



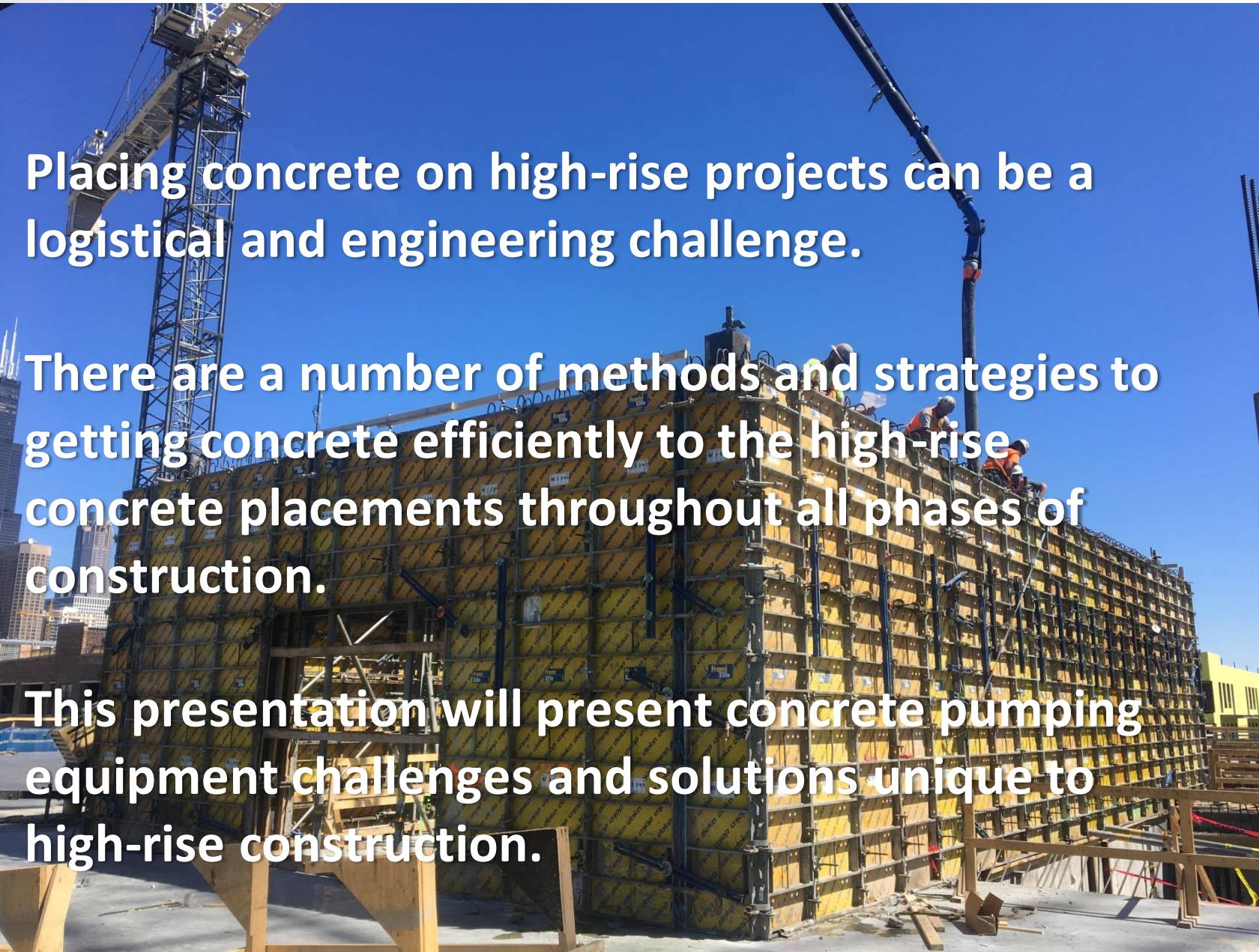
What Are We Going to Pump That With?

“What has really made the difference for concrete construction [is] the development of high-strength concrete mixes, the greatly increased efficiency of concrete pumps and placing booms and the development of forming systems that can be erected safely and quickly, then moved to the next location.”

- **Stan Korista**

Skidmore, Owings & Merrill





Placing concrete on high-rise projects can be a logistical and engineering challenge.

There are a number of methods and strategies to getting concrete efficiently to the high-rise concrete placements throughout all phases of construction.

This presentation will present concrete pumping equipment challenges and solutions unique to high-rise construction.

ACI 304.2R-17

Guide to Placing Concrete by Pumping Methods

Reported by ACI Committee 304



History & Background



History & Background

- First patented concrete pumps patented in 1913
- After WWII, rebuilding of Europe spurred on development and adoption of concrete pumps & booms
- German companies Putzmeister & Schwing world leaders in technology development

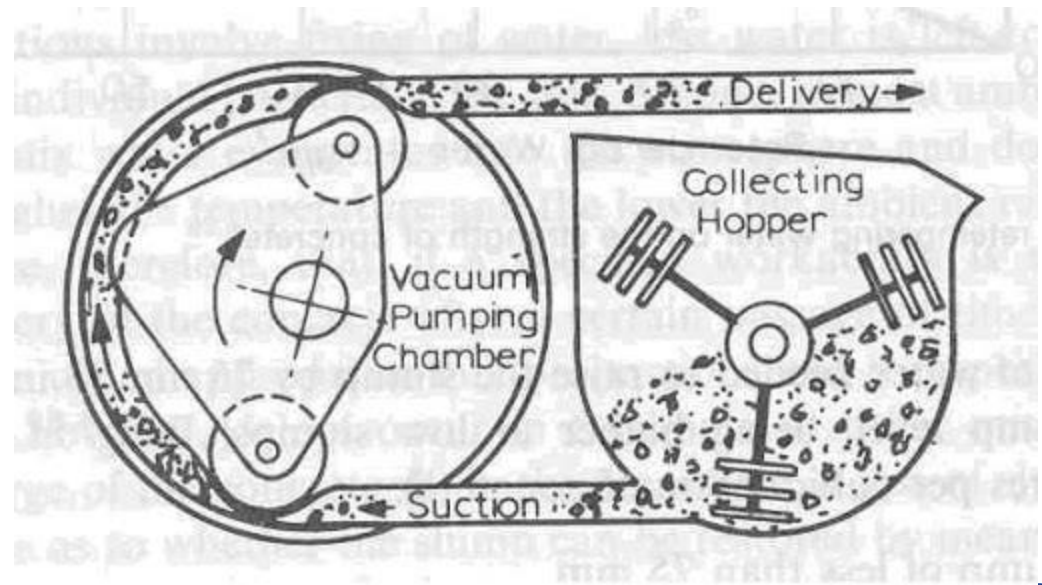


First Putzmeister truck-mounted concrete pump with M 16 boom and 100 mm delivery line on Mercedes-Benz L 808

