403 N. WABASH

NOVEL SUPPORT FOR A TOWER CRANE

Eamonn Connolly SE, PE
Director of Engineering
James McHugh Construction Co.

• 3

ACI Fall 2018 Convention
Las Vegas, NV
October 16, 2018

Learning Objectives

- Project Logistics
- Design Considerations for supporting a tower crane
- Tower Crane Assembly/Disassembly Process
- Requirements for Mobile Crane Installation in public way

403 N Wabash

THE PROJECT

NEW 18 STORY,

150,000 SQ. FT,

VERTICAL EXPANSION

TO EXISTING 4 STORY

1980's GARAGE

ADJACENT TO 1930's

VIADUCT

McHUGH

James McHugh Construction Co.

Project Team and Consultants

belgravia group

bKL ARCHITECTURE

UZUN +CASE

db|HMS

Kettelkamp & Kettelkamp landscape architecture

SPACECO INC. SI
CONSULTING ENGINEERS
SITE DEVELOPMENT ENGINEERS
LAND SURVEYORS

Quast Consulting & Testing Inc.

FTL FLOOD Testing Laboratories, Inc.

Terracon

Shiner+Associates, Inc.

MORROW
Tel: (503) 585-5721
Fax: (503) 315-1279
E-Mail: engineering@morrow.com
PO Box 3306
3218 Pringle Road SE
Salem Oregon 97302-0306
USA
The American Home of LIEBHERR

McHUGH
James McHugh Construction Co.

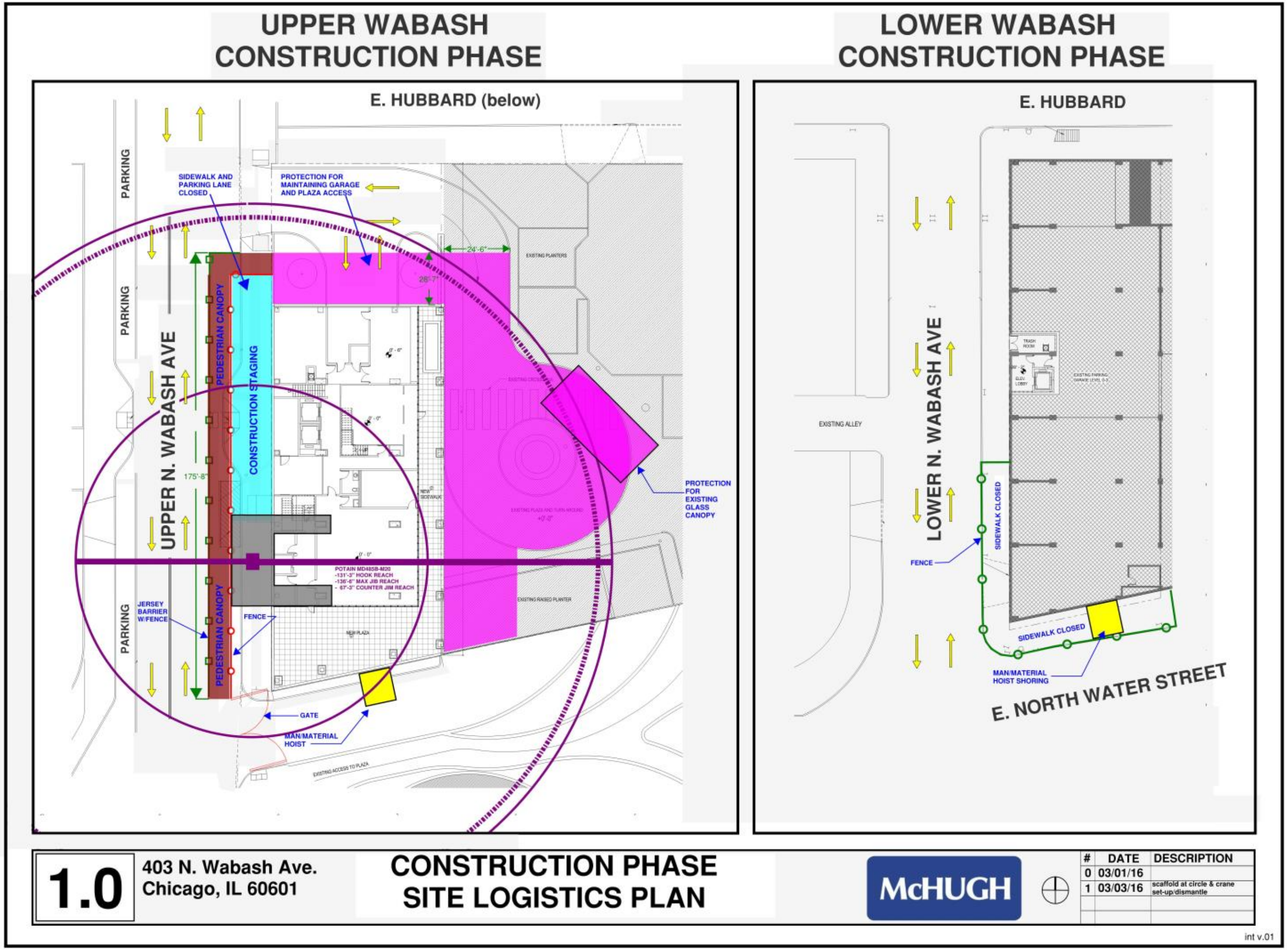
SITE LOGISITCS

Dock and Hoist

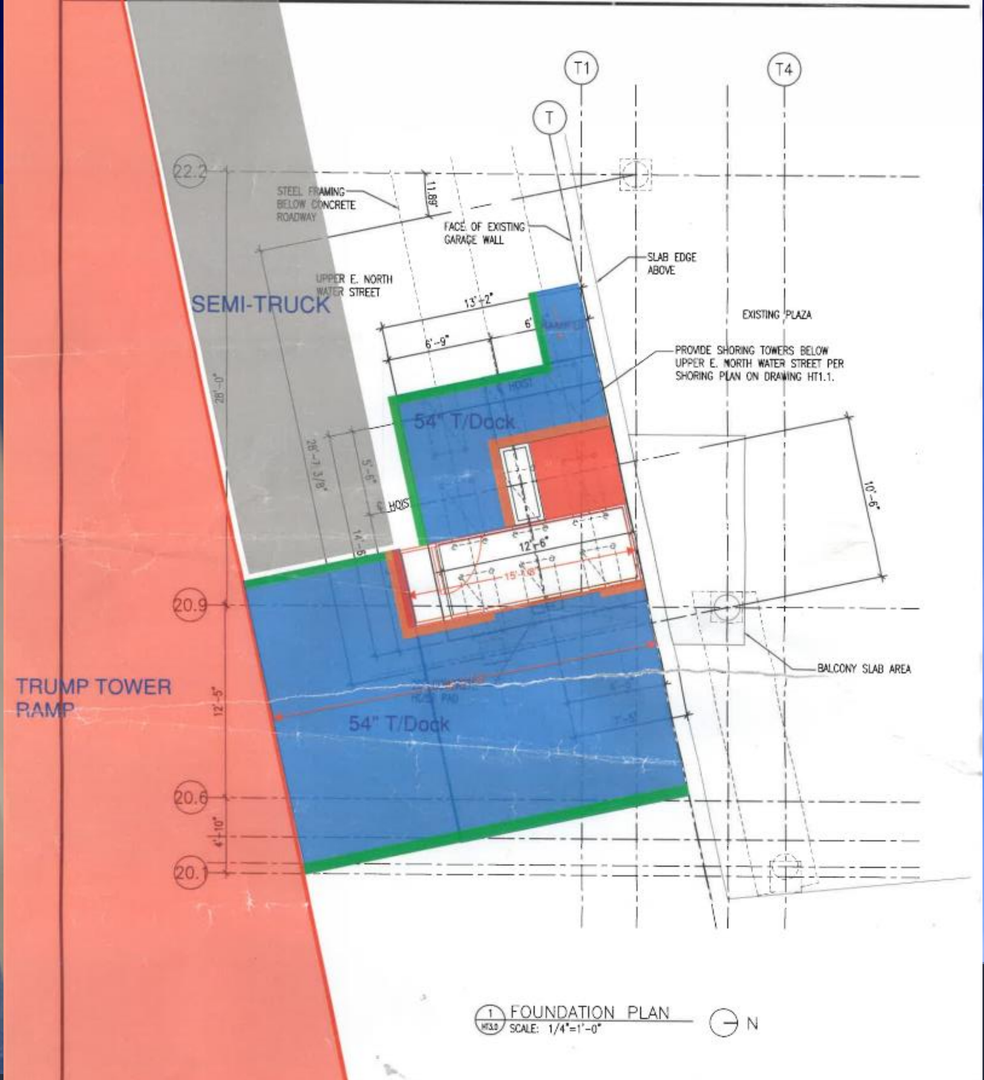
- Limited Space
- Location Options
- One Small Hoist

