Michigan Department of Transportation

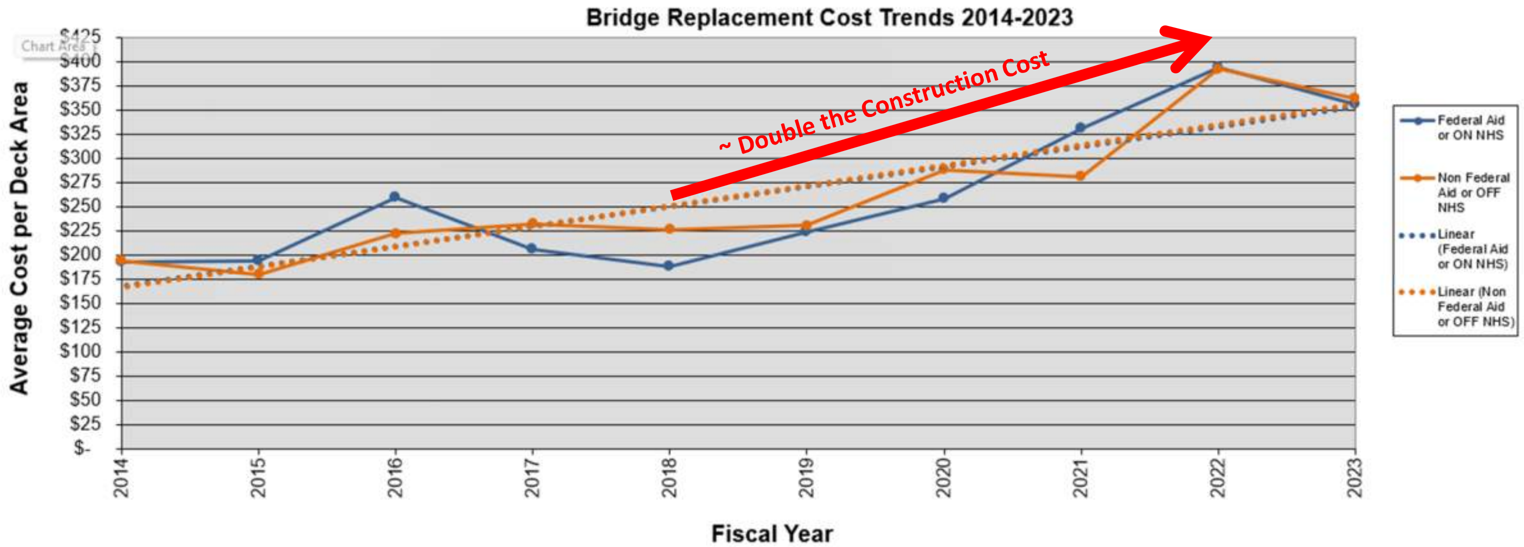
RS&H

October 10, 2024

RS&H
Project Controls Group (PCG)

Crane 101

Kyle Kopper



MDOT

BUREAU of BRIDGES and STRUCTURES

Kyle Kopper

BUREAU of BRIDGES and STRUCTURES

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Kyle Kopper

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BUREAU of BRIDGES
SPANNING CONNECTING
SAFELY EFFICIENTLY
and STRUCTURES

Kyle Kopper

Source: MDOT YouTube Channel

Watch a timelapse video of the girder setting on YouTube.
Search for “M-43 Beam Setting Timelapse”

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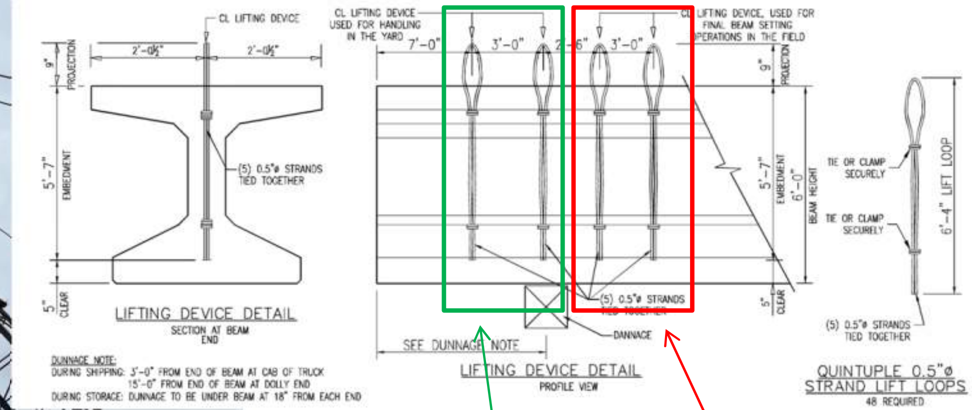

Lifting loops used by the crane on the side the beams were delivered to move the beam to where the second crane could reach.

Lifting loops used by the two cranes to set the beam in the final location.

Source: Melissa Donoso

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Source: Melissa Donoso

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Kyle Kopper

Crane 101

Agenda

- Overview of the PCG
- Objectives
- Crane Basics
- Crane Check Worksheet
- Decision Tree/Snake
- Example Project

TK0

RS&H PCG Staff

Bob Jones
National Leader

Travis Kaess, PE
Sr National Project Controls Specialist

Bill Deacon, PE
Chief Estimator

Slide 11

TK0 Just have the 3 presenters

Kaess, Travis, 2024-10-03T16:34:48.233

Project Controls Group - Nationwide

CPM Scheduling

Overseeing
$7B+
of construction

75+
projects

Claim Analysis

$500M+
in claims

20+
projects

Cost Estimating

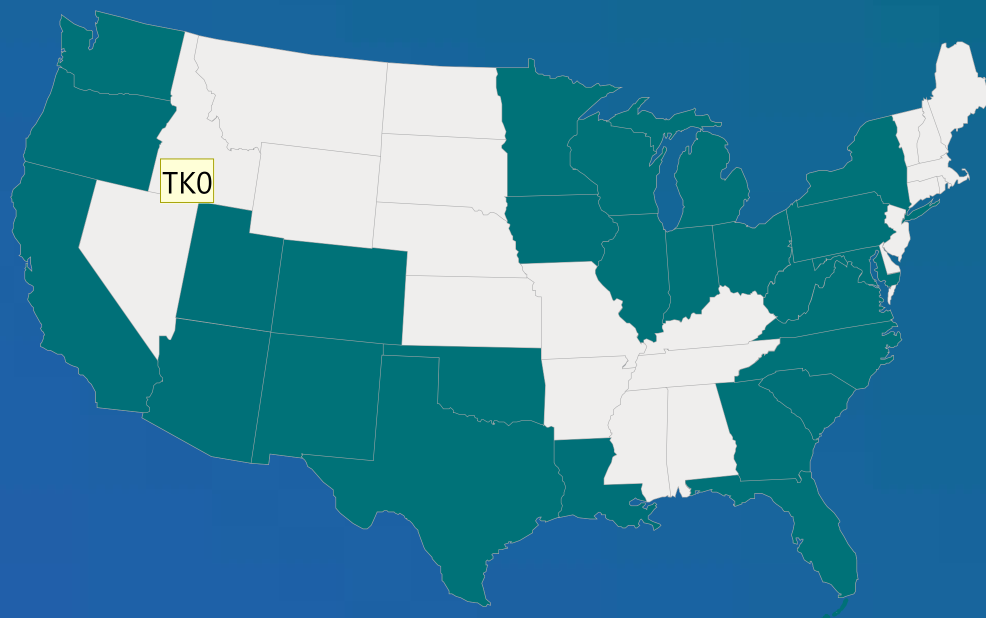
Performed ICE on over
$7B+
of construction