Pumps

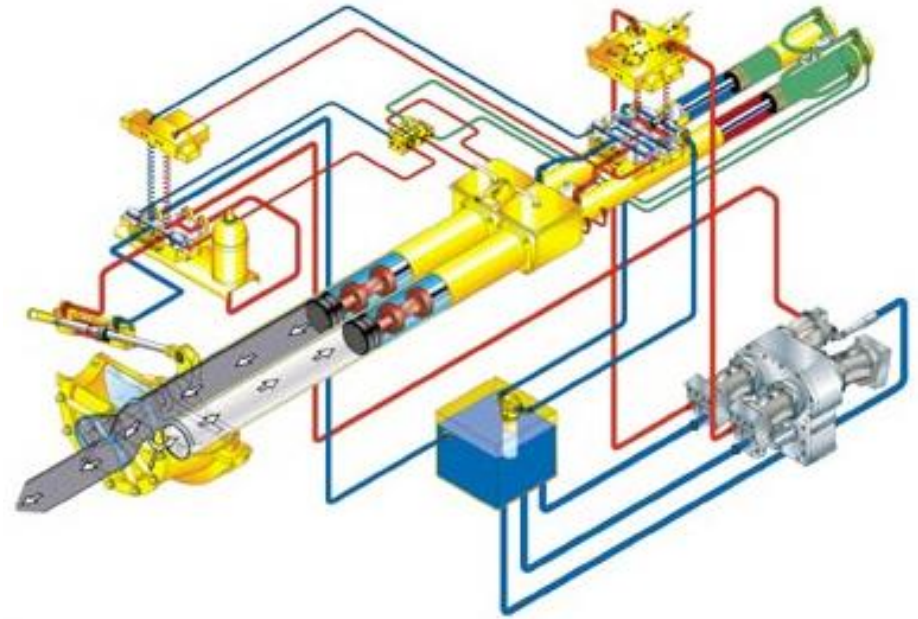
Types of Pumps

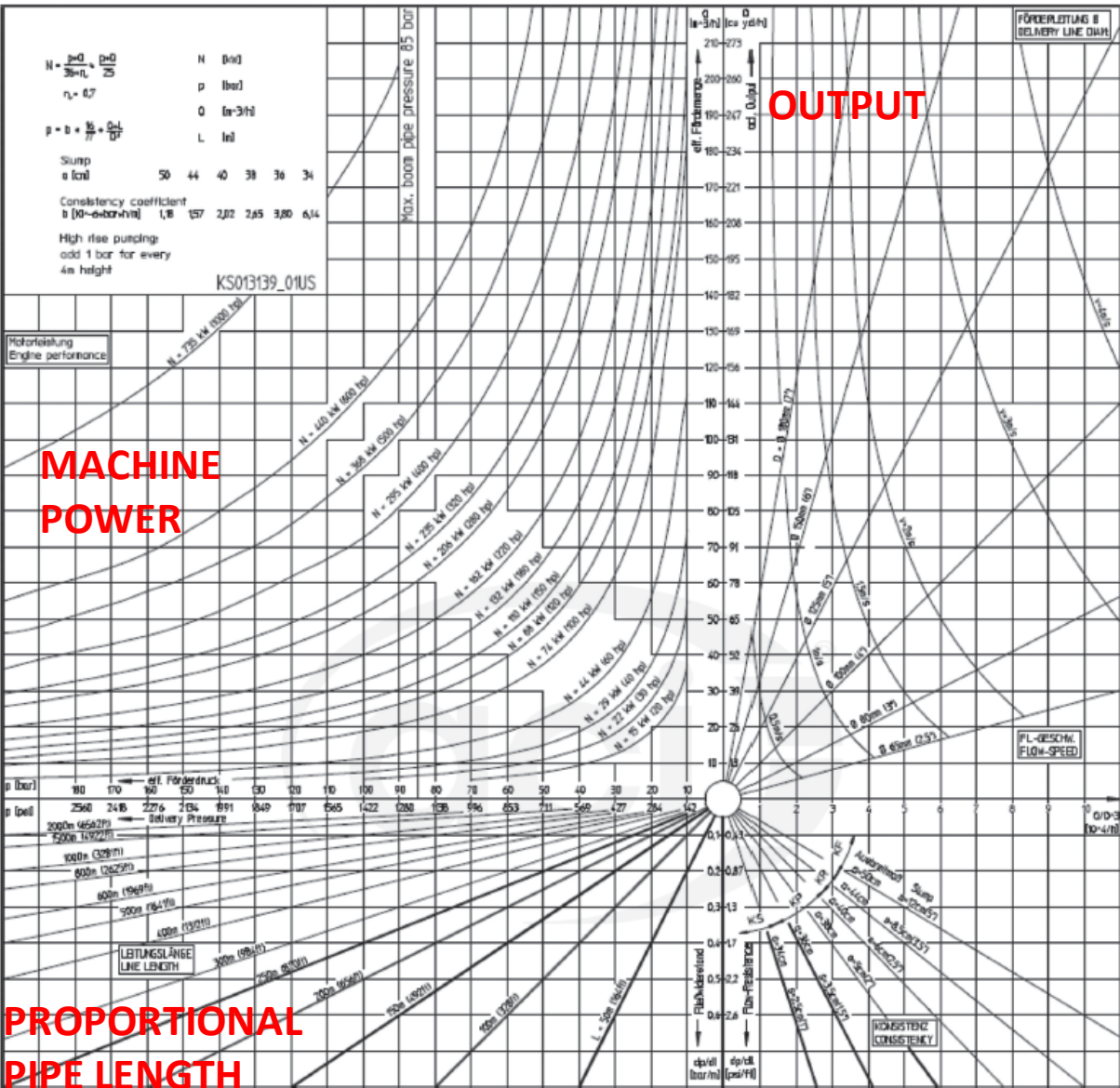
- Pneumatic Pumps
 - Limited use, primarily used in shotcrete applications
- Squeeze pumps
 - Low pressure & smooth flow
 - Limited distance and limited to highly flowable concrete, grout, cellular concrete, shotcrete



Types of Pumps

- Hydraulic piston pump
 - Most common
 - Can pump high volumes at very high pressures
 - 133 cubic yards/hour at 150 bar with cut off at 250 bar
 - Pump great height and distances (max ht >600m)
 - Burj Khalifa (2008) 606m @ 200 bar
 - Upto 571 kW Diesel Engine





PUMP PRESSURE

MACHINE POWER

OUTPUT

PIPE DIA

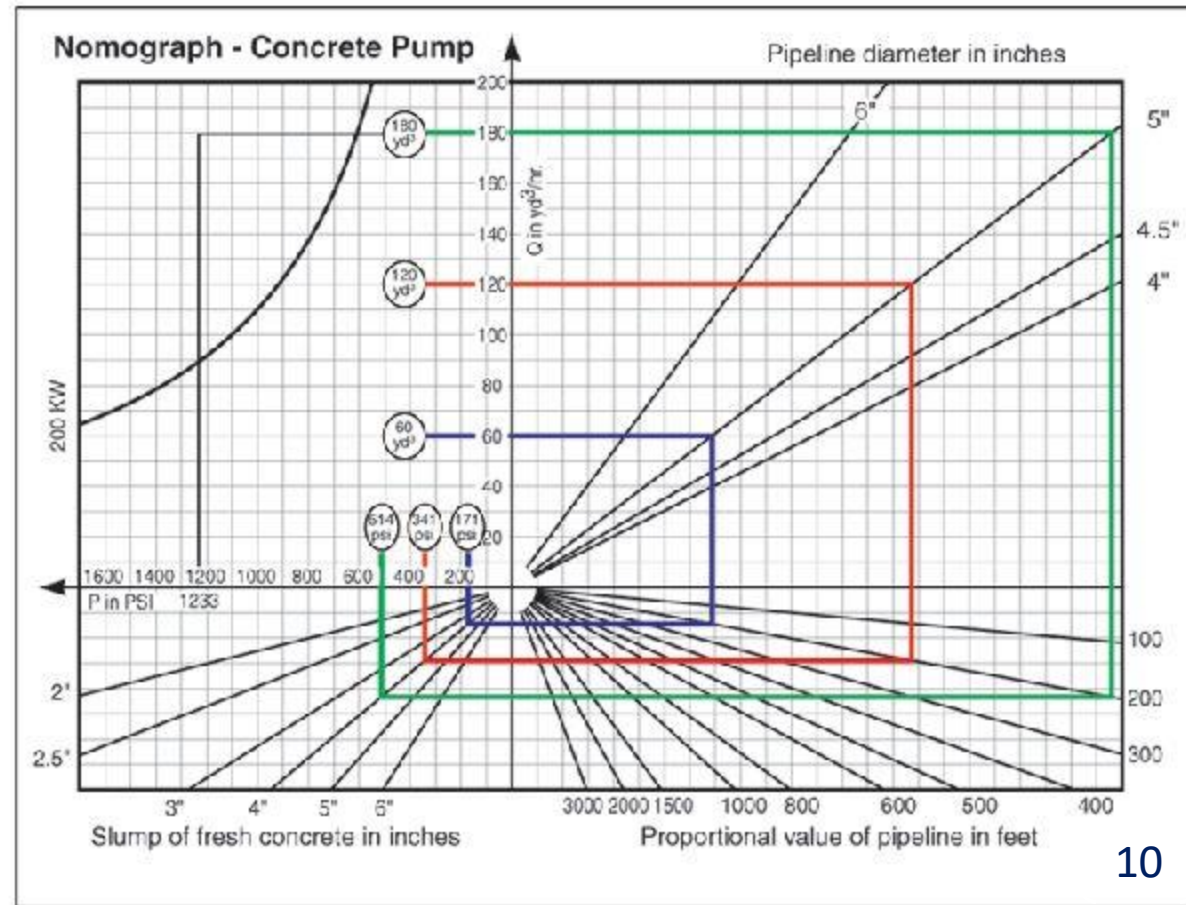
CONCRETE SLUMP

PROPORTIONAL PIPE LENGTH

Fig. 5.4—Pressure-volume nomograph (courtesy of Putzmeister).