No laydown area for materials

- Canopy over 405 Dr.
- Crane access to canopy



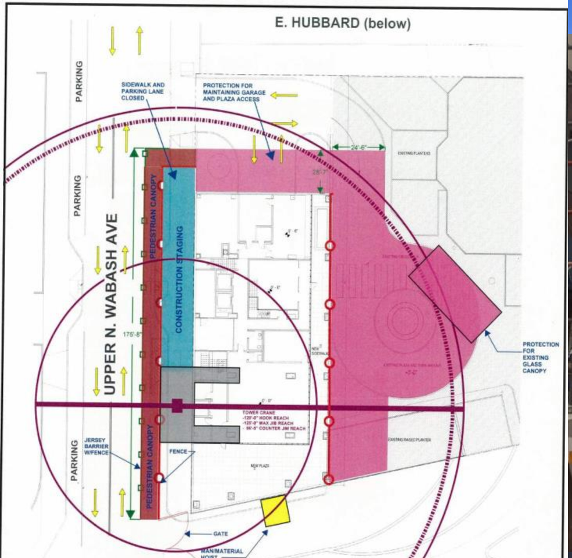
SITE LOGISITCS

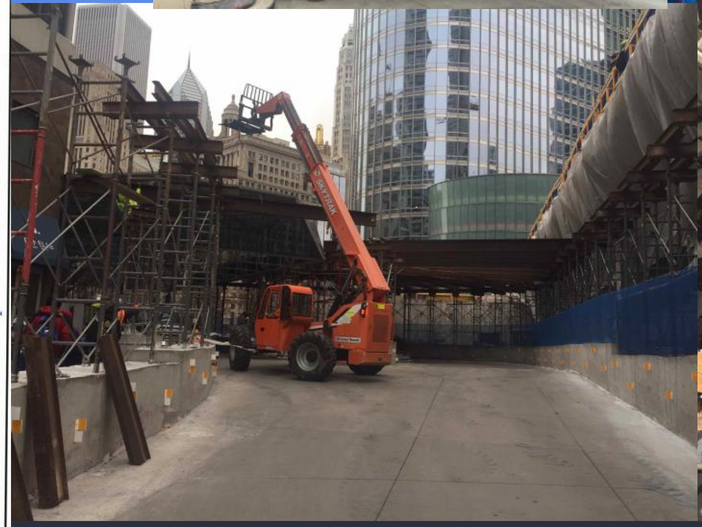


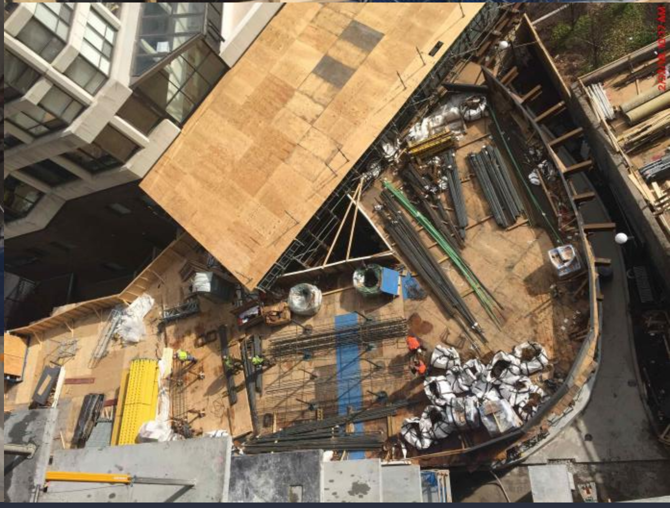
CANOPY OVER RIVER PLAZA

No laydown area for materials

- Canopy over 405 Dr.
- Crane access to canopy
- Designed for 250 psf LL
- Large reaction loads on existing structure checked







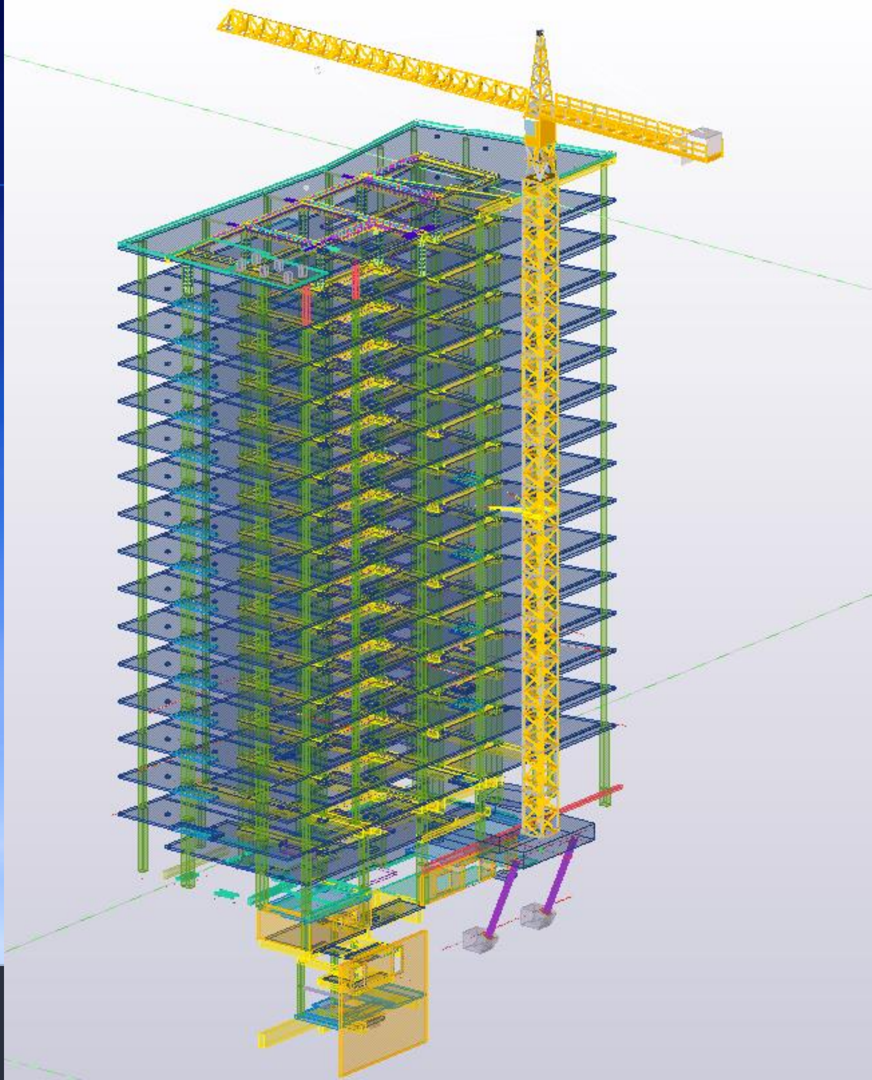
THE DESIGN

PROBLEM:

- Need crane
- Logistics/public requirements
- Existing structure
- Adj. To 1930’s viaduct
- No new foundations

