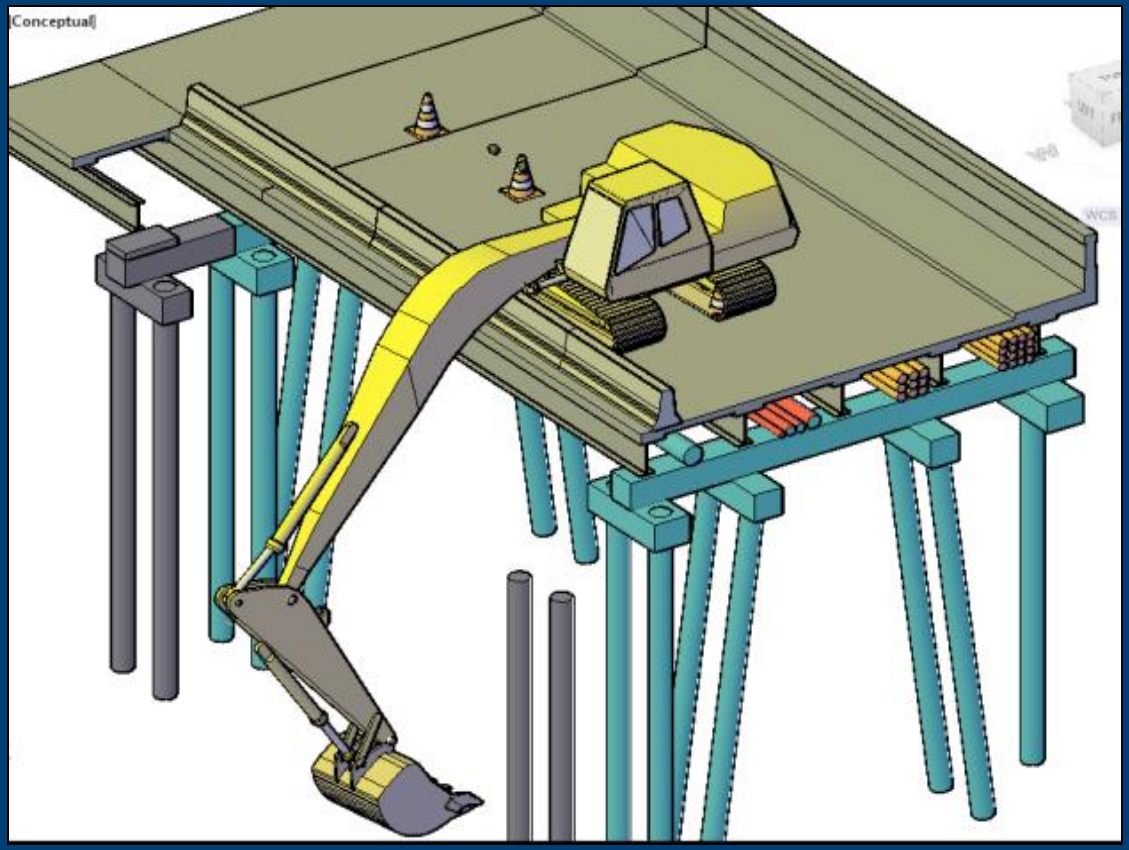
METHODS

Stage 6 – Wire Saw Existing Bent and top of concrete piles - pick with Crane from Trestle



METHODS

Stage 7 – Shear Existing Piles (16” Conc.) with 345 excavator sitting on existing bridge. Piles picked with Crane from Work Trestle



METHODS

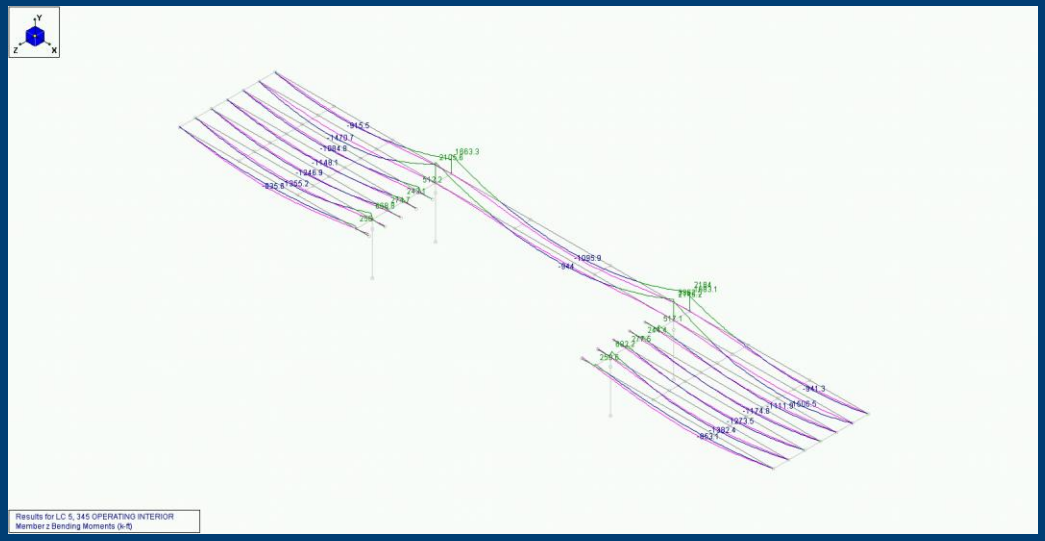
METHODS

DESIGN BEST PRACTICES

- ADD SUPPLEMENTAL SUPPORT WHEN NECESSARY

DESIGN BEST PRACTICES

- EVALUATING EA STAGE EFFECIENTLY
  - HAND CALCS
  - RISA 3D
  - MIDAS CIVIL



DESIGN BEST PRACTICES

- CONSIDER RISKS
  - HIGH RISK SAFETY
  - HIGH RISK COST
  - ADJACENT STRUCTURES
  - PLAN THE WORK , WORK THE PLAN

DESIGN BEST PRACTICES

- DESIGN TIPS
  - CONSERVATIVE LOAD FACTORS
  - CONSIDER SERVICEABILIITY (IF APPLICABLE)
  - TYPICAL EXCAVATOR 80 KIP

DESIGN BEST PRACTICES

- DESIGN TIPS
  - CRANE MATS (IF NECESSARY)
  - LOAD DISTRIBUTION FRAMES (BYPASS DECK)
  - PROVIDE TEMP. FALSEWORK SHORING (IF NECESSARY)

QUESTIONS?

Thank you

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