Sizing Pumps

- Pump Pressure Function of...
 - Machine Power
 - Output
 - Pipe Diameter
 - Proportional Length of Pipe, including provisions for bends (add 1m for each 90 bend)
 - Concrete Slump
 - Height difference (add 1 bar for each m ht)



Sizing Pumps

Sizing Pumps

- Online tools available

Machine power

↑

<input type="text" value="200"/>	Pressure [bar]
<input type="text" value="58.9"/>	Output [m ³]
<input type="text" value="471.20"/>	Power [kw]
<input type="text" value="640.83"/>	Power [hp]

$$\text{power} = \frac{\text{pressure} \cdot \text{output}}{25}$$
$$\text{pressure} = \frac{25 \cdot \text{power}}{\text{output}}$$
$$\text{output} = \frac{25 \cdot \text{power}}{\text{pressure}}$$

Delivery line pressure

↑

<input type="text" value="1.57"/>	Tenacity factor [b]
<input type="checkbox"/>	Water/cement factor <0,42
<input checked="" type="checkbox"/>	Water/cement factor >0,42
<input type="text" value="700"/>	Pipe length [m]
<input type="text" value="150"/>	Pipe diameter [mm]
<input type="text" value="30"/>	Output [m ³ /h]
<input type="text" value="600"/>	Height difference [m]
<input type="text" value="193.78"/>	Delivery pressure [bar]

$$\text{Press.} = \text{height diff.} \cdot 0.24 + \frac{b \cdot 16 \cdot \text{output} \cdot \text{length}}{\pi \cdot \text{diameter}^3}$$

Pipes

Sizing Pipe

- Size pipe based on project pumping parameters
- Wall thickness reqd as a function of pressure, $T=P*d(3/10,000)$ (SI)
- Hardened Steel Pipe w/ min. S.F. = 2.0
- Pipe reused
 - Requires inspection, visual & wall thickness measurement.
 - Track yardage conveyed
 - Newer pipe cycled in at high pressure areas
- Bolted or quick release couplings

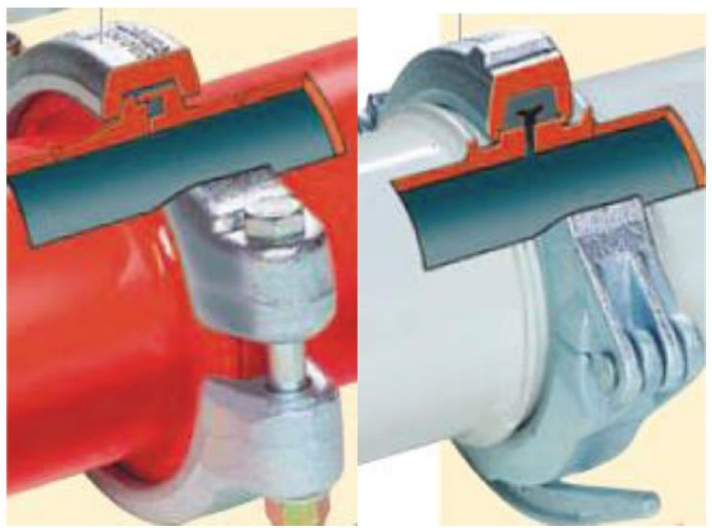
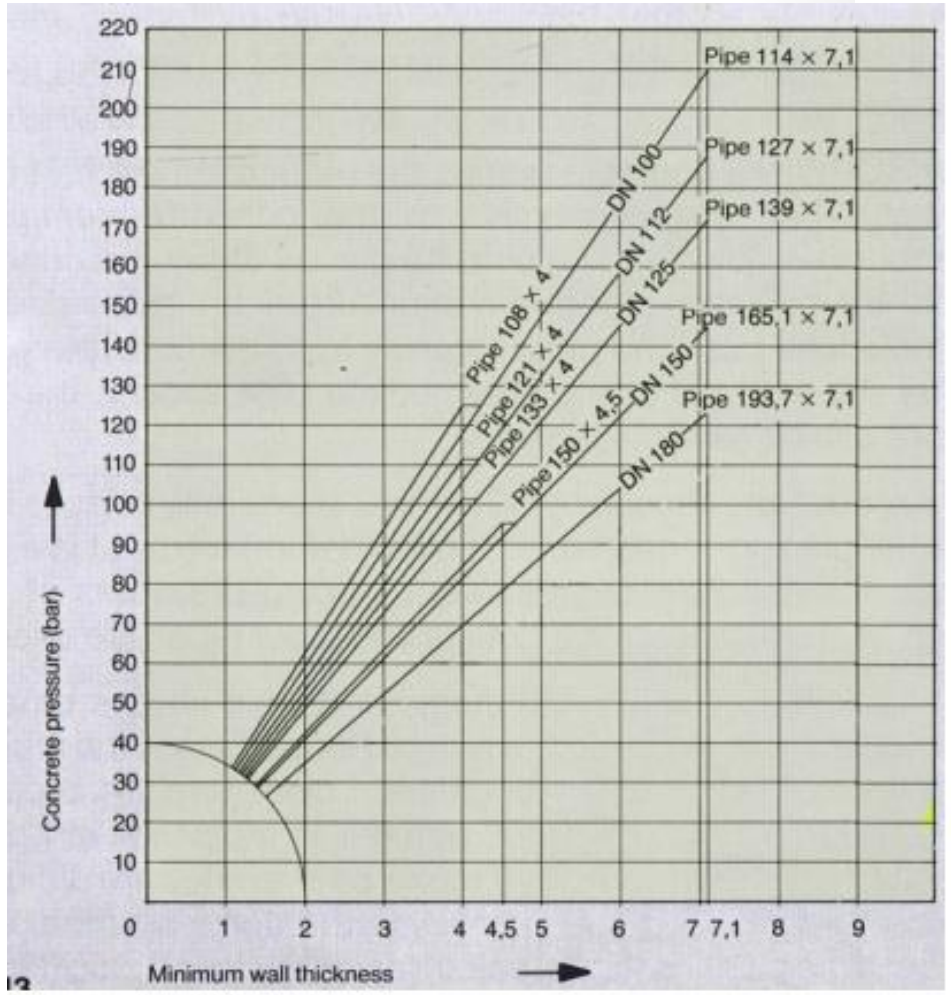


Fig. 4.7.3.1—Pipeline connection types (photo courtesy of Esser Pipe Technology).



Pipe life expectancy

- 1/2" wall – 120,000 yds
- 1/4" wall – 60,000 yds

Securing Pipe

- Pipe needs to be well anchored!!



Horizontal Pipe line anchored to floor



90° turn anchored in a concrete block



Vertical turn anchored in concrete

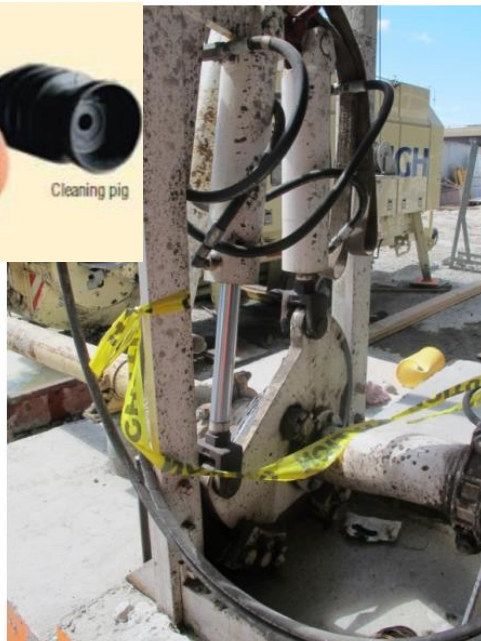
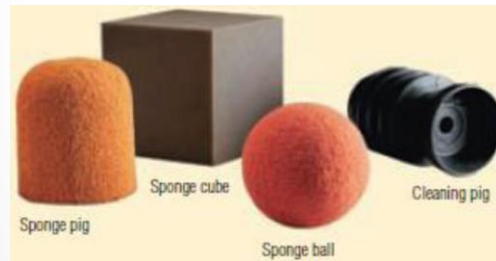
CLEANING OUT