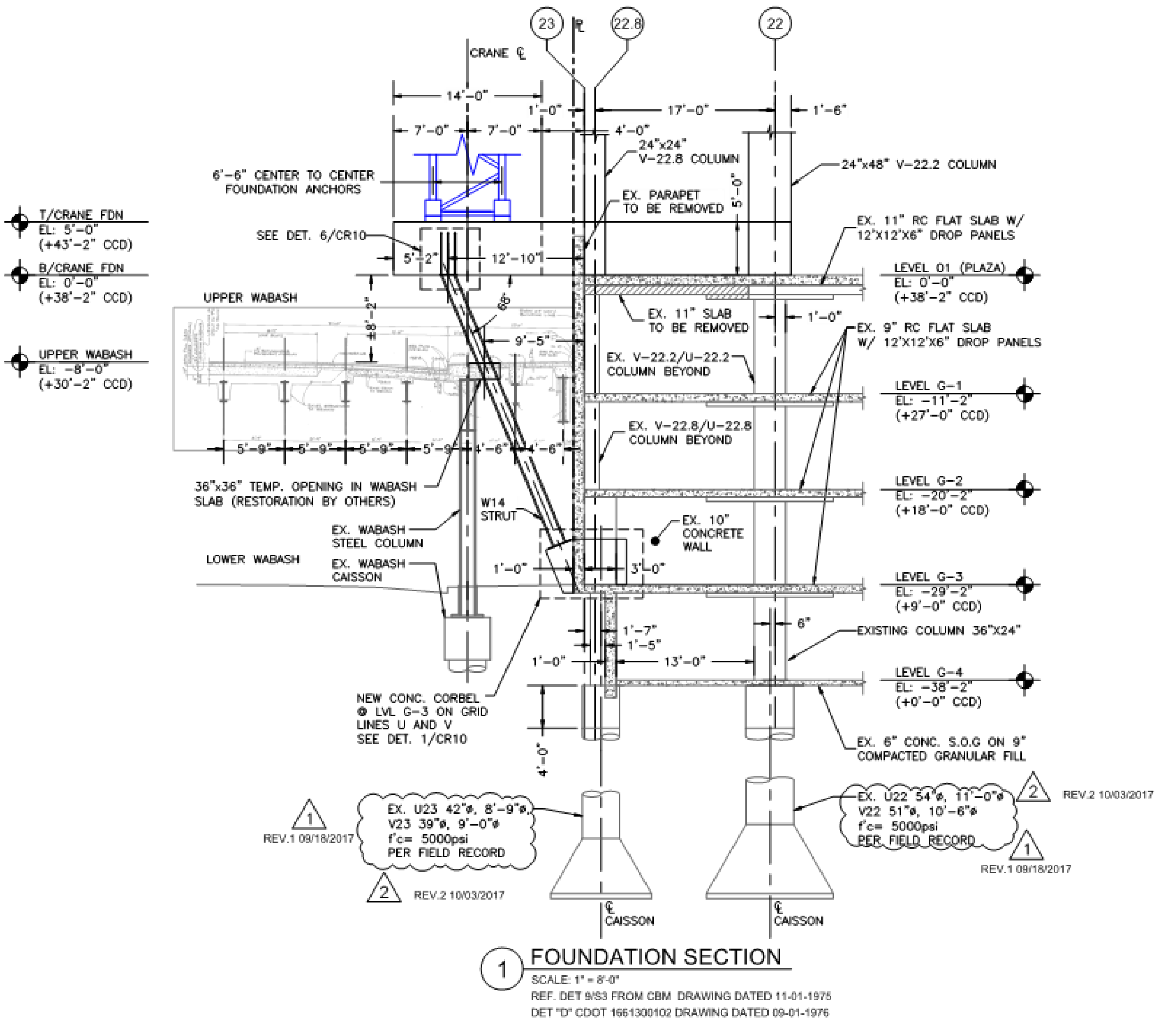
SOLUTION:

- Design “floating” crane pad that levitates 18’ out and 8’ over public way!



THE DESIGN

- No New Foundations!
- All crane loads supported by existing belled caissons
- No loads applied to Wabash Viaduct
- Sloping W14 struts supported on new conc corbels added to ex. 10” E-W walls btwn G-3 & G2



THE DESIGN

Review of 1973 boring logs, 1975 caisson field records & additional borings with pressure meter tests

Allowable design bearing pressure of 30ksf at -80CCD

Extensive concrete core testing

f'c=5500psi for ex. caisson & f'c=5000psi ex. cols, walls

CONCRETE CORE TEST REPORT

Report Number: MR155026.0005
Service Date: 09/24/15
Report Date: 10/14/15
Task:

Terracon
135 Ambassador Dr.
Naperville, IL 60540
630-717-4263

Client

Belgravia Group
Attn: Stuart Kantoff
1101 W. Monroe, Suite 200
Chicago, IL 60607

Project

403 N Wabash Tower
403 North Wabash
Chicago, IL

Project Number: MR155026

Material Information

Specified Strength:

Specified Length:
Mix ID:
Nominal Maximum Size Aggregate:

Sample Information

Placement Date:
Date Tested: 10/01/15 Time: 0000
Sampled By:
Drill Directions: Vertical
Date Core Obtained: 09/24/15 Time: 0000
Date Ends Trimmed: 09/30/15 Time: 0000
Moisture Conditioning History: According to ASTM C-42

Laboratory Test Data

Core ID	Location	Cored Length (in)	Trim Length (in)	Capped Length (in)	Diam. (in)	Area (sq in)	Length / Diam. Ratio	Max Load (lbs)	Corr. Factor	Comp. Strength (psi)	Fracture Type	Density (pcf)
1	S1, Y-20	7.4	5.1	5.3	2.74	5.90	1.92	25980	1.000	4410	3	136.9
2	S1, Y-22	8.0	5.2	5.3	2.74	5.90	1.95	39630	1.000	6720	2	138.4
3	S1, W-23	7.8	5.2	5.4	2.74	5.90	1.97	37450	1.000	6350	3	141.2
4	S1, T-21	7.4	5.0	5.0	2.75	5.94	1.81	32630	1.000	5490	1	142.2
5	S2, X-23	7.9	5.1	5.1	2.75	5.94	1.86	32130	1.000	5410	3	141.7
6	S3, X-20	6.3	5.3	5.3	2.75	5.94	1.91	49930	1.000	8410	1	141.7
7	S1, Y-21	5.5	3.3	3.3	1.77	2.46	1.85	23180	1.000	9420	3	145.5
8	S1, T-20	4.8	3.3	3.3	1.73	2.35	1.93	15610	1.000	6640	3	143.2
9	S2, T-23	5.5	3.4	3.4	1.75	2.41	1.93	13510	1.000	5620	3	136.1
10	Core # 5 Caisson	10.5	5.1	5.4	2.70	5.73	1.99	44320	1.000	7740	1	148.9
11	Core # 6 Caisson	9.0	5.1	5.3	2.70	5.73	1.97	41980	1.000	7330	1	148.5
12	Core # 7 Caisson Top	15.5	5.3	5.6	2.70	5.73	2.06	45110	1.000	7880	1	144.9
13	Core # 7 Caisson Bottom		5.1	5.3	2.70	5.73	1.97	43080	1.000	7520	1	148.8

SHEET No. 129

RIVER PLAZA APT'S
Rush & N. Water Sts.
Chicago, Ill.

16991-C

HARDPAN CAISSON FIELD RECORD

CAISSON No. U-23 CAISSON MARK

DATE EXCAVATION START 11-6-75 FINISH 11-7-75
BOTTOM APPROVED 11-7-75
CONCRETE PLACED 11-7-75

	DESIGN	ACTUAL
TOP ELEV. *	-4.67	-4.67
BOTTOM ELEV. *	-72.00'	-82.54
SHAFT DIAMETER	36"	36"
BELL DIAMETER	8'9"	8'0"
CAISSON LENGTH	67.33	77.87
NO & SIZE OF BARS	8-#8	8-#6
BAR LENGTH	14	14
TIES	13-#4	13-#4
TOP ALIGNMENT *	4% = 1 3/4	0"N/S, 0"E/W
BOTTOM ALIGNMENT	1% = 8"	
CONCRETE VOLUME	— c.y.	37 c.y. **
GROUT VOLUME	— c.y.	12 c.y. **

ELEV.: -4.67

TEMPORARY TOP CAPING
TOP ELEV.: 15.48
LENGTH:

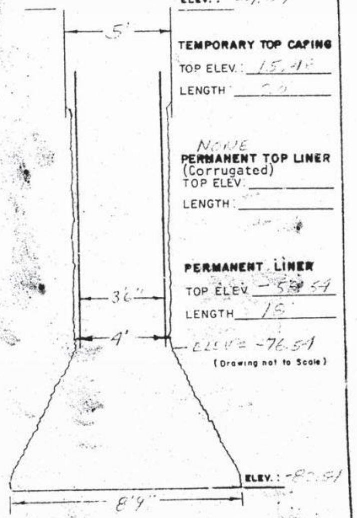
NONE
PERMANENT TOP LINER (Corrugated)
TOP ELEV.
LENGTH:

PERMANENT LINER
TOP ELEV -59.54
LENGTH 15

CONCRETE STRENGTH: ______ psi, ______ DAY
REQ'D 5000 psi - 28yd³ ______ psi ______ DAY
* 6500 psi - 9yd³ ______ psi, ______ DAY

TEST PROBE DEPTH & RESULTS NONE

UNCONF. COMP. STRENGTH 15.0 tsf
SOIL DESCRIPTION HARDPAN
DESIGN BEARING 15.0 tsf, APPROVED 15.0 tsf
ELEV. REFERENCE Chicago City Datum