Transportation
Aviation
Aerospace
Corporate
Federal

Constructability Reviews

$5B+
of construction

Logistics
Language
Schedule
Coordination



Bob Jones

Slide 12

TK0 Match green color (typ)

Kaess, Travis, 2024-09-03T20:58:59.223

Project Controls Group

CONTRACTOR EXPERIENCE

Disciplines

- Bridges
- Concrete Paving
- Excavation
- Underground
- Service Centers
- Toll Facilities

Contracts

- Design Build
- Progressive DB
- A+B
- CMGC / CM@R
- P3
- Emergency

Claims

- Federal
- State
- Provincial
- Arbitration / Mediation

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Bob Jones

Objectives

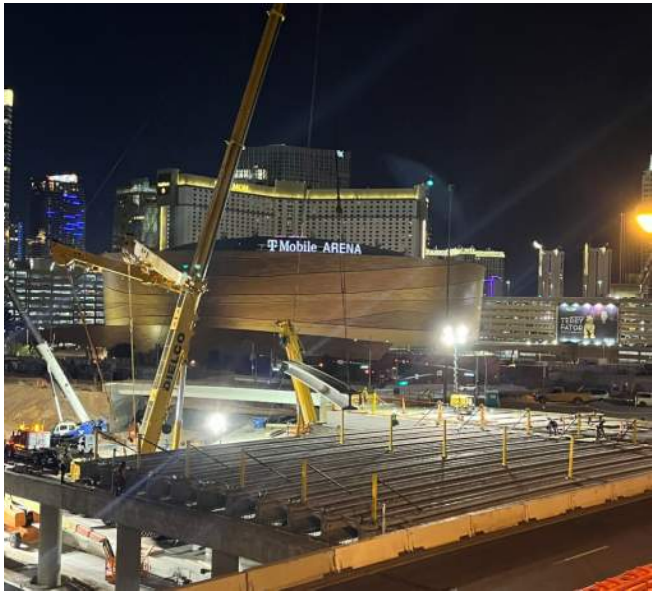
- Constructible Bridge Designs
- Cost Efficient Bridge Designs
- Repeatable Process
- Reduce Risk

"An engineer can do for a dollar what any fool can do for two"

- Arthur M. Wellington

Crane Basics – Types

- Typical Cranes
  - *Crawler / Lattice Boom*
  - *Hydraulic*



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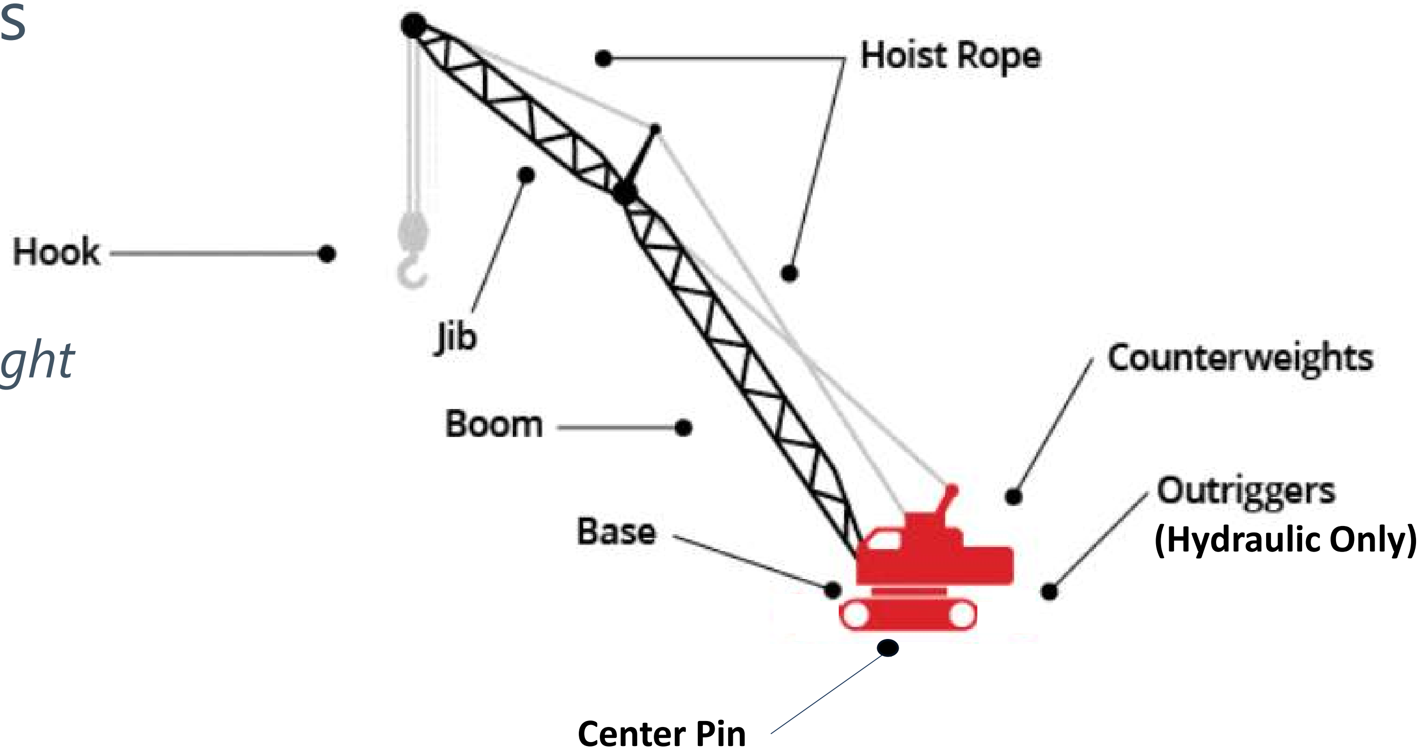
Travis Kaess