Compressed air with sponge pig for clean out

- Safety issues, only trained personnel
- Close coordination between working deck crew and pump operator to prevent air pockets
- E Mod mixes are problematic, needed to purge line with a traditional 4ksi mix into conc bucket before cleanout

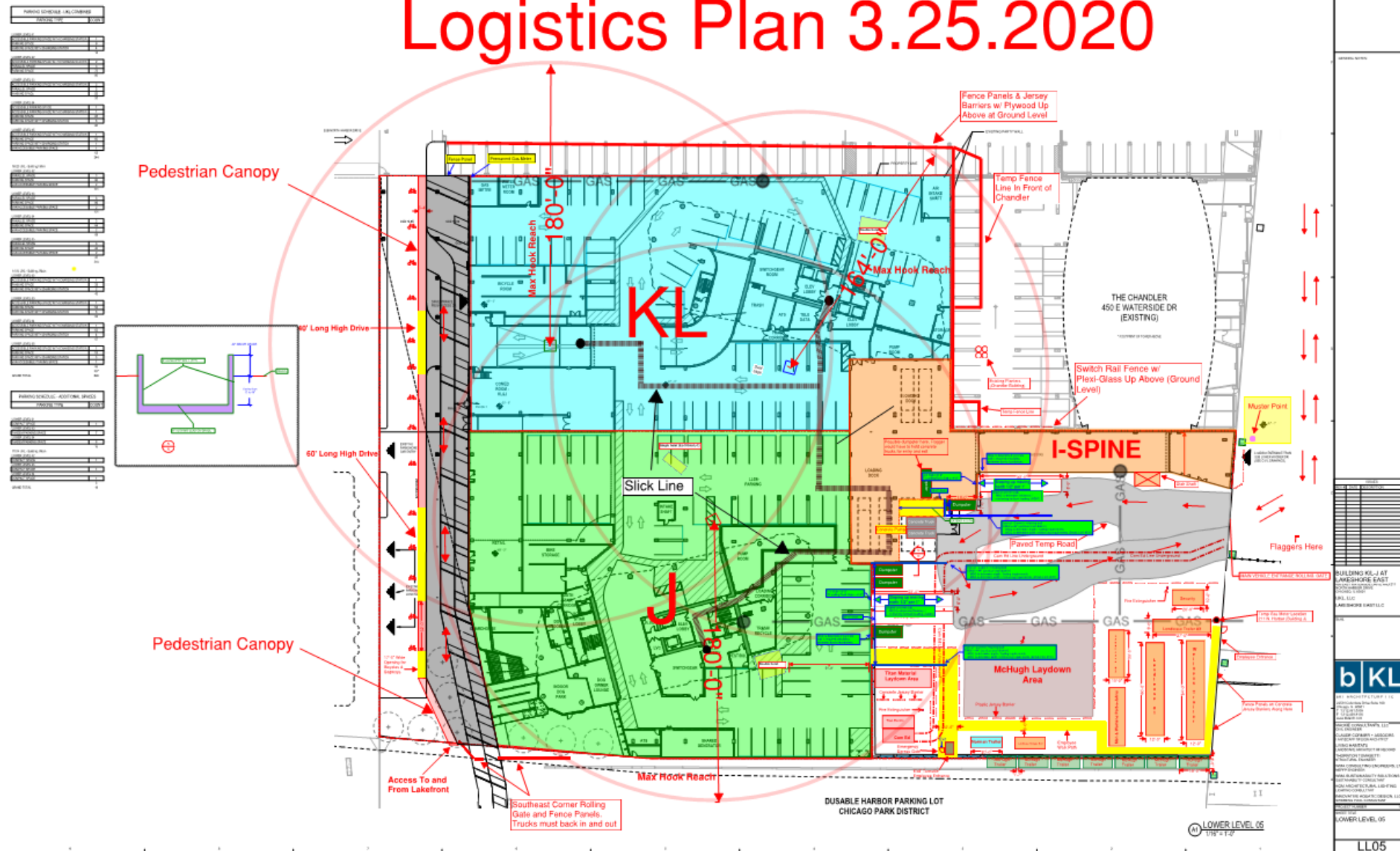


This discharge pipe sends the concrete back into the truck to be taken away. Notice the trap basket to catch the sponge ball



This valve switches the pipeline from the pump to the discharge pipe

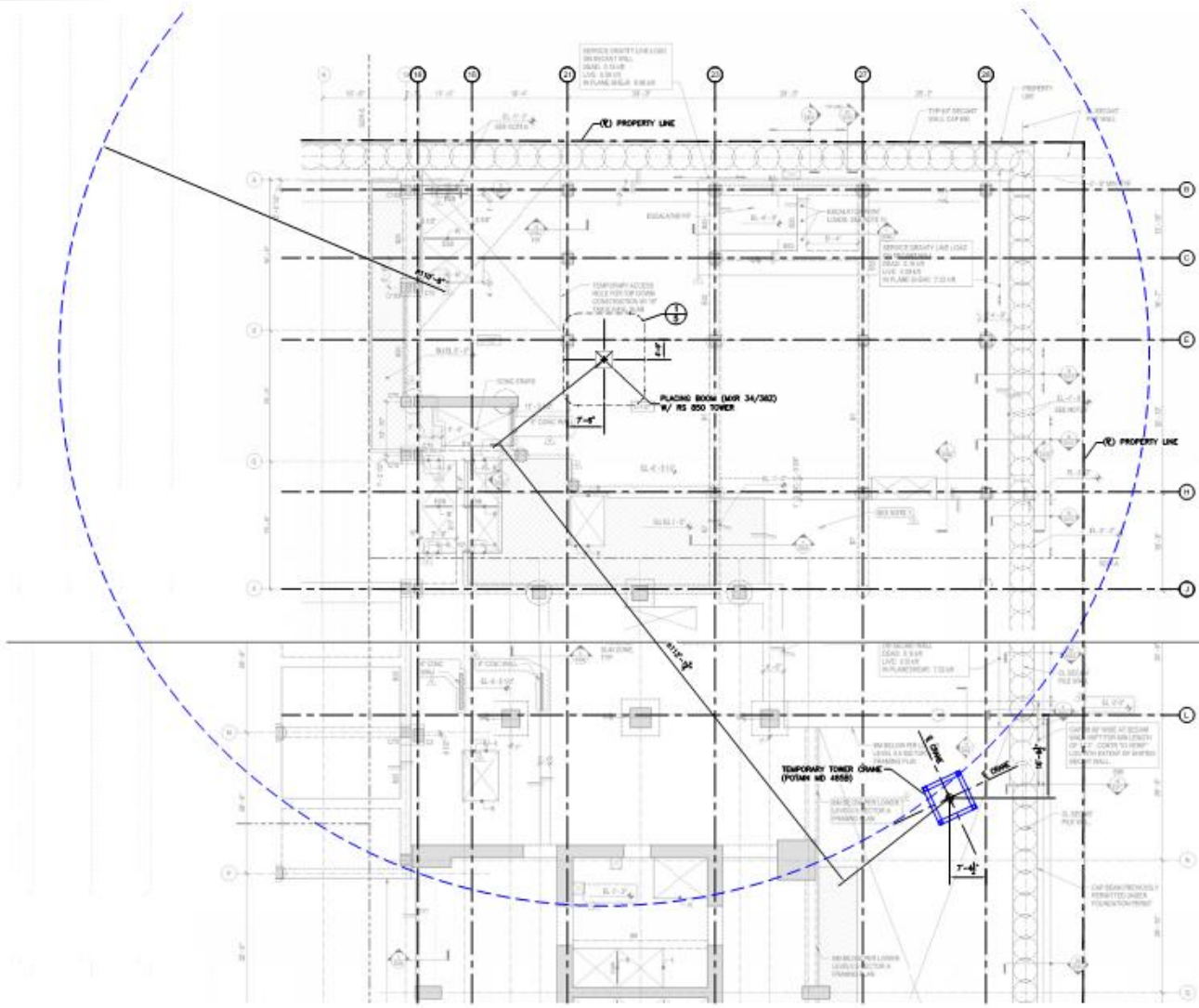
Logistics Plan 3.25.2020



Pump Placement

- Easily accessible from public road
- Room for two trucks at pump
- Room for staging trucks
- Good practice to have a horizontal run of 10% of vertical height