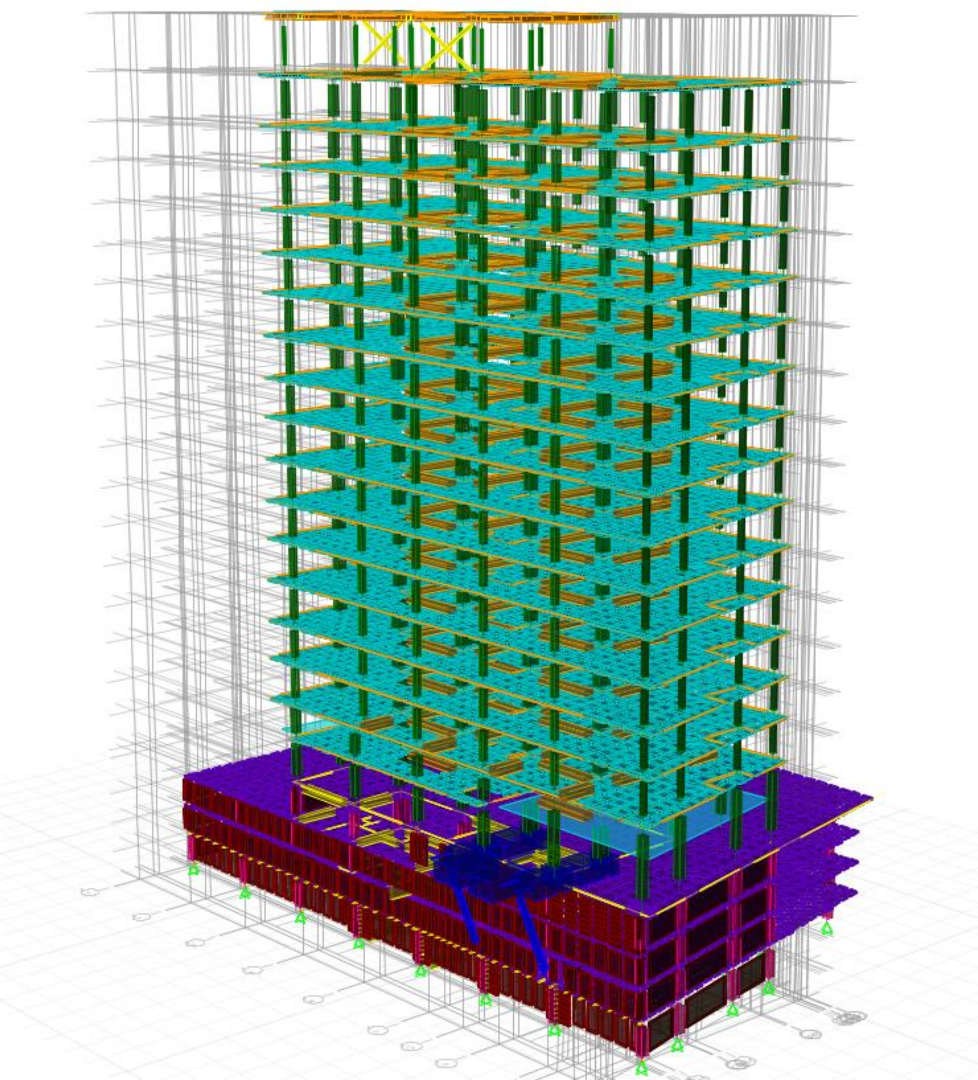
REMARKS FIRST 9yd³ OF CONCRETE WAS 6500 psi BECAUSE SHAFT WAS REDUCED THROUGH THE PERMANENT STEEL CASING BY TWO TO THREE INCHES

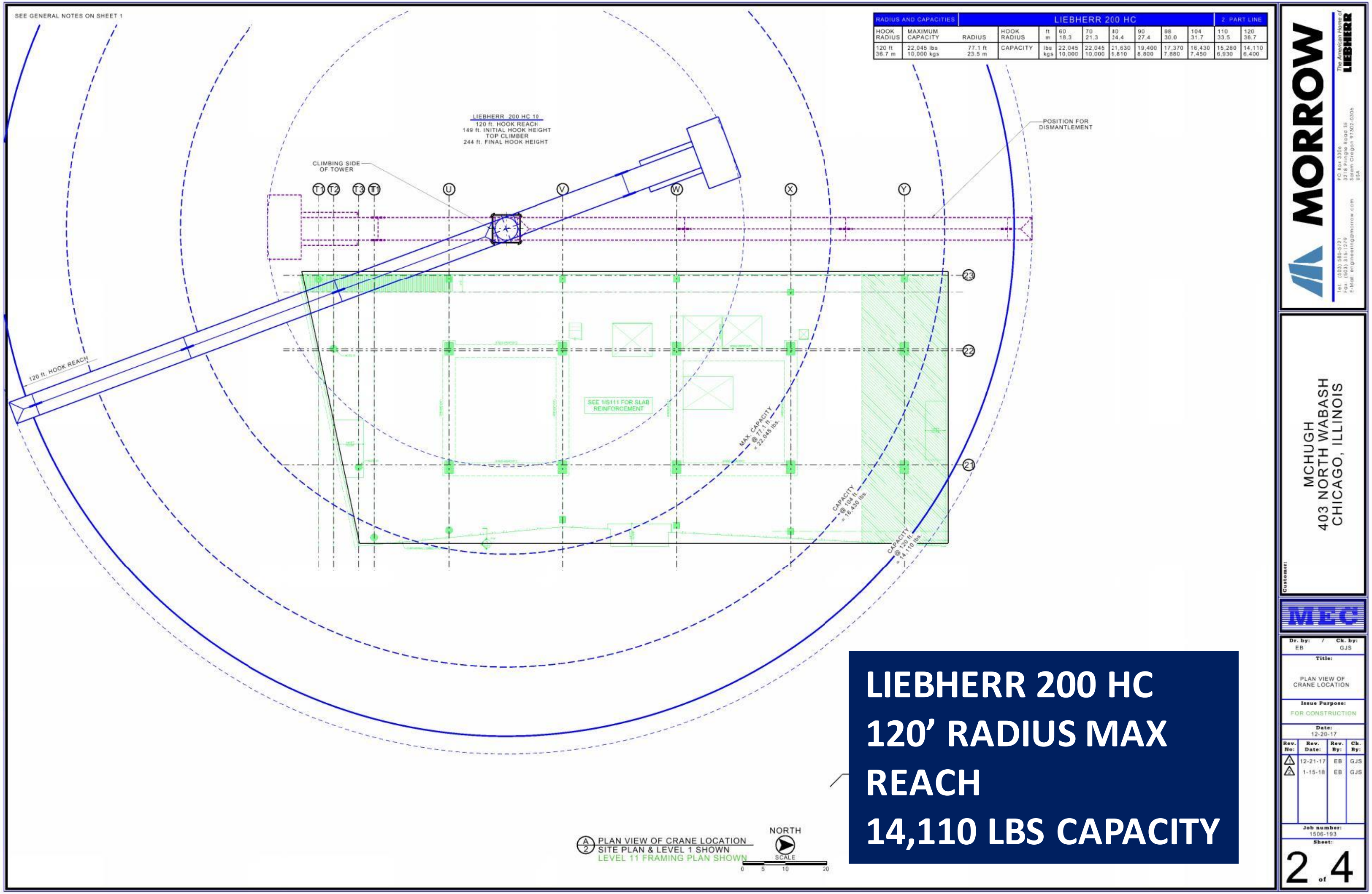
* BY OTHERS ** BASED ON CONC. TICKETS

STRUCTURAL ENGINEER Cohen, Baretto, Marchertas
INSPECTED BY SOIL TESTING SERVICES, INC.
CAISSON CONTR. Case International
GEN. CONTR. Jas. McHugh Construction Co.

THE DESIGN

- Tower Crane fdn added to shared SEOR ETABS model
- Load Combinations w/ TC forces added
- ETABS model include ASCE 37 temp. structure 0.85 reduction factor. During construction, LL is assumed to be 50% full design LL
- Building check for additional Tower Crane forces:
  - Caisson Vertical Reaction
  - Story Forces
  - Story Drift
- Tower Crane Beam Design
- W14x211 Strut Design
- Corbel Design
- Strut Connection Design
  - W14- TC Mat Connection
  - W14- Corbel Connection
- Existing column check





RADIUS AND CAPACITIES			LIEBHERR 200 HC									2 PART LINE	
HOOK RADIUS	MAXIMUM CAPACITY	RADIUS	HOOK RADIUS	ft m	60 18.3	70 21.3	80 24.4	90 27.4	98 30.0	104 31.7	110 33.5	120 36.7
120 ft 36.7 m	22,045 lbs 10,000 kgs	77.1 ft 23.5 m	CAPACITY	lbs kgs	22,045 10,000	22,045 10,000	21,630 9,810	19,400 8,800	17,370 7,880	16,430 7,450	15,280 6,930	14,110 6,400