Crane Basics - Parts

- Components
  - *Hook*
  - *Hoist*
  - *Boom*
  - *Jib*
  - *Counterweight*
  - *Outriggers*
  - *Base*
  - *Center Pin*



Crane Basics - Terms

- Terms
  - *Load*
  - *Capacity*
  - *Crane Chart*
  - *Radius*
  - *Offsets*
  - *Site Plan*
  - *Critical Pick*

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Crane Basics

- Load
  - *Weight of Load*
  - *Weight of Rigging*
  - *Total Weight*

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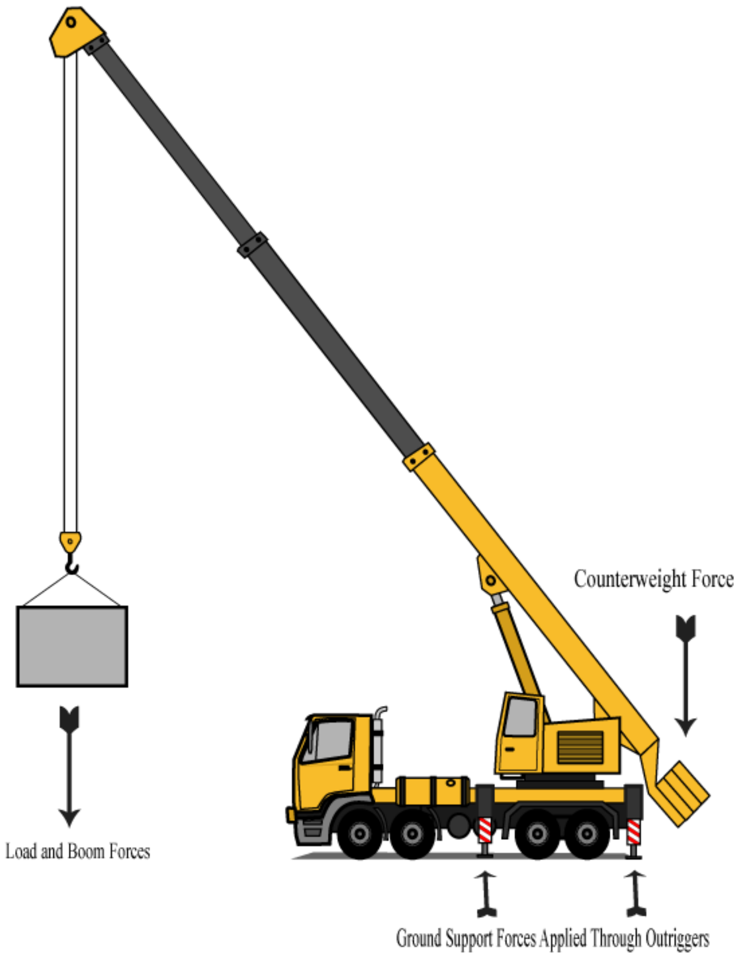
Crane Basics

- Capacity
  - *Crane Configuration*
  - *Structural Limitations*
  - *Distance to Load (Radius)*
  - *Load and Rigging Weight*
  - *Ground Conditions*
  - *Ambient Weather Conditions*
    - *22 mph max wind speed (typ)*



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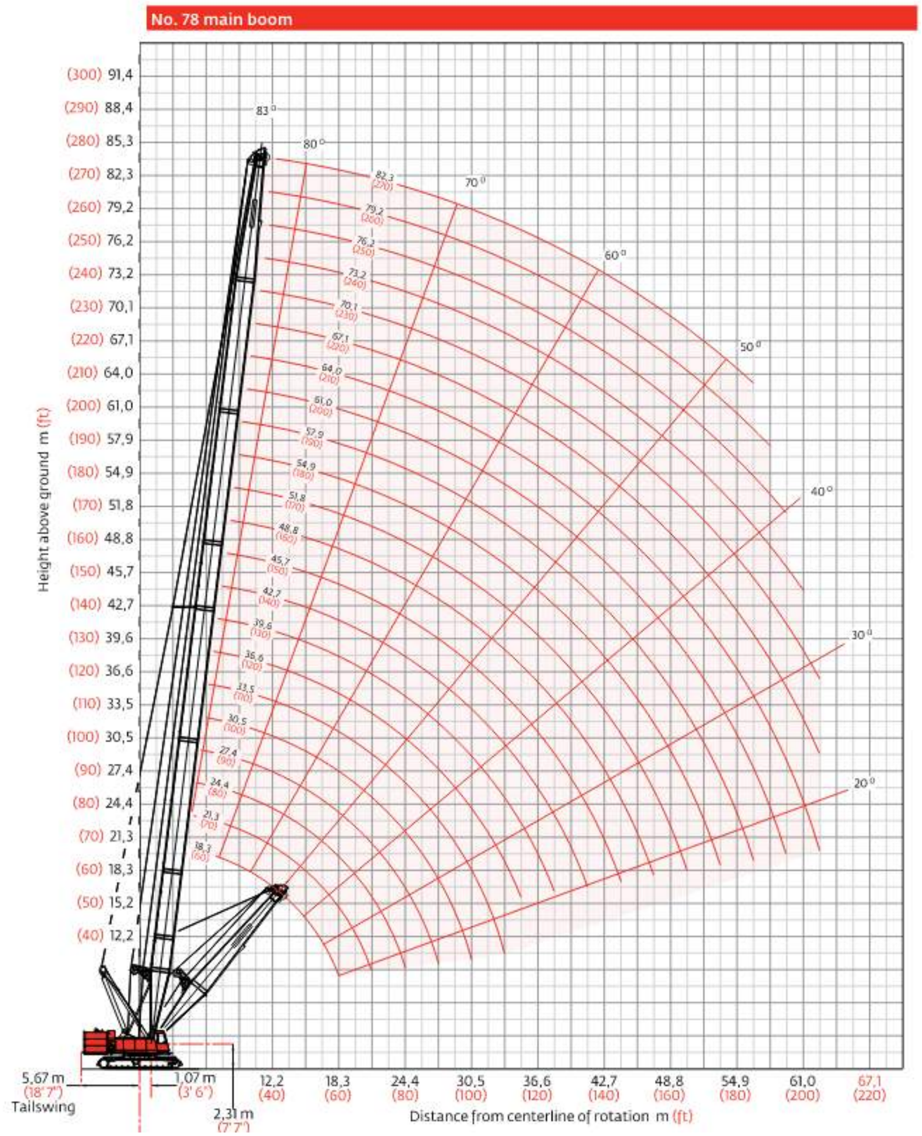
Crane Basics