- GENERAL NOTES:**
1. CONTRACTOR TO VERIFY ALL DIMENSIONS AND SITE CONDITIONS IN FIELD PRIOR TO COMMENCING WITH WORK OR FABRICATION OF STEEL COMPONENTS. ANY ERRORS, OMISSIONS OR UNUSUAL FIELD CONDITIONS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
 2. THE INSTALLATION, OPERATION AND MAINTENANCE OF THE PLACING BOOM (MOR 34/382) IS TO BE IN ACCORDANCE WITH THE IBC (LATEST EDITION) AND APPLICABLE ANSI CODE & OSHA RULES.
 3. ALL MANUFACTURER'S INSTALLATION, OPERATION, MAINTENANCE, AND DISMANTLING INSTRUCTIONS AS SPECIFIED IN THE PUTZMEISTER SERVICE MANUAL FOR RS 850 TOWER ARE TO BE FOLLOWED.
 4. DO NOT OPERATE THE PLACING BOOM WHEN THE WIND SPEED EXCEEDS 45 MPH.
 5. THE OPERATION OF THE PLACING BOOM MAY LOOSEN BOLTS AND FITTINGS. CHECK BOLTS AND FITTINGS REGULARLY FOR TIGHTNESS.
 6. TOWER TO BE PLUMB AND PACKED OUT TO LEVEL, AS REQUIRED PER MANUFACTURER'S MANUAL.

Range from 24 m to 42m (79'-137') working radius

1 PLACING BOOM LAYOUT
 SCALE: 1/8" = 1'-0"
 REF. S201A AND S201B LEVEL 1 SECTOR PLAN A AND B
 MAGNUSSON KLEMENCIC ASSOCIATES (MKA), DATED 11-22-2019



McHUGH INSTALLATION OF PUTZMEISTER PLACING BOOM MODEL 34/382 ON RS 850 TOWER ONE CHICAGO SQUARE, CHICAGO, IL
 PLACING BOOM LAYOUT AREA "B"



02-13-20
EXPIRES: 11-30-20

SHORING SCHEDULE	
BUILDING STORY HEIGHT	TYPE OF SHORES (MIN. TOTAL CAPACITY 800PSF)**
UP TO 11.5 FT	(S)-MF30
UP TO 15 FT	(S)-MF40
UP TO 19 FT	(S)-MF25

NOTES:

- (S) REMOVAL SHORES: (1) BELOW EACH LOWER WEDGE CORNER BRACKET AND (2) BELOW EACH HORIZONTAL BOLT/TWANSVERSE BEAM BY PUTZMEISTER. SEE DET. 1, 4 AND 5 ON SHEET 1.
- OCURS ONLY BELOW SLAB SUPPORTING HORIZONTAL BOLTS/TWANSVERSE BEAMS.
- (S) REMOVAL SHORES (T) (1) BELOW EACH LOWER WEDGE CORNER BRACKET AND (2) BELOW EACH HORIZONTAL BOLT/TWANSVERSE BEAM BY PUTZMEISTER. SEE DET. 1, 4 AND 5 ON SHEET 1.

* THE SHORING SCHEDULE FEATURES PRODUCTS BY PERI FORMING. OTHER PRODUCTS MAY BE SUBSTITUTED IF OF EQUIVALENT LOAD CARRYING CAPACITY.

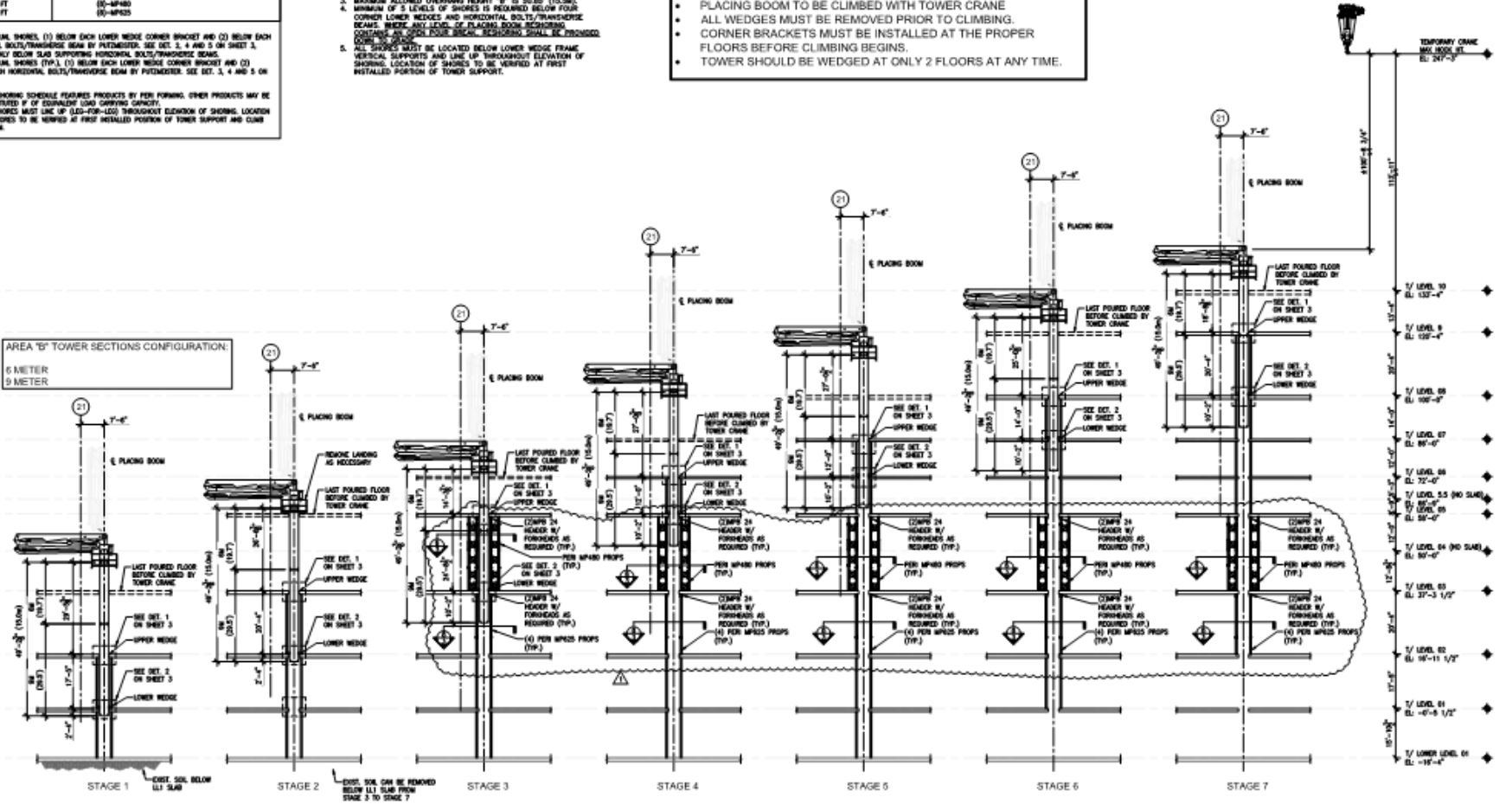
** ALL SHORES MUST LINE UP (LEG-FOR-LEG) THROUGHOUT ELEVATION OF SHORING. LOCATION OF SHORES TO BE VERIFIED AT FIRST INSTALLED POSITION OF TOWER SUPPORT AND CLIMB SYSTEM.

- IMPORTANT NOTES:**
- PLACING BOOM REST POSITION AND CLIMBING POSITION SHOULD BE VERTICAL.
 - MINIMUM ANCHORING HEIGHT "C" IS 12.0' (3.66M) BETWEEN THE CONNECTED FLOORS.
 - MAXIMUM ALLOWED OVERHANG HEIGHT "B" IS 50.25' (15.50M).
 - MINIMUM OF 5 LEVELS OF SHORES IS REQUIRED BELOW FOUR-CORNER LOWER WEDGES AND HORIZONTAL BOLTS/TWANSVERSE BEAMS. VERIFY ANY LEVEL OF PLACING BOOM SCHEDULED FOR CONSTRUCTION OF CONCRETE SLAB. SCHEDULE SHALL BE PROVIDED TO THE CONTRACTOR.
 - ALL SHORES MUST BE LOCATED BELOW LOWER WEDGE FRAME VERTICAL SUPPORTS AND LINE UP THROUGHOUT ELEVATION OF SHORING. LOCATION OF SHORES TO BE VERIFIED AT FIRST INSTALLED POSITION OF TOWER SUPPORT.