LIEBHERR 200 HC
120' RADIUS MAX REACH
14,110 LBS CAPACITY

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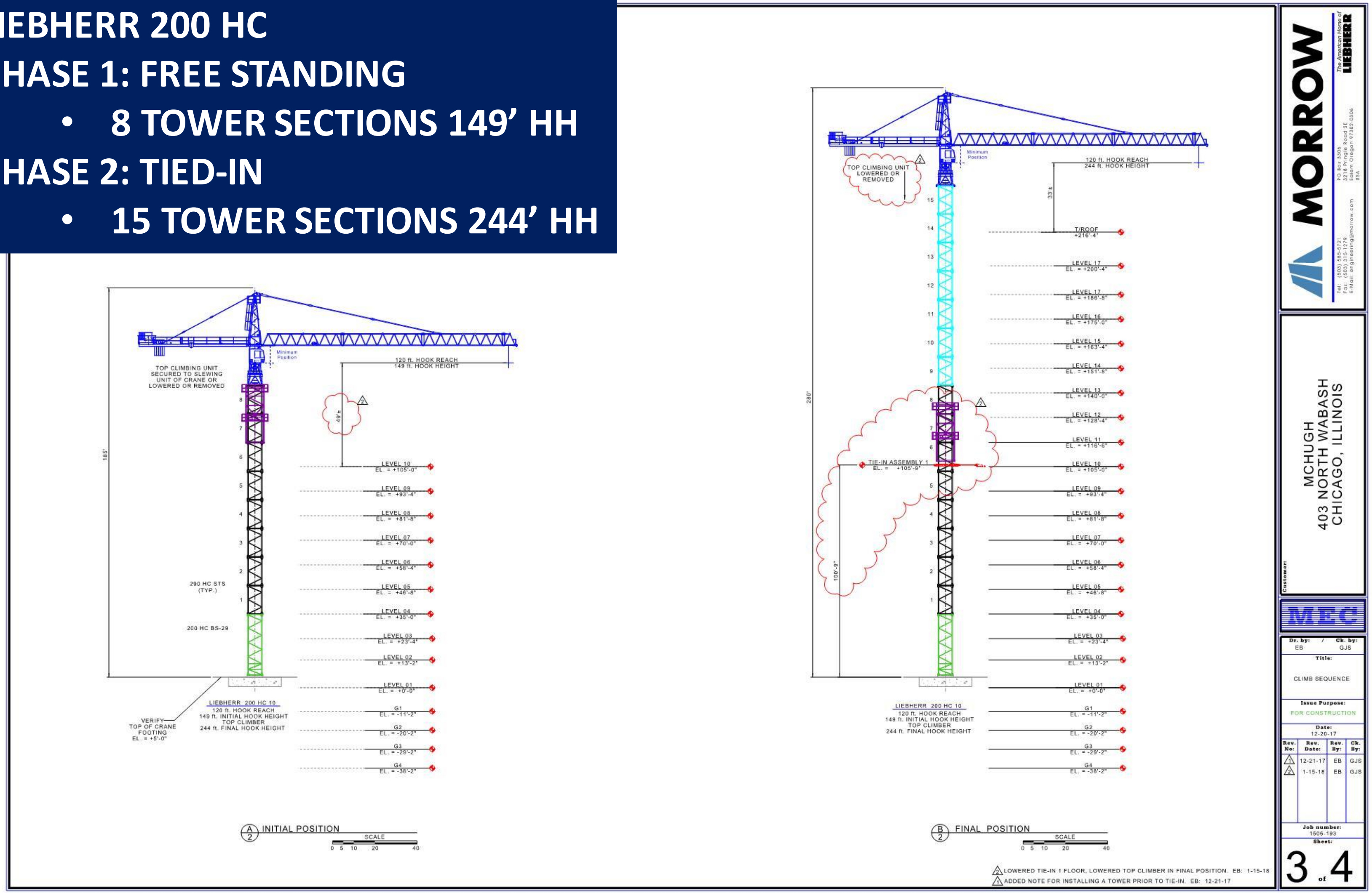
LIEBHERR 200 HC

PHASE 1: FREE STANDING

- 8 TOWER SECTIONS 149’ HH

PHASE 2: TIED-IN

- 15 TOWER SECTIONS 244’ HH



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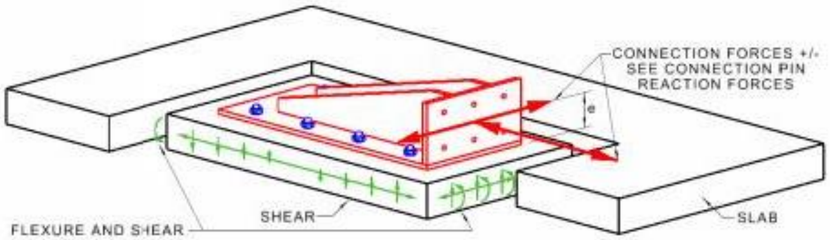
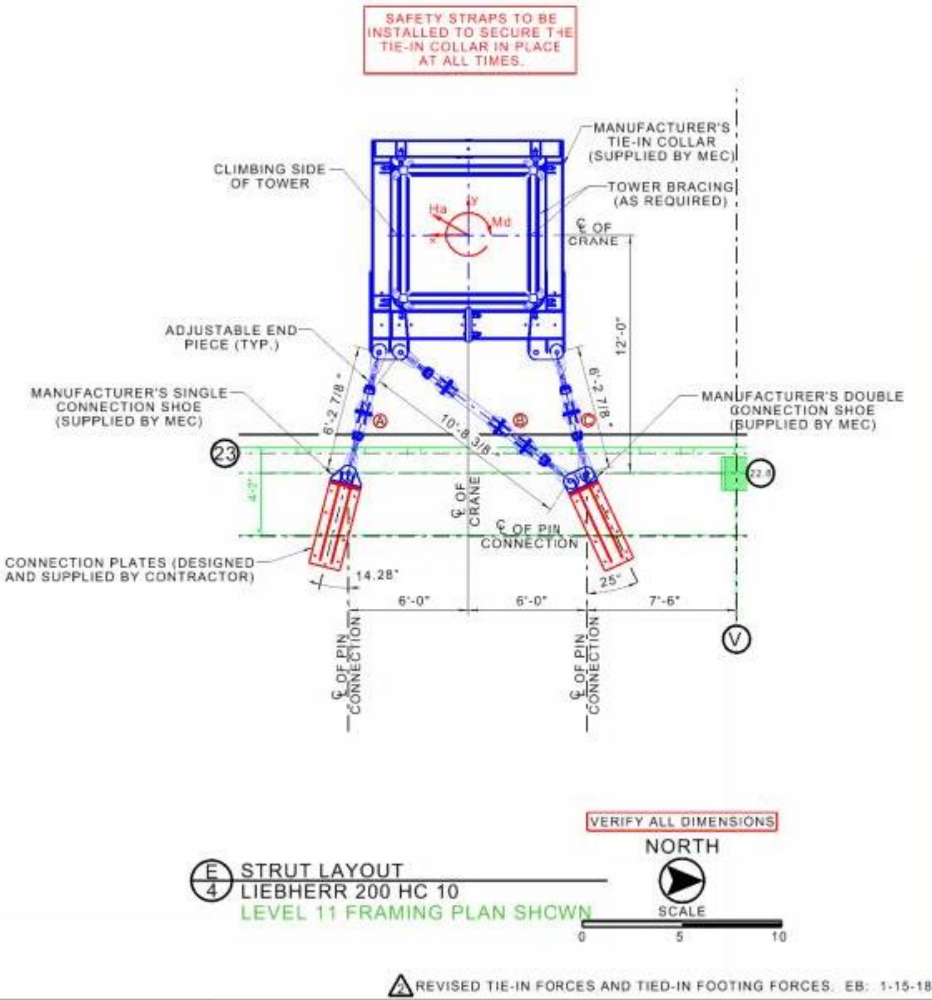
NOTE: THE ABOVE CONNECTION PIN REACTIONS ARE FOR THE CLIMBING SEQUENCE SPECIFIED ON THE ATTACHED PAGES AND THE STRUT LAYOUT INDICATED ON THIS PAGE. IF AT ANY TIME THE CLIMBING SEQUENCE OR STRUT LAYOUT SHOULD CHANGE, MEC'S ENGINEERING DEPARTMENT MUST BE NOTIFIED TO DETERMINE IF THE CONNECTION PIN REACTIONS HAVE CHANGED.