- Capacity
  - *Range Diagram*
  - *Boom Configuration*
  - *Boom Angle*



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Slide 20

TK0 Combine or fast-track slides 17, 18, & 19

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Crane Basics

- Capacity
  - *Load Chart*

40 - 125 ft. (12 - 38 m) | 11,500 lbs. (5216 kg) | 100% | 360°

Pounds

Feet	40	45	55	65	75	85	95	105	115	125
10	140,000 (70)	105,000 (72.5)								
12	111,000 (67)	105,000 (70)	94,600 (74)							
15	91,450 (61.5)	91,000 (65.5)	88,250 (70.5)	71,050 (74)						
20	69,550 (52.5)	69,050 (58)	68,400 (65)	60,400 (69)	55,250 (72.5)	48,150 (75)				
25	55,050 (41.5)	54,600 (49.5)	53,950 (58.5)	53,450 (64.5)	47,950 (68.5)	41,700 (71.5)	38,000 (73.5)	33,350 (75.5)		
30	42,950 (26)	42,450 (39.5)	41,700 (52)	41,200 (59)	41,950 (64)	36,700 (67.5)	33,300 (70.5)	30,750 (72.5)	24,550 (75)	*23,700 (76.5)
35		33,700 (26)	33,000 (44.5)	32,500 (53.5)	33,250 (59.5)	32,600 (64)	29,550 (67)	27,300 (69.5)	21,700 (72)	21,900 (74)

I0 - 125 ft. 12 - 38 m) | 11,500 lbs. (5216 kg) | 50% 17' 4" Spread | 360°

Pounds

Feet	40	45	55	65	75	85	95	105	115	125
10	116,000 (70)	105,000 (72.5)								
12	102,500 (67)	102,000 (70)	94,600 (74)							
15	86,800 (61.5)	86,350 (65.5)	85,800 (70.5)	71,050 (74)						
20	67,250 (52.5)	64,850 (58)	60,550 (65)	56,950 (69)	55,250 (72.5)	48,150 (75)				
25	45,750 (41.5)	44,950 (49.5)	42,050 (58.5)	39,700 (64.5)	39,100 (68.5)	38,900 (71.5)	38,000 (73.5)	33,350 (75.5)		
30	32,500 (26)	32,050 (39.5)	31,000 (52)	29,250 (59)	29,050 (64)	29,250 (67.5)	29,300 (70.5)	29,250 (72.5)	24,550 (75)	*23,700 (76.5)
35		23,900 (26)	23,350 (44.5)	22,250 (53.5)	22,300 (59.5)	22,700 (64)	22,900 (67)	23,050 (69.5)	21,700 (72)	21,900 (74)

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Crane Basics

- Capacity
  - *Types of Failures*

BOOM LENGTH												Maximum Load Chart in pounds (lbs) with fully extended outrigger
OPERATING RADIUS (FT)	27 FT		34 FT		43 FT		52 FT		61 FT		70 FT	
	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)
5	77	34,000*										
10	66	21,100*	71	17,100*	75	16,000*	78	15,700*				
15	54	15,100*	62	14,000*	68	12,100*	72	11,100*	75	10,800*	77	9,600*
20	39	11,100*	51	10,100*	61	9,100*	66	8,600*	71	8,200*	73	7,300*
25	17	7,900*	40	7,700*	53	7,100*	61	6,900*	66	6,600*	69	5,900*
30			23	6,500*	44	6,100*	54	5,600*	60	5,300*	64	4,900*
35					33	4,800*	47	4,700*	54	4,600*	60	4,150*
40					16	3,500*	38	4,100*	48	3,900*	55	3,550*
45							27	3,250*	41	3,200*	49	3,050*
50							9	2,950*	33	2,800*	44	2,650*
55									23	2,500*	37	2,350*
60											29	1,900*
65											19	1,700*
STOWED JIB DEDUCTIONS (POUNDS)	450		360		260		230		200		175	

NOTE: STRUCTURAL STRENGTH RATINGS IN CHART ARE INDICATED WIH AN ASTERISK *

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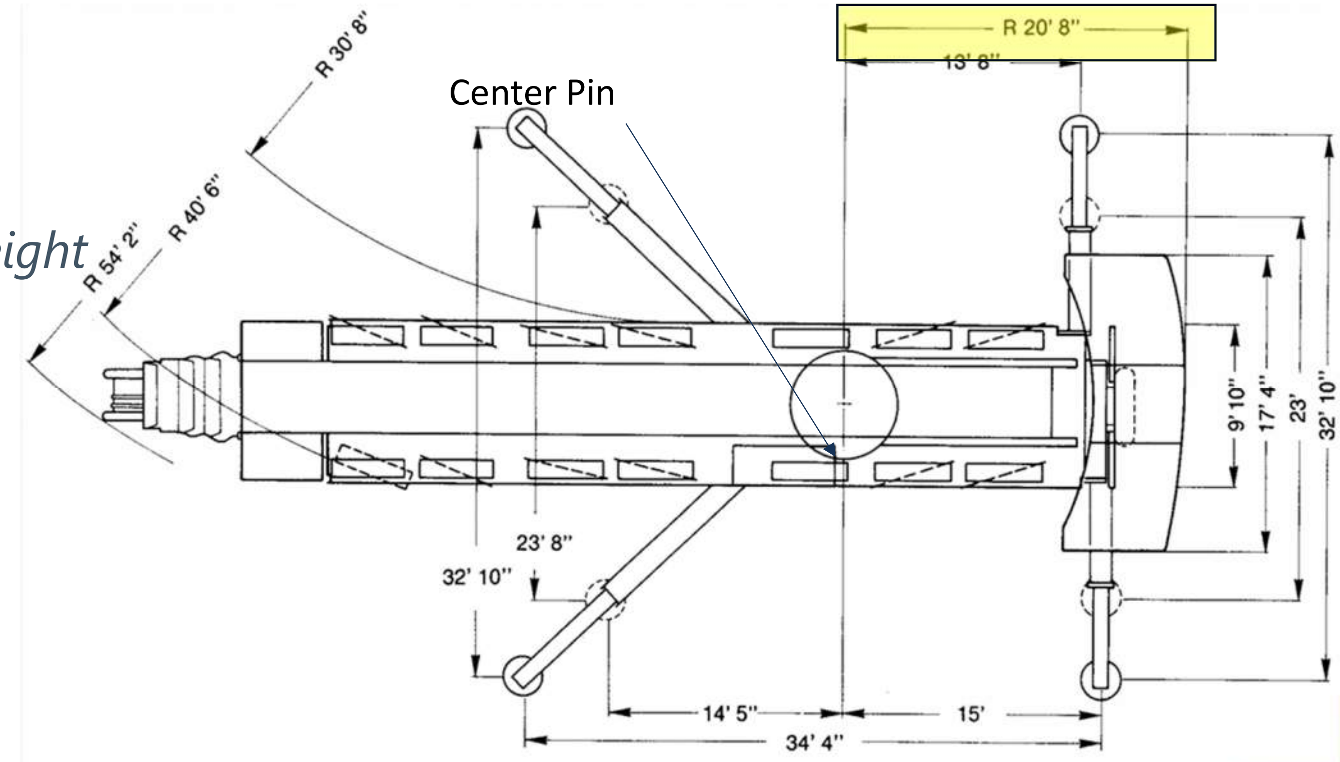
Crane Basics