NOTE:

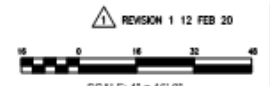
- PLACING BOOM TO BE CLIMBED WITH TOWER CRANE
- ALL WEDGES MUST BE REMOVED PRIOR TO CLIMBING.
- CORNER BRACKETS MUST BE INSTALLED AT THE PROPER FLOORS BEFORE CLIMBING BEGINS.
- TOWER SHOULD BE WEDGED AT ONLY 2 FLOORS AT ANY TIME.

AREA "B" TOWER SECTIONS CONFIGURATION:
6 METER
3 METER



1 PLACING BOOM CLIMB SCHEDULE
SCALE: 1/16" = 1'-0"

PLACING BOOM CLIMB SCHEDULE
SCALE: 1/16" = 1'-0"
** ENSURE MIN. 10'-6" OF RAIL IS AVAILABLE ABOVE SLAB



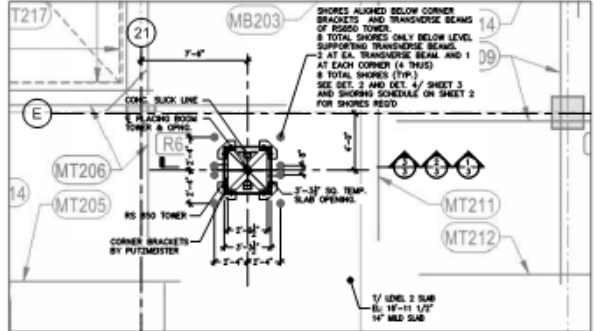
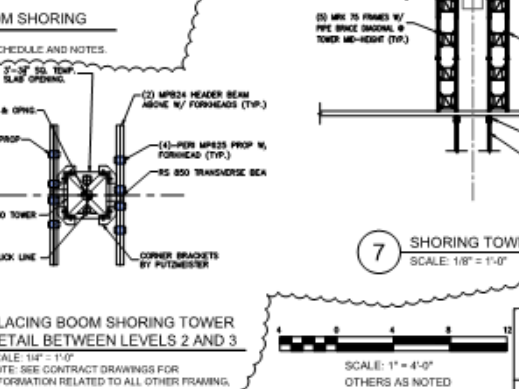
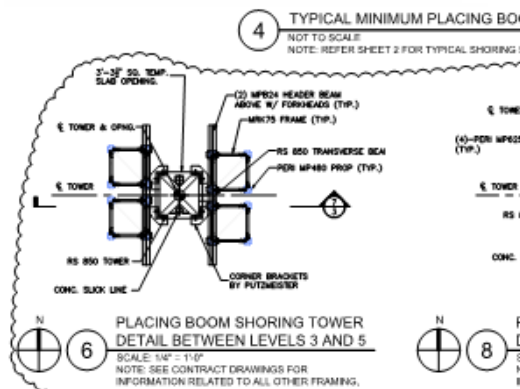
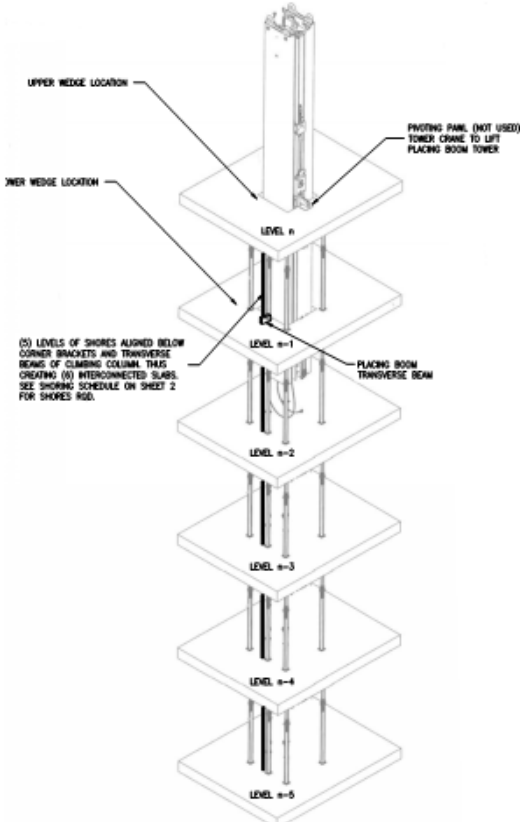
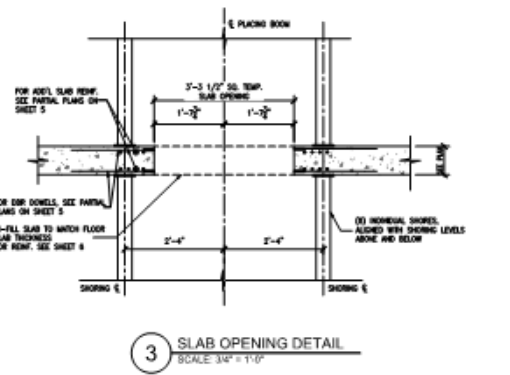
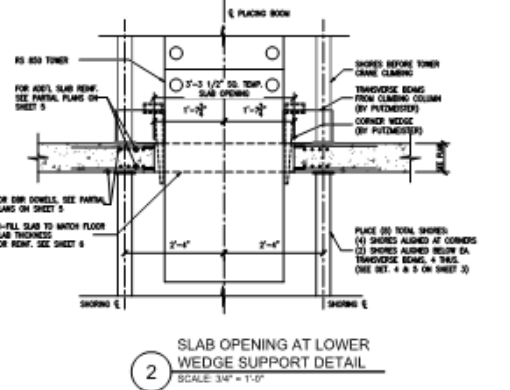
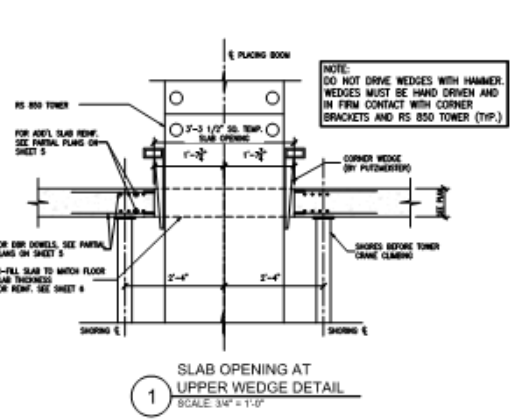
McHUGH

1737 S. MORRIS AVE

INSTALLATION OF PUTZMEISTER PLACING BOOM
MODEL 34/35C ON R5 850 TOWER
ONE CHICAGO SQUARE, CHICAGO, IL

PLACING BOOM CLIMB SCHEDULE - AREA "B"

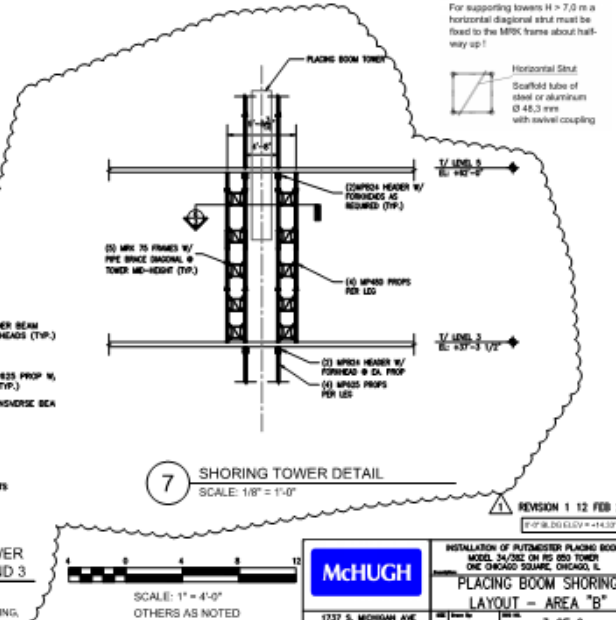
NOTES:
CONCRETE COMPRESSIVE STRENGTH FOR UPPER WEDGE, LOWER WEDGE, AND SHORING FLOORS SUPPORTING PLACING BOOM SHALL BE AT FULL STRENGTH (f_c = 5700 PSI). ALL POST-TENSIONED SLABS SHALL BE FULLY POST-TENSIONED AND SELF SUPPORTING AT THE TIME OF CLIMBING.