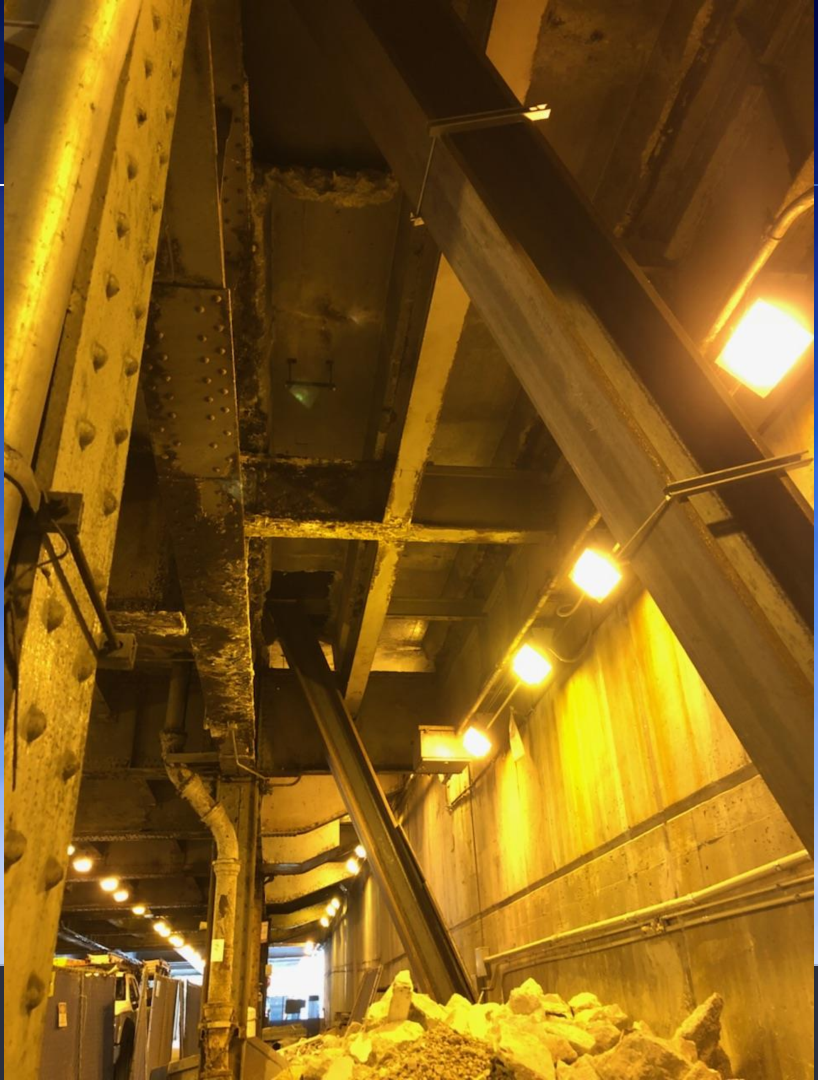
ACI 318-11 11.11.7
TRANSFER OF UNBALANCED MOMENT IN SLAB-COLUMN CONNECTIONS

1. ALL TIE-IN ASSEMBLY COMPONENTS SUPPLIED BY CONTRACTOR MUST BE DESIGNED BY AN ENGINEER REGISTERED WITH THE PROJECT LOCAL JURISDICTION.
2. CYCLIC LOADS WITH REVERSAL WILL OCCUR. ALL BOLTS SHALL BE DESIGNED AND TENSIONED FOR CYCLIC LOADING CONDITIONS.
3. THE TRANSFER OF UNBALANCED MOMENT IS ONE OF THE MOST CRITICAL DESIGN CONDITIONS FOR TWO WAY SLAB SYSTEMS. THE CONCRETE FLOOR SHALL BE DESIGNED AND REINFORCED AT EACH TIE-IN ASSEMBLY FOR TRANSFER OF ECCENTRIC LOADS BY SHEAR AND FLEXURE IN THE SLAB PER ACI 318 BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.



Construction

- Critical path
- Field verification
- Select the right mix!
- Demo considerations



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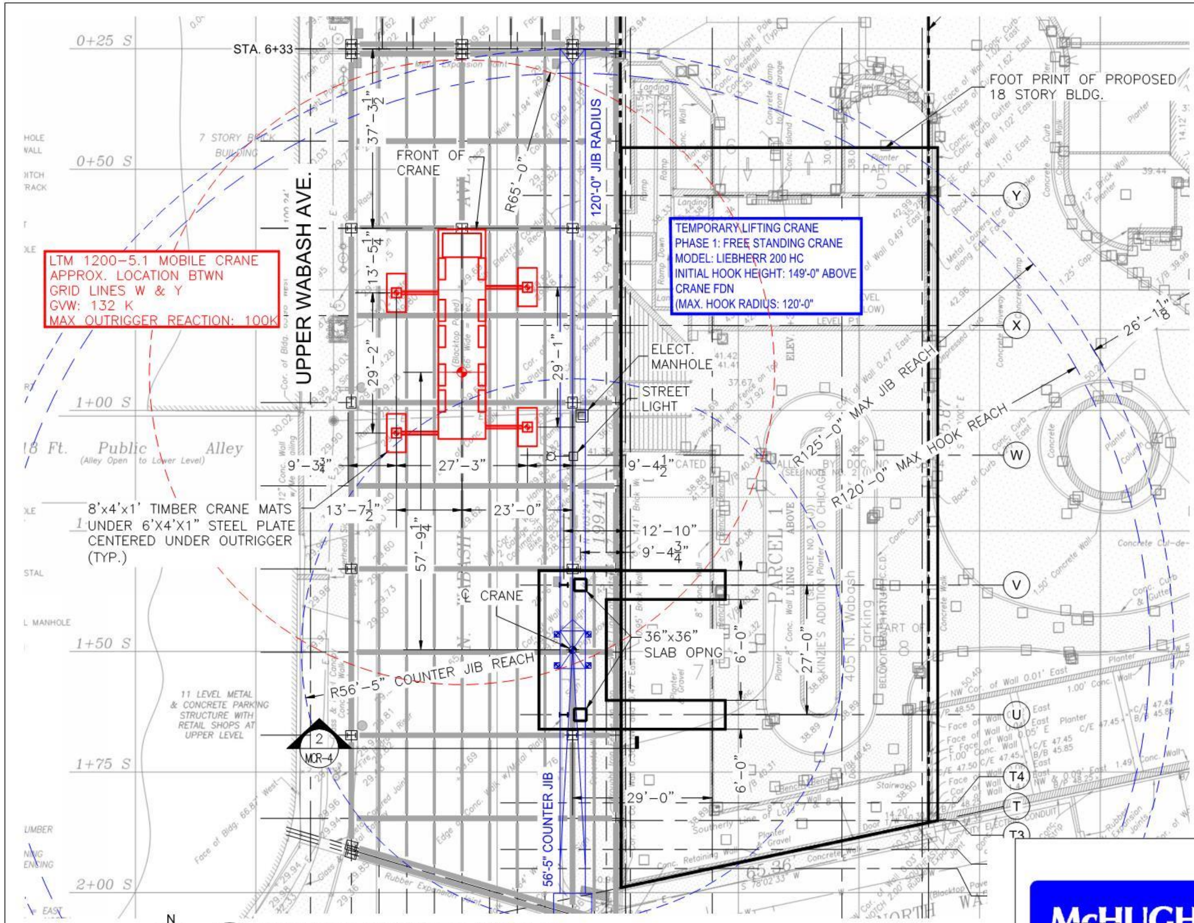

1 MOBILE CRANE LAYOUT

SCALE: 1" = 20'-0"

REF. C-300 SPACECO PROJECT DRAWINGS ,

1661300094 CDOT ARCHIVE WABASH AVE. VIADUCT REPAIR DWG. DATED 09-01-76

SHORING NOTES

- ENSURE THAT ALL PERI PRODUCTS ARE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS
- PROPS SHALL BE INSTALLED VERTICALLY PLUMB WITH MAX 1/8" IN 3 FT OUT OF VERTICAL
- PROPS ARE TO BE INSTALLED SNUG TIGHT
- DURING CRANE TRAVEL AND OPERATION, FREQUENT INSPECTION OF PROPS SHALL BE PERFORMED TO ENSURE THAT THEY REMAIN PLUMB AND SNUG TIGHT
- SHORES SHALL BE LAID OUT SUCH THAT MISALIGNMENT DOES NOT ~~EXCEED 4 IN.~~
- PROPS TO BE PRE-LOADED TO 10% OF ANTICIPATED LOAD (1200LBS) SPECIFIED BY CDOT TO BE ACHIEVED BY PROP SCREW MECHANISM