- Radius
  - *Load to Center Pin*
  - *Front of Tracks to Center Pin*
  - *Back of Counterweight to Center Pin*
  - *Offsets*
  - *Pick Point*
  - *Center of Load*



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Crane Basics

- Safety
  - *MIOSHA Standards*
  - *MIOSHA Table A*
  - *Booting Lines*

TABLE A—MINIMUM CLEARANCE DISTANCES	
Voltage (nominal, kV, alternating current)	**Minimum clearance distance (feet)**
up to 50	10
over 50 to 200	15
over 200 to 350	20
over 350 to 500	25
over 500 to 750	35
over 750 to 1,000	45
over 1,000	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).
Note: The value that follows "to" is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.	

https://www.michigan.gov/leo/bureaus-agencies/miosha/standards

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Crane Basics

- Safety
  - *Critical Pick*

Crane	Type	Radius	Capacity	Capacity (75%)
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	30	144,600.00	108,450.00
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	35	114,850.00	86,137.50
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	40	94,450.00	70,837.50
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	50	68,910.00	51,682.50
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	60	53,160.00	39,870.00
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	70	42,570.00	31,927.50
Terex HC 165 (165 Ton) - 160 FT Boom	Crawler	80	35,280.00	26,460.00

Crane Basics Beam Erection

- Constructability
  - *60" bulb tee – 150' long span = 168,000#*
  - *Have a Plan that can be constructed*

Crane Basics

- Safety
  - *FAA*
  - *Crane Access*
  - *Questions?*

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Break

Crane Footprints

- Radius
  - *Example: Bluebeam / CAD / Other*
  - *Crane Footprints*

Bridge 101 Quick Reference Guide

Standard Crane Footprints

Crane	Picking Capacity	Crane Weight	Length	Width	Center Pin Distance	
	Tons	***Tons***	***Ft-In***	***Ft-In***	***Ft-In***	
Grove RT-870	70	54	28'-3"	26'-7"	14'-6"	Hydraulic
Terex HC-110	110	100	20'-11"	18'-8"	10'-6"	Crawler
Terex HC-165	165	155	25'-1"	20'-9"	12'-7"	Crawler
Manitowac 777	200	171	29'-11"	20'-8"	13'-0"	Crawler
Manitowac 1400	220	189	27'-3"	25'-4"	13'-8"	Crawler
Terex HC-230	230	193	29'-0"	23'-8"	14-6"	Crawler
Terex HC-275	275	254	30'-0"	23'-8"	15'-0"	Crawler
Demag AC 300	360	72	53'-7"	27'-11"	19'-0"	Hydraulic
Demag AC 1200	500	92.4	57'-7"	32'-10"	20'-8"	Hydraulic

Crane Check Worksheet

- Crane Check Worksheet
  - *Tool Overview*

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Form XX
BOBS Crane Selection

1/25/2024

Project Name:	BOBS Sample Project
Project Number:	111-11111
Scenario Description:	48" Bulb-T; Single Crane; Behind Abutment
Scenario #:	1
Evaluator Name:	Kyle Kopper
Evaluation Date:	7/7/2023

Crane Type	All (Typical)
Load	**Weight (lbs)**
Beam/Girder:	70,000
Concrete?:	Yes (Typical)
Two Cranes?:	No
Barge?:	No
Safety Factor (Concrete Only):	3,500
Rigging:	7,500
Total:	**81,000**
Radius	**Distance (FT)**
Pick Location:	Behind Abutment
Beam/Girder Height:	4
Backwall Offset:	10
Center Pin:	15
Reference Line to Midspan of Pick:	26
Radius Override:	
Total:	**51**
Crane Chart Radius:	**60**
Non-Critical (<75% Capacity)	
Crane Selection:	Terex HC 275 (275 Ton) - 160 FT Boom
Crane Type:	Crawler
Note:	Larger than Typical

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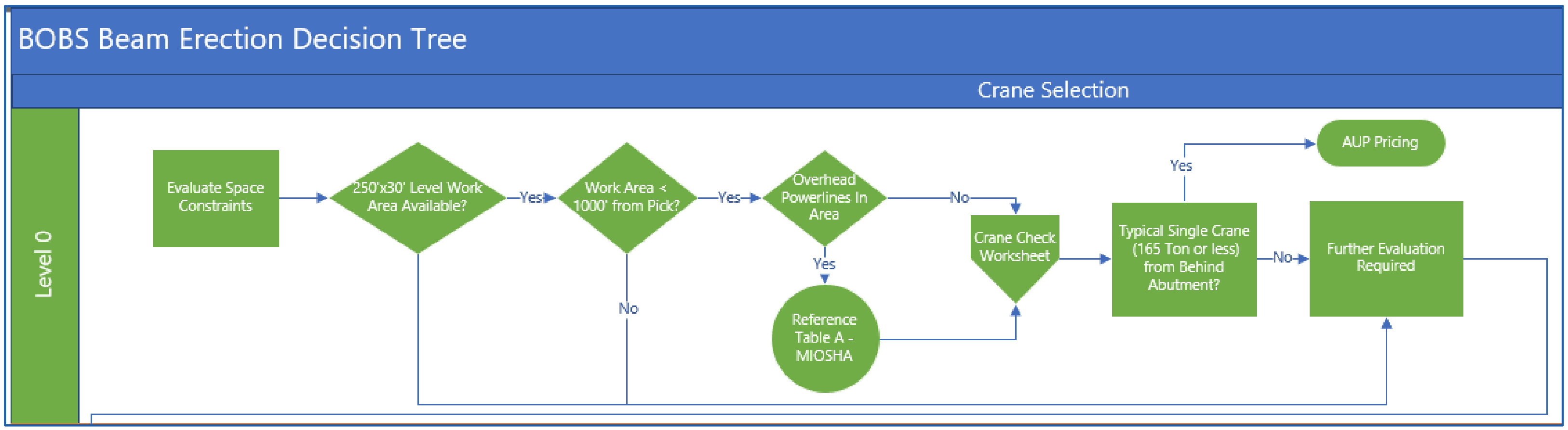
Decision Tree/Snake