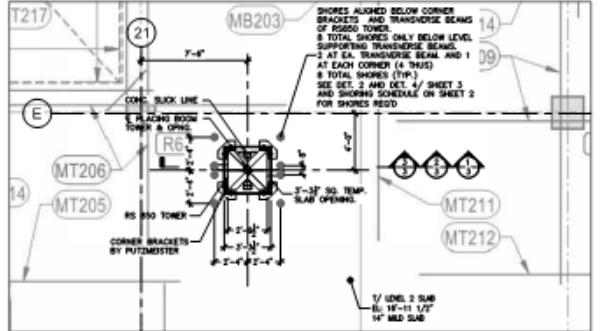
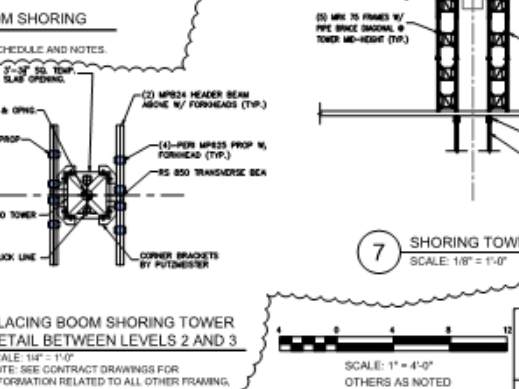
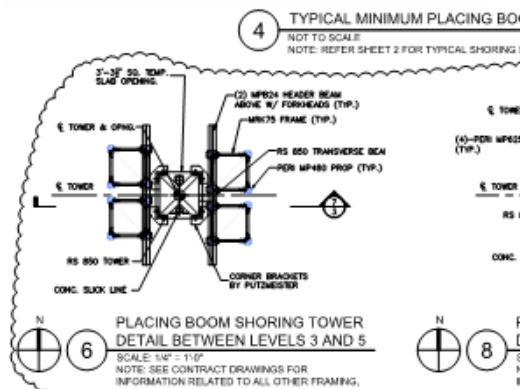
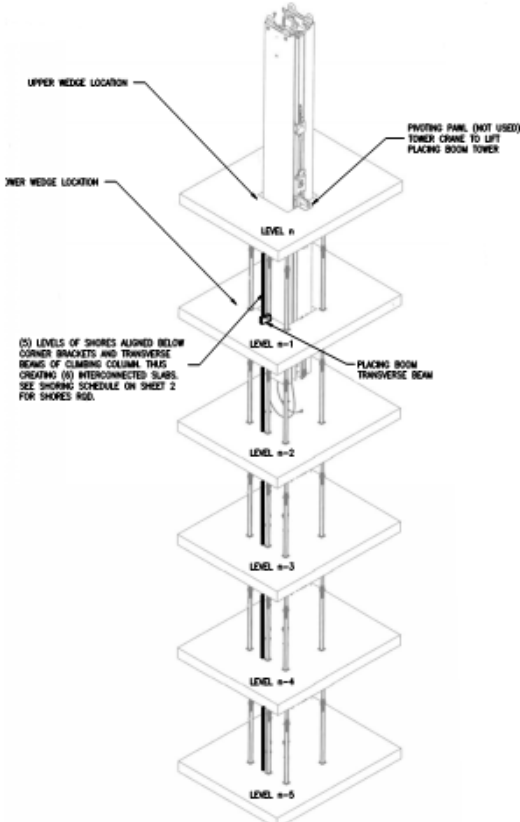
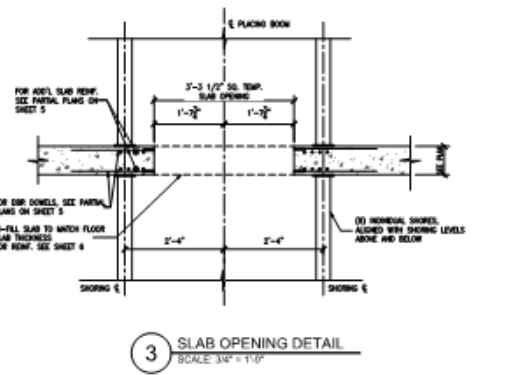
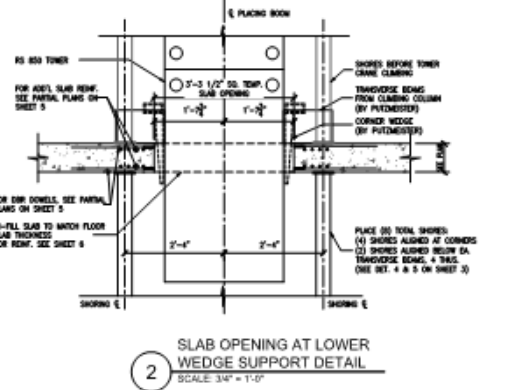
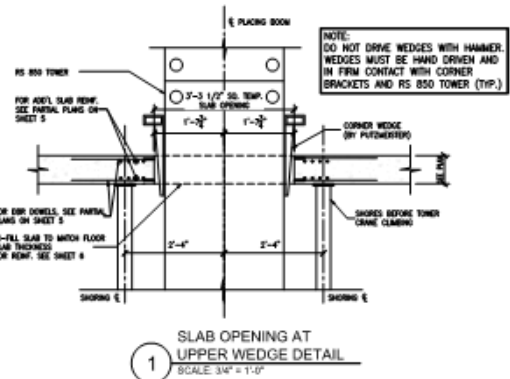


REVISION 1 12 FEB 20
1/4" = 1'-0" (1/4" = 1'-0")

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1337 S. MORRAN AVE

INSTALLATION OF PUTZMEISTER PLACING BOOM MODEL 34/36C ON RS 850 TOWER ONE CHICAGO SQUARE, CHICAGO, IL
PLACING BOOM SHORING LAYOUT - AREA "B"





REVISION 1 12 FEB 20
1/2" @ 12" O.C. @ 14.5' @ 100'

McHUGH

INSTALLATION OF PUTZMEISTER PLACING BOOM MODEL 34/36C ON RS 850 TOWER ONE CHICAGO SQUARE, CHICAGO, IL

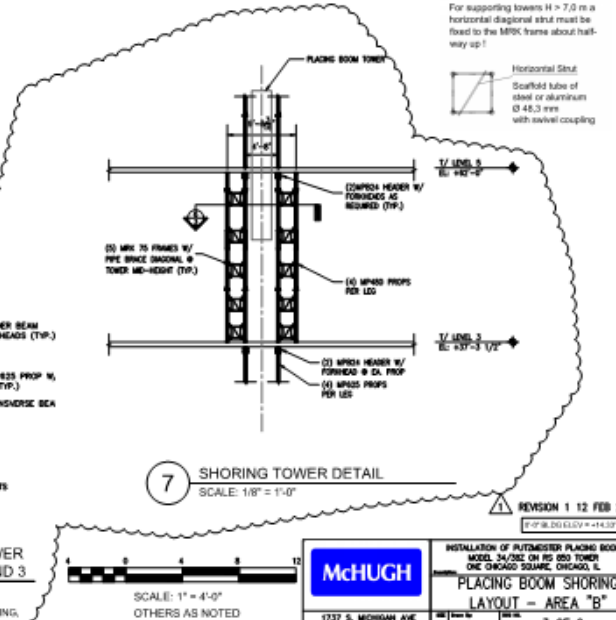
PLACING BOOM SHORING LAYOUT - AREA "B"