1 REV.1 10-02-2017

1 REV.1 10-02-2017

McHUGH

Description: TEMPORARY CONSTRUCTION MOBILE CRANE ON EXISTING BRIDGE – LTM 1200-5.1
403 N. WABASH, CHICAGO, IL

MOBILE CRANE LAYOUT

SIZE	Drawn By: AHL	DWG NO. MCR-1	REV
SCALE As Shown	ISSUE: ISSUE FOR PERMIT	Date: 31 AUGUST 2017	

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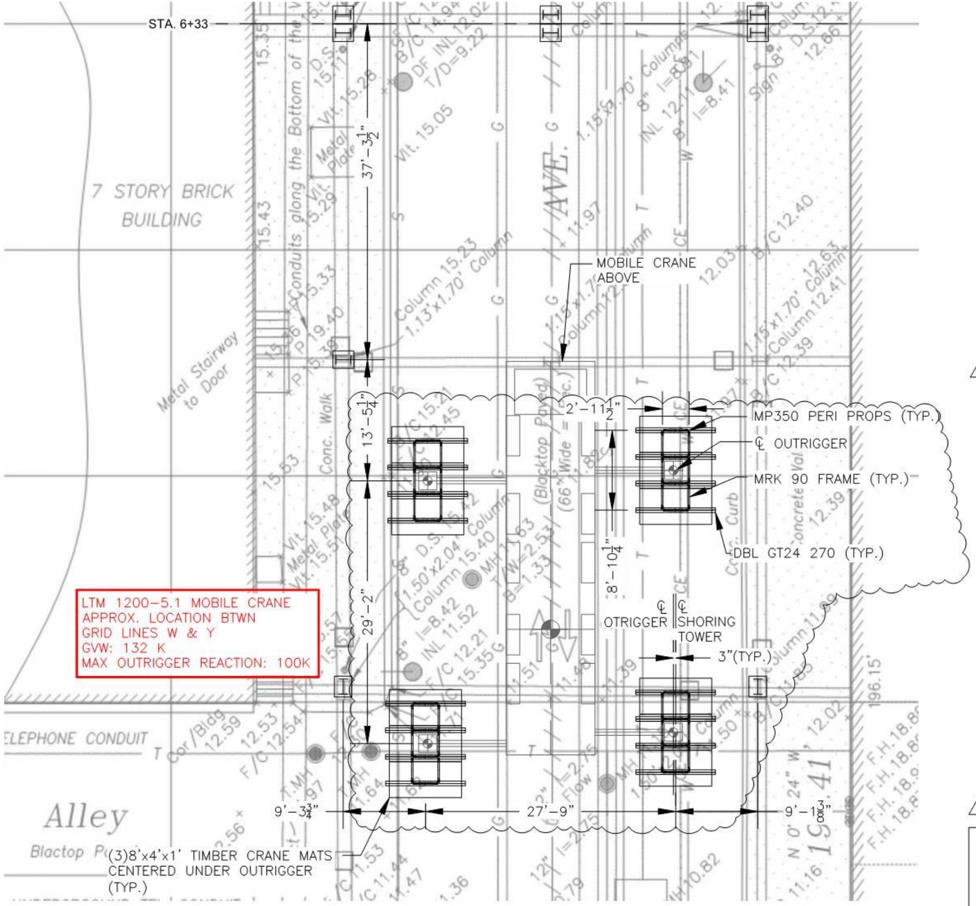

1 LOWER WABASH PLAN

SCALE: 3/32" = 1'-0"

REF. C-301 SPACECO PROJECT DRAWING.

2 REV.2 11-09-2017

2 REV.2 11-09-2017

McHUGH	Description: TEMPORARY CONSTRUCTION MOBILE CRANE ON EXISTING BRIDGE – LTM 1200–5.1 403 N. WABASH, CHICAGO, IL
	MOBILE CRANE LAYOUT
	SIZE · Drawn By: AHL · DWG NO. MCR–3 · REV
	SCALE: As Shown · ISSUE: ISSUE FOR PERMIT · Date: 31 AUGUST 2017

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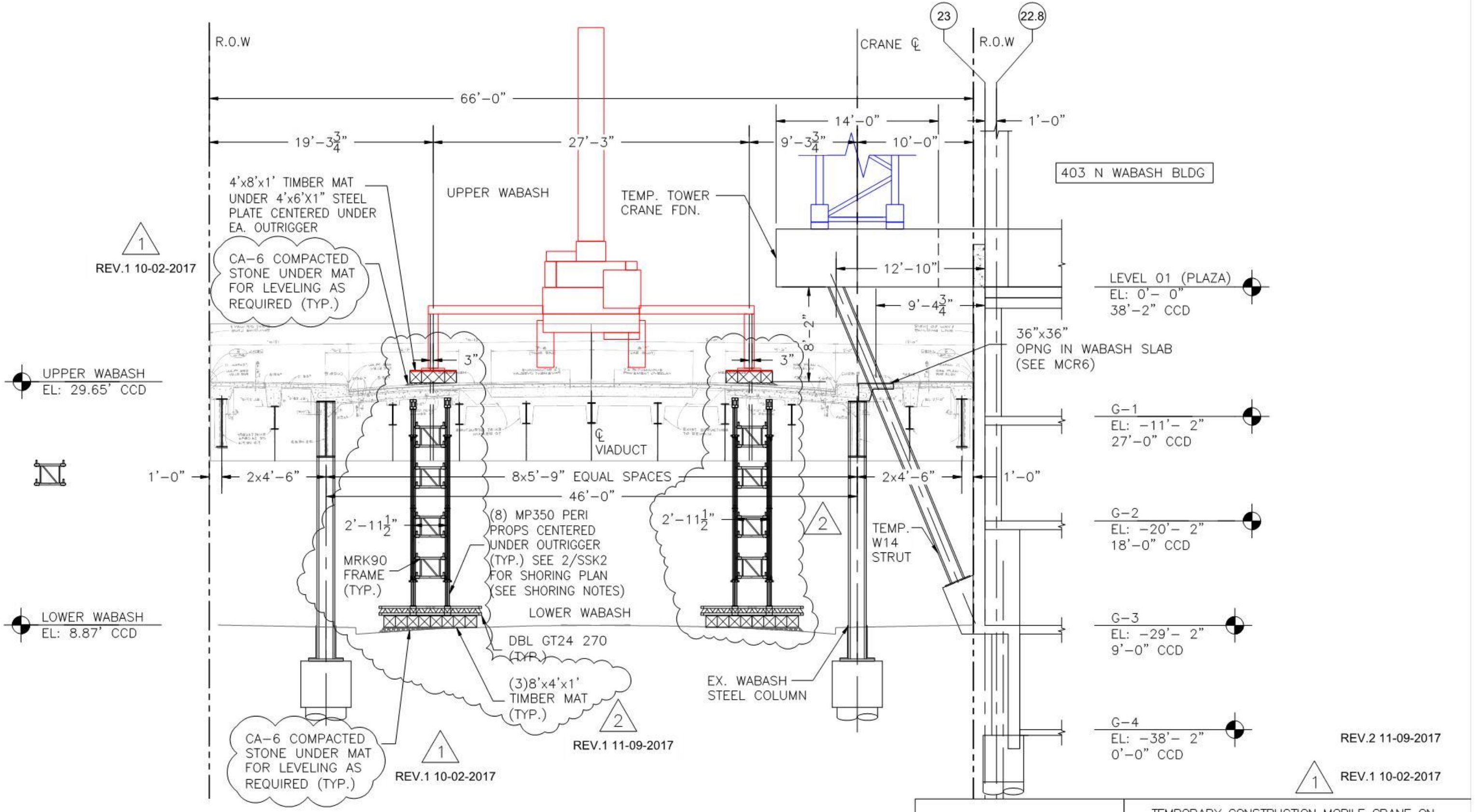

1 SECTION

SCALE: 1/8" = 1'-0"