- Decision Tree/Snake
  - *Tool Overview*



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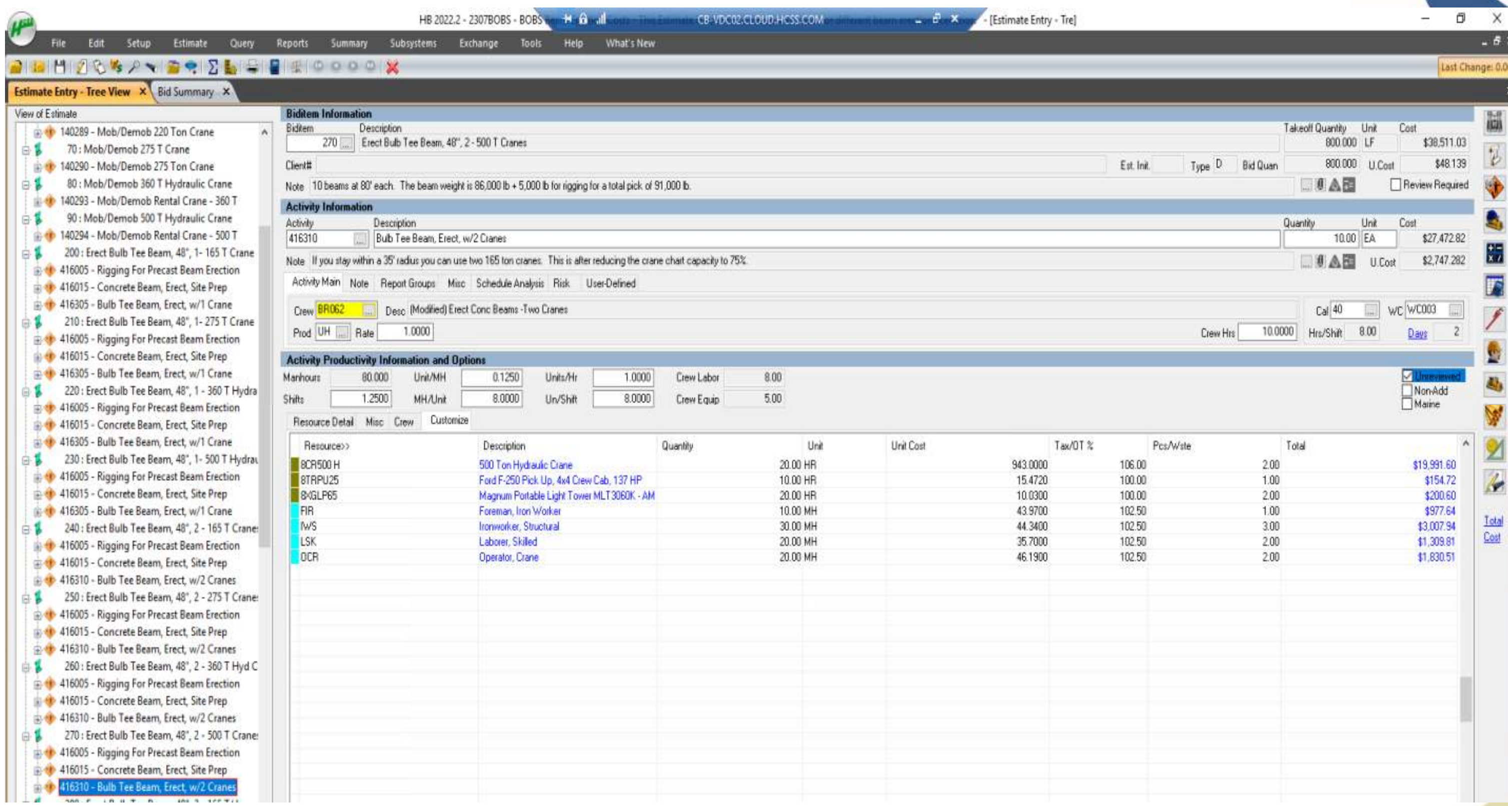
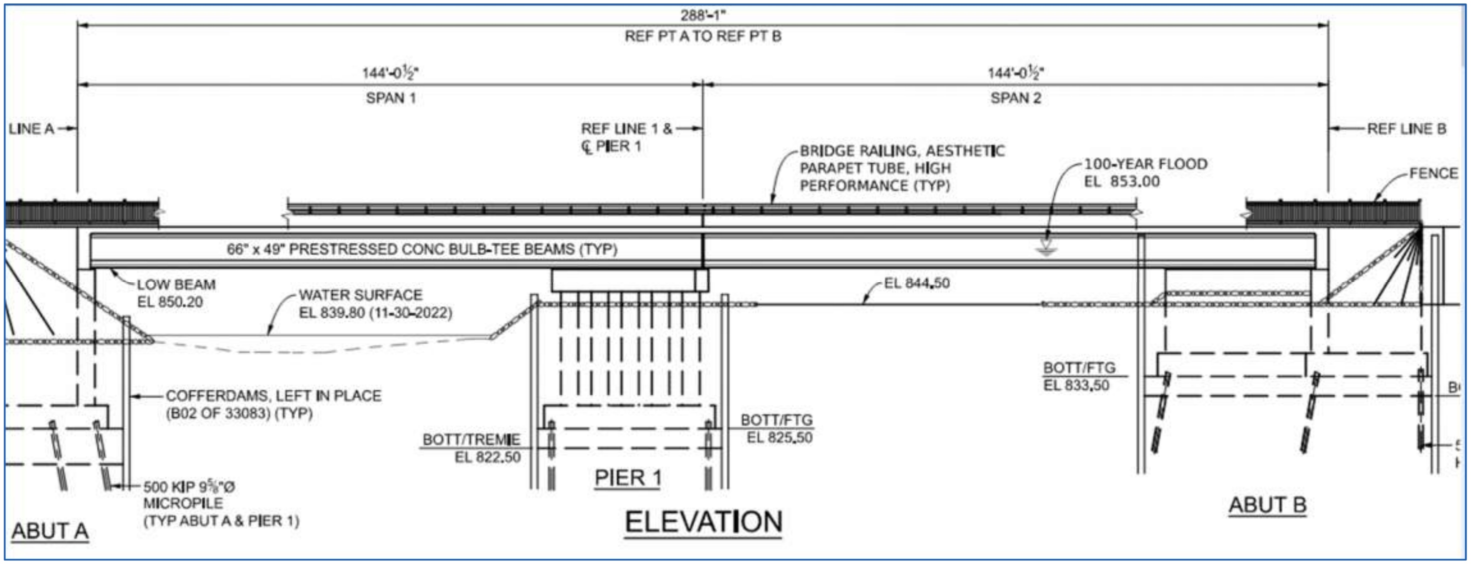
Decision Tree/Snake

- Decision Tree/Snake
  - *Cost:*



Example Project

- Example Project
  - *Example:*



Implementation

1. Help make ***objective*** decisions about the type of superstructure to propose on a project as part of the Structure Study.
2. Help us determine how much the average unit price (AUP) for the erection of the superstructure should be increased based on the anticipated means and methods the Contractor will use to erect the proposed superstructure.
3. Help us to identify additional measures that should be incorporated into projects to help facilitate the construction of the bridge. This could include, but is not limited to:
   a. The need to obtain grading permits to accommodate crane access.
   b. Relocating existing utilities that are in conflict (both overhead and buried).
   c. Including materials to construct crane pads.
   d. Identifying areas that may need to be temporarily graded to provide reasonable access for cranes.
4. Provide information and data to have informed conversations with the Construction Engineer about the space and time required to build the bridge.
5. Provide information and data to have informed conversations with the Traffic Engineer about maintaining traffic concepts and the space required to build the bridge.
6. Help us identify projects with unique challenges or constraints that will impact the construction of the bridge, and projects where we must engage BOBS Construction to help ensure that the advertised project documents include a feasible means of building the project.

Thank you

Questions?

RS&H PCG - Unrivaled Contractor Experience

Heavy Civil Prime Contractor

- Bridges
- Paving
- Excavation

Innovative Contract Formats

- Design Build
- P3
- Phased DB (Progressive)
- CMGC / CMAR
- A+B

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Bob Jones

RS&H PCG – Nationwide

CPM Scheduling

Overseeing $7B of construction	70+ projects

Claim Analysis

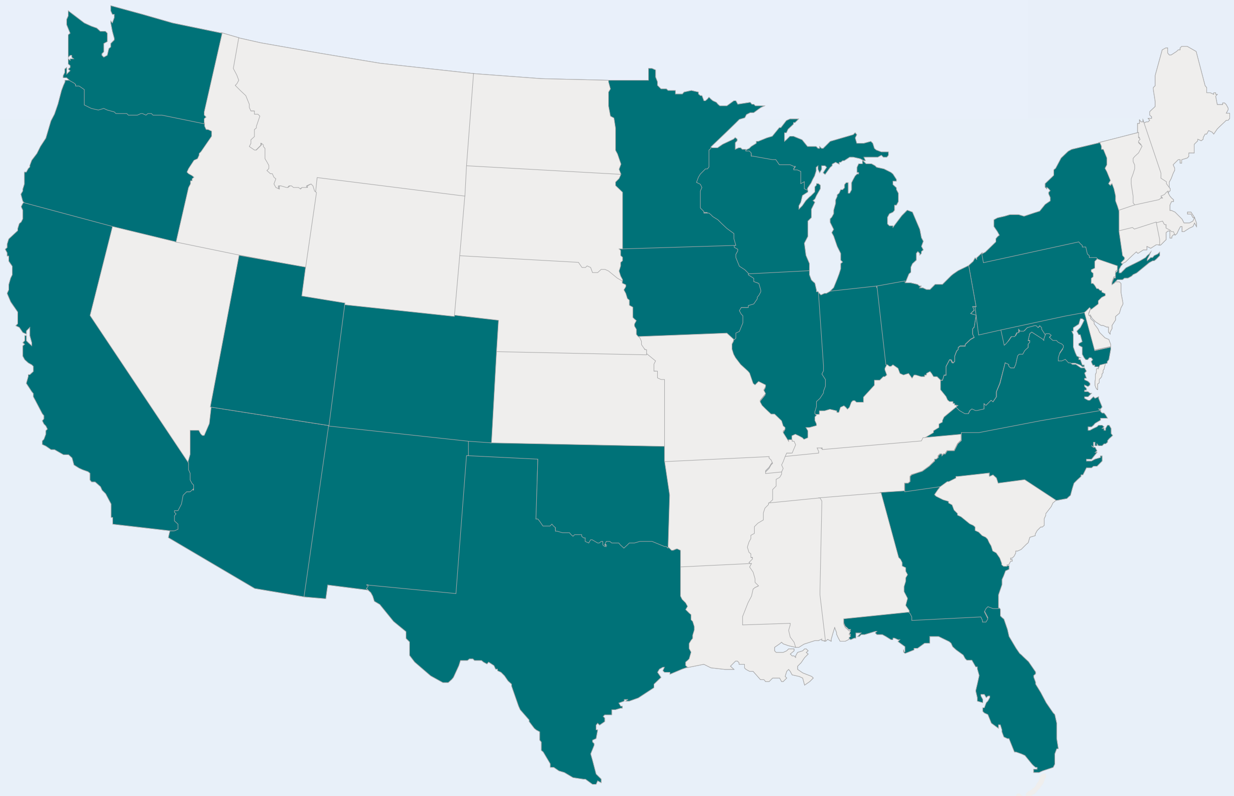
$500M+ in claims	20+ projects

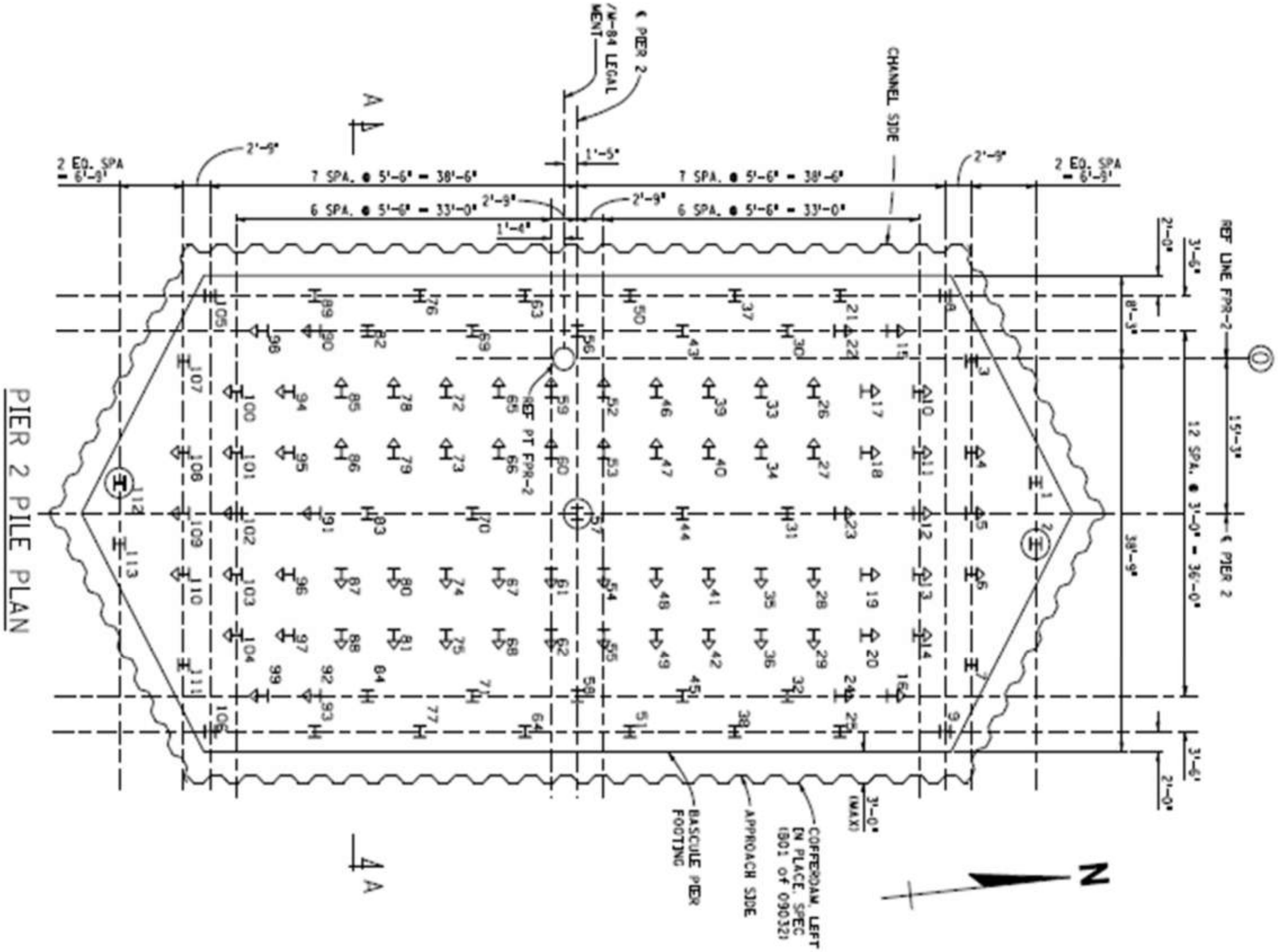
Constructability Reviews

$5B of construction	Site Logistics Contract language Schedule 3rd party coordination

Cost Estimating

ICE Services $7B of construction	6 States