REF. 1661300102 CDOT ARCHIVE WABASH AVE. VIADUCT REPAIR DWG DATED 09-01-76

McHUGH

Description: TEMPORARY CONSTRUCTION MOBILE CRANE ON EXISTING BRIDGE – LTM 1200–5.1
403 N. WABASH, CHICAGO, IL

WABASH AVE VIADUCT SECTION

SIZE	Drawn By: AHL	DWG NO. MCR–4	REV
SCALE As Shown	ISSUE: ISSUE FOR PERMIT	Date: 31 AUGUST 2017	

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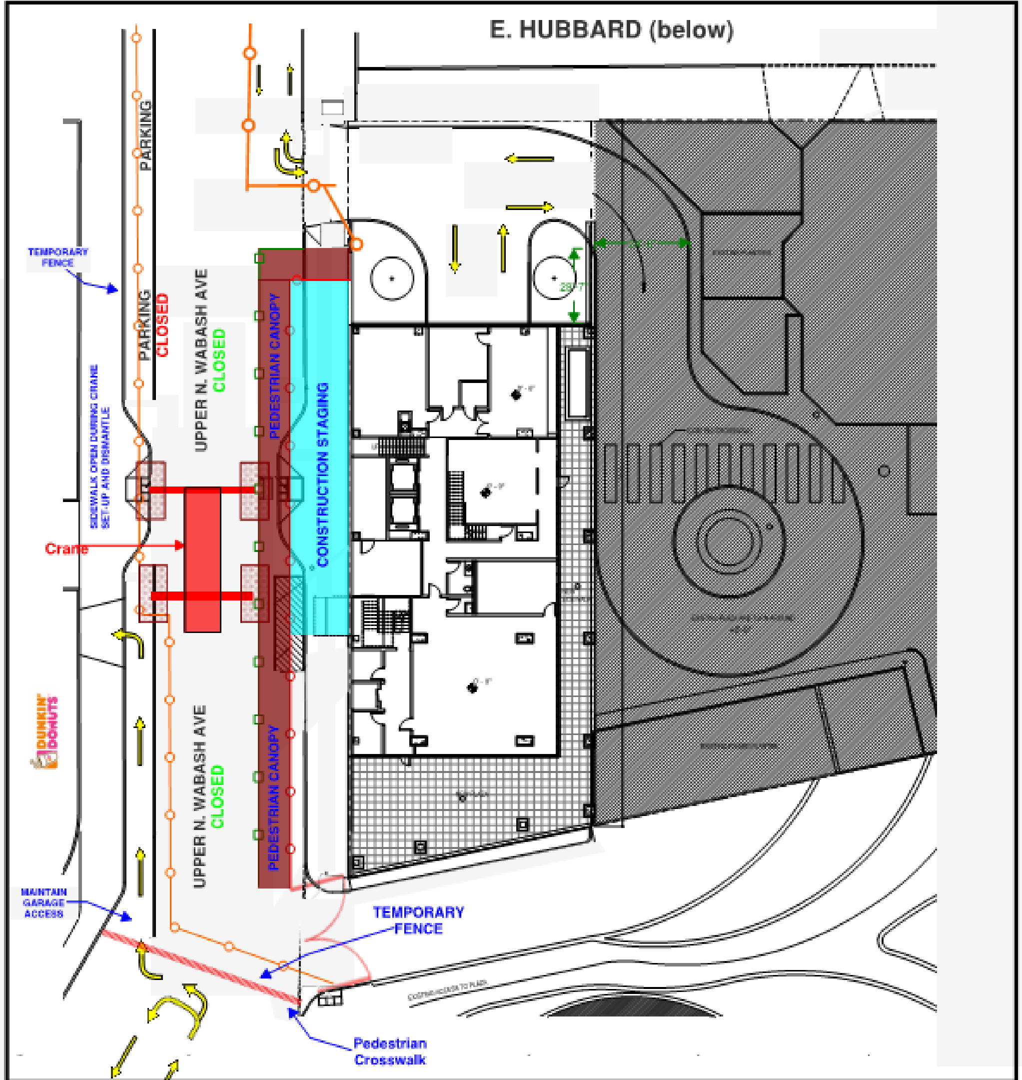
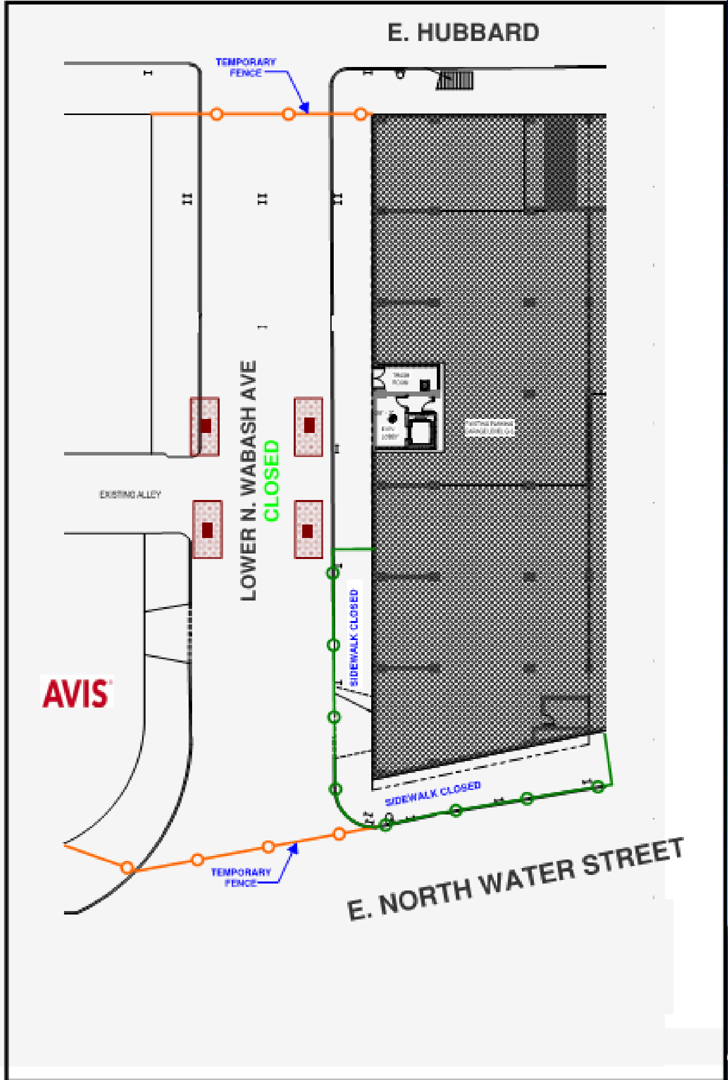
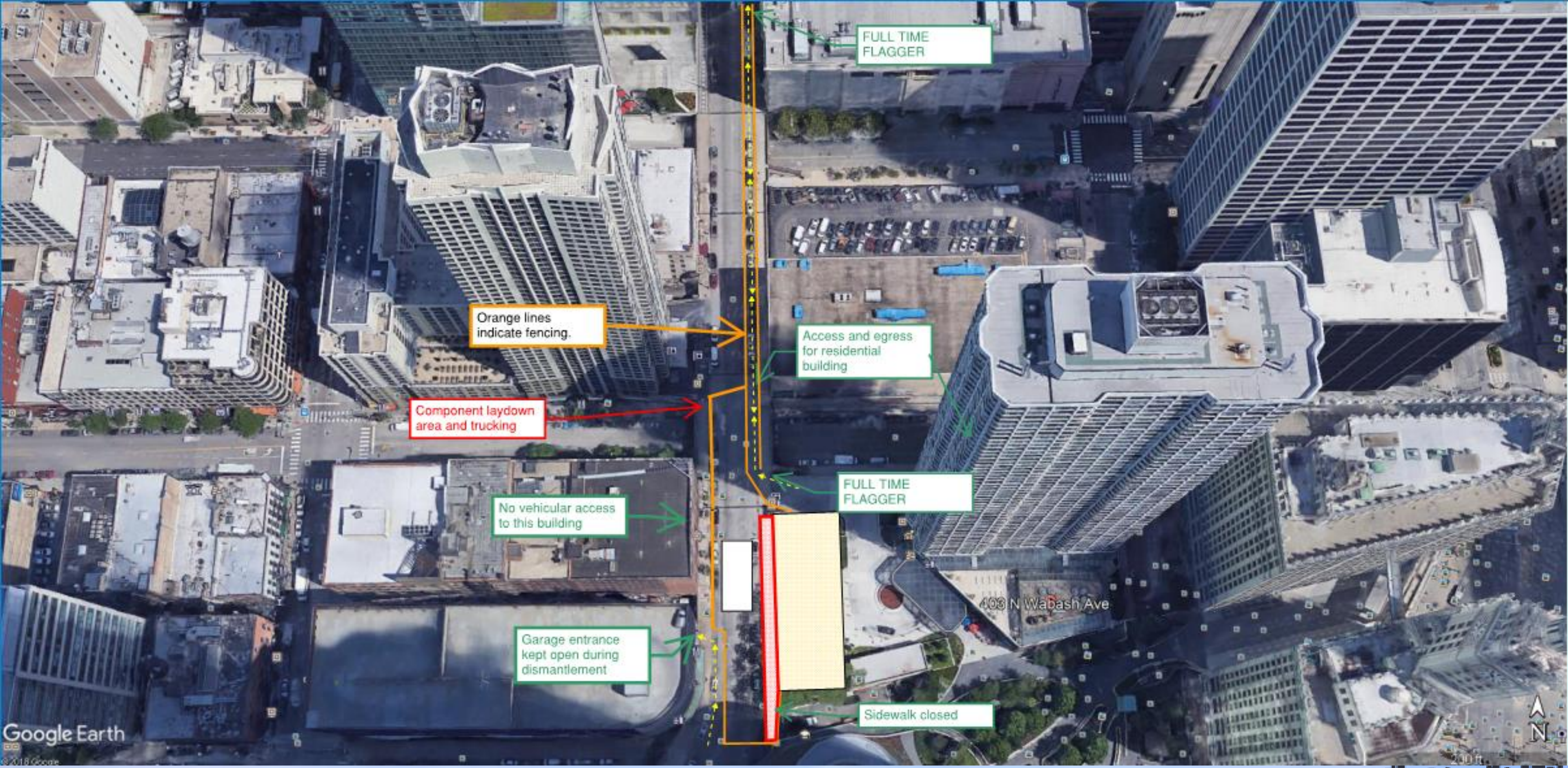

E. HUBBARD (below)
PARKING
TEMPORARY FENCE
PARKING
CLOSED
UPPER N. WABASH AVE
CLOSED
PEDESTRIAN CANOPY
CONSTRUCTION STAGING
SIDEWALK OPEN DURING CRANE SET-UP AND DISMANTLE
Crane
UPPER N. WABASH AVE
CLOSED
PEDESTRIAN CANOPY
MAINTAIN GARAGE ACCESS
TEMPORARY FENCE
Pedestrian Crosswalk


E. HUBBARD
TEMPORARY FENCE
EXISTING ALLEY
LOWER N. WABASH AVE
CLOSED
AVIS
SIDEWALK CLOSED
SIDEWALK CLOSED
TEMPORARY FENCE
E. NORTH WATER STREET



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CONCLUSIONS

- Think outside the box
- Need LOTS of info, FAST!
- Requires team effort
- Careful planning & execution

Thank You!

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