PIER 2 PILE PLAN
CHANNEL SIDE
APPROACH SIDE
BASCULE PIER FOOTING
COFFERDAM, LEFT IN PLACE, SPEC
REF LINE FPR-2
REF PT FPR-2
7 SPA. @ 5'-6" = 38'-6"
6 SPA. @ 5'-6" = 33'-0"
12 SPA. @ 3'-0" = 36'-0"
2 EQ. SPA
N

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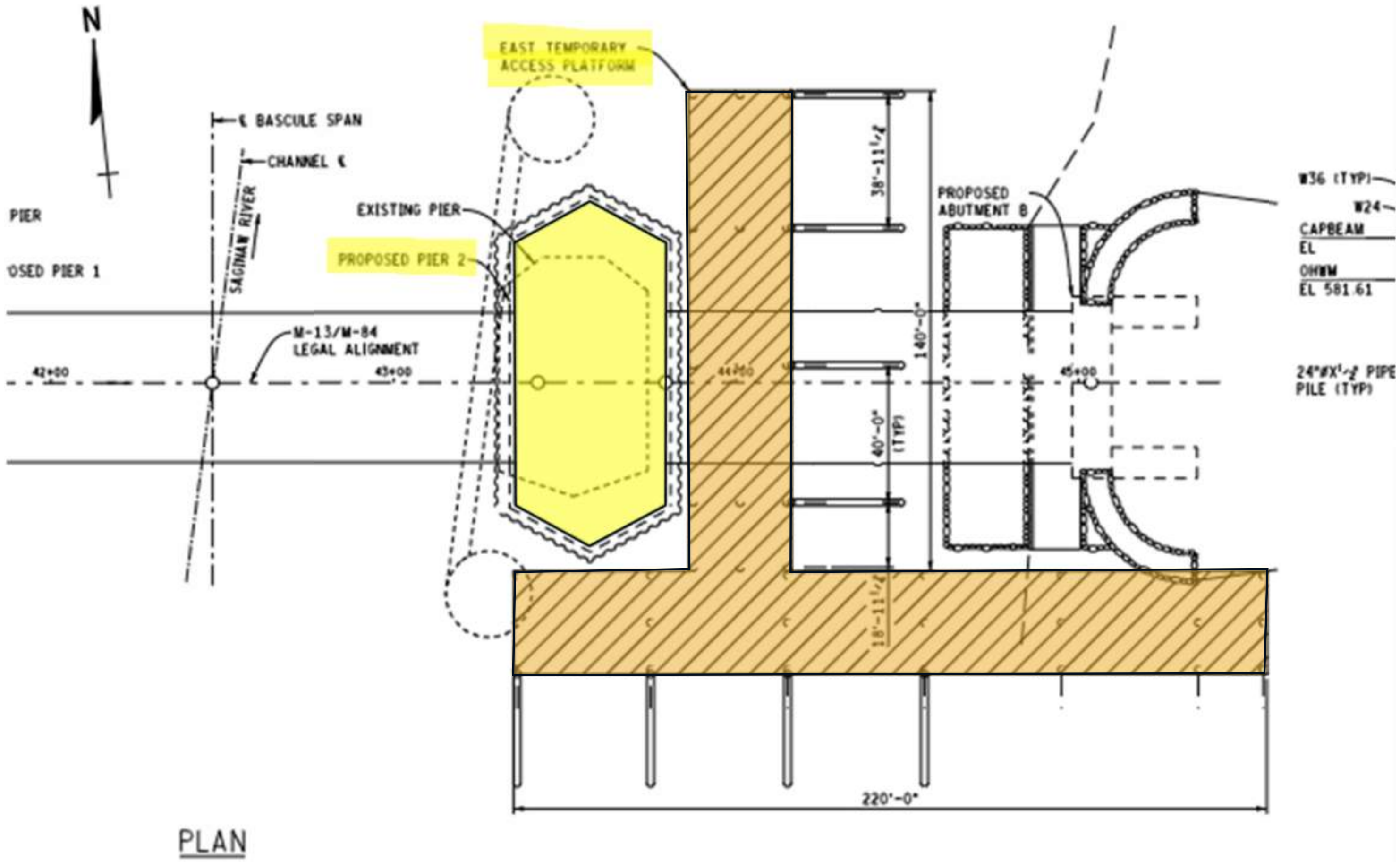

N
℄ BASCULE SPAN
CHANNEL ℄
SAGINAW RIVER
PIER
OSED PIER 1
EAST TEMPORARY
ACCESS PLATFORM
EXISTING PIER
PROPOSED PIER 2
M-13/M-84
LEGAL ALIGNMENT
42+00
43+00
44+00
45+00
38'-11 1/4"
140'-0"
40'-0" (TYP)
18'-11 1/4"
220'-0"
PROPOSED
ABUTMENT B
W36 (TYP)
W24
CAPBEAM
EL
OHWM
EL 581.61
24"ØX1/2" PIPE
PILE (TYP)
PLAN

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