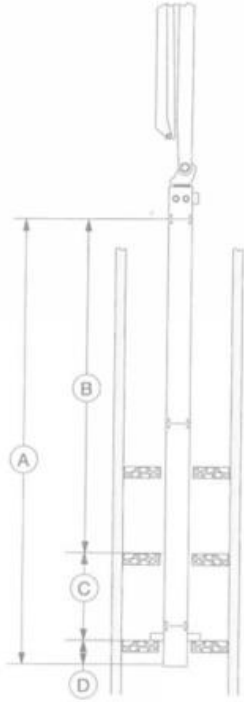
1337 S. MORRISON AVE

CHICAGO, ILLINOIS

02-12-20

EXPIRES: 11-30-20

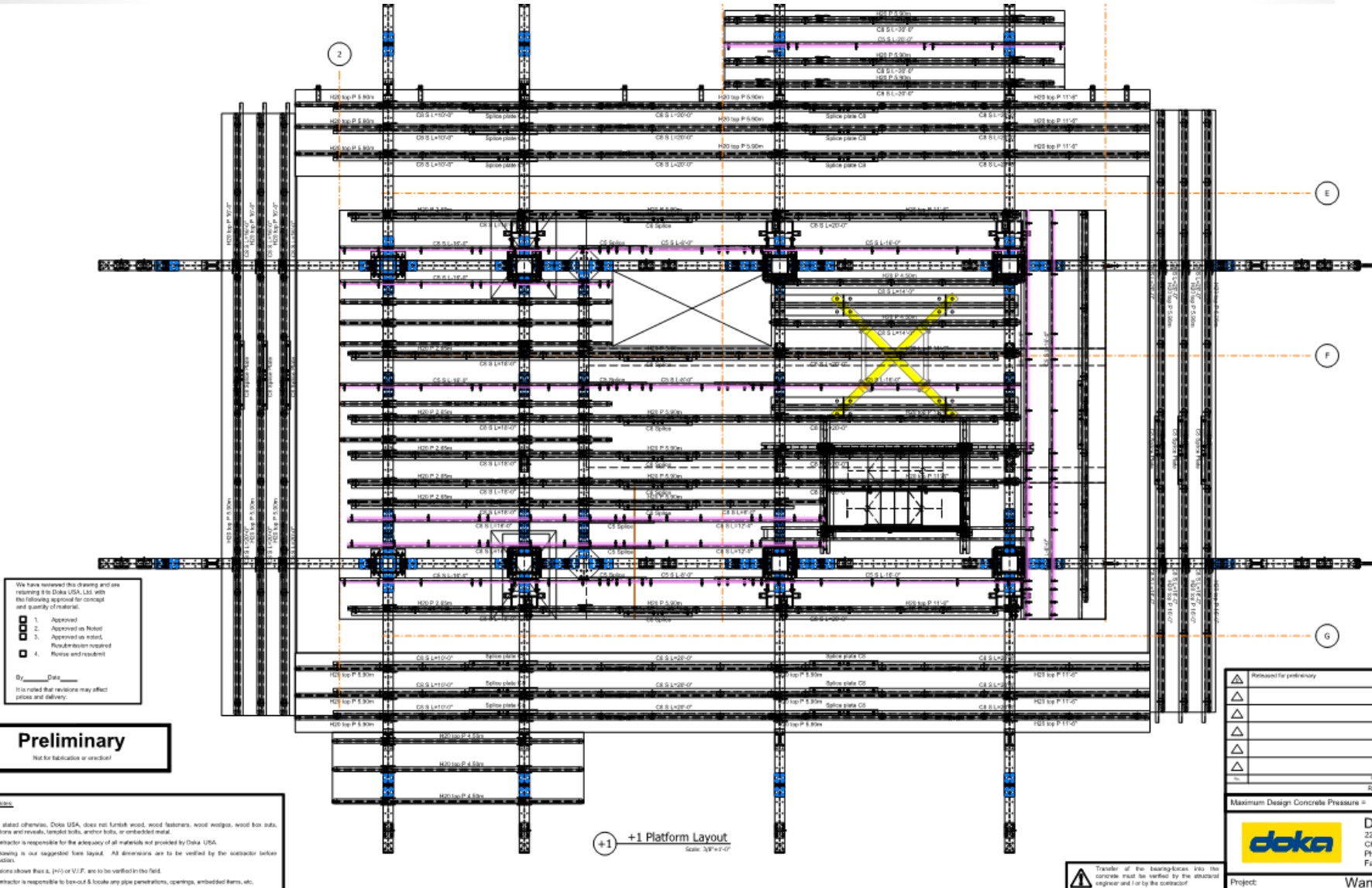




No.	Length of the tubular column ...	Height of job > 20.5 m
A	for clamped stationary boom, max.	15.0m (49.2 FT)
B	above the uppermost fixing point, max.	3.6m (11.81 FT)
C	between two fixing points, min.	3.65m (12.0 FT)
D	below the last fixing point, min.	0.7m (2.3 FT)
	Boom rest position and climbing position	vertical

2 LIMIT PARAMETERS FROM PUTZMEISTER
 NOT TO SCALE
 NOTE: REFER PUTZMEISTER RS 850 TOWER MANUAL FOR ASSEMBLY





We have reviewed this drawing and are returning it to Doka USA, LLC with the following approval for concept and quantity of material:

- 1. Approved
- 2. Approved as Noted
- 3. Approved as noted. Revisions required
- 4. Not approved

By: _____ Date: _____
 It is noted that revisions may affect price and delivery.

Preliminary
 Not for fabrication or erection!

- General Notes:**
- Unless stated otherwise, Doka USA, does not furnish wood, wood fasteners, wood wedges, wood box outs, cut-offs and reveals, laminated bolts, anchor bolts, or unbracketed metal.
 - The contractor is responsible for the adequacy of all materials not provided by Doka USA.
 - This drawing is our suggested site layout. All dimensions are to be verified by the contractor before construction.
 - Dimensions shown (such as, H+V) or V.P.F. are to be verified in the field.
 - The contractor is responsible to box-out & locate any pipe penetrations, openings, embedded items, etc.

+1 Platform Layout
 Scale: 3/8"=1'-0"

△	Released for preliminary
△	
△	
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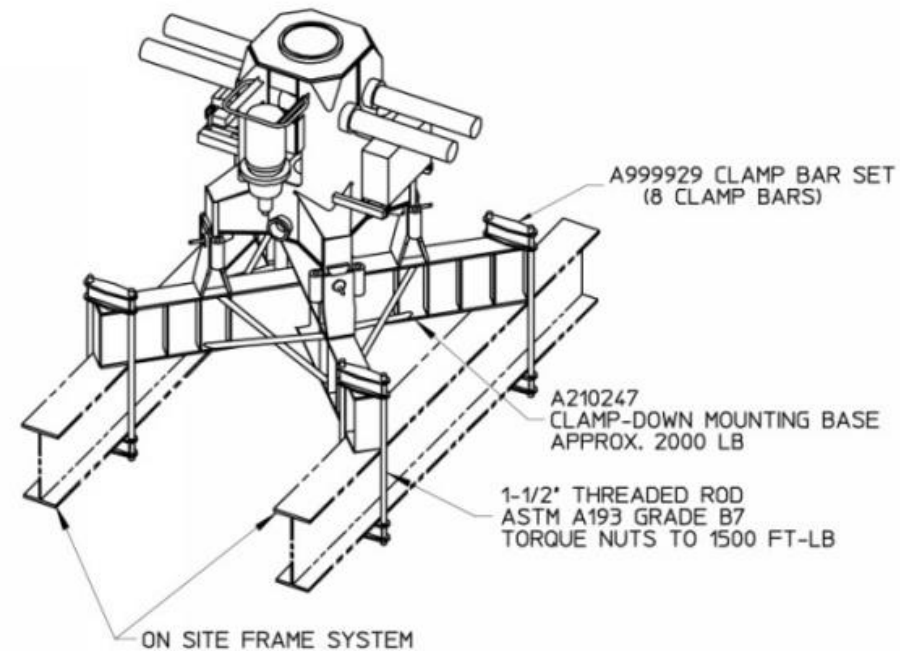
Maximum Design Concrete Pressure = 1200



Project: **Wanda Vista**

Transfer of the loadings into the concrete must be verified by the structural engineer and / or by the contractor





Base of Placing Boom attached to forming system at central core.



- Prime w/ grout to create boundary layer
- Adequate Concrete Paste to suspend aggregate
- Normal Weight Aggregate
 - Consistent grading
 - Max size is $1/3$ Diameter of pipe I.D.
 - Shape, angular or rounded aggregate
 - Fine aggregates, natural are better than artificial
 - Pumpability is improved with decrease in the fineness modulus , i.e.use of finer fines (ACI 304.2R. 5.3)
- Lightweight aggregate
 - Assure properly saturated
 - Presoaking coarse and fine aggregate
- Slump
 - Higher slump mixes are better
- Admixtures
 - Any admixture that increases workability will usually improve pumpability
 - Normal and high range water-reducing admixtures (super plasticizers)
 - Supplementary cementitious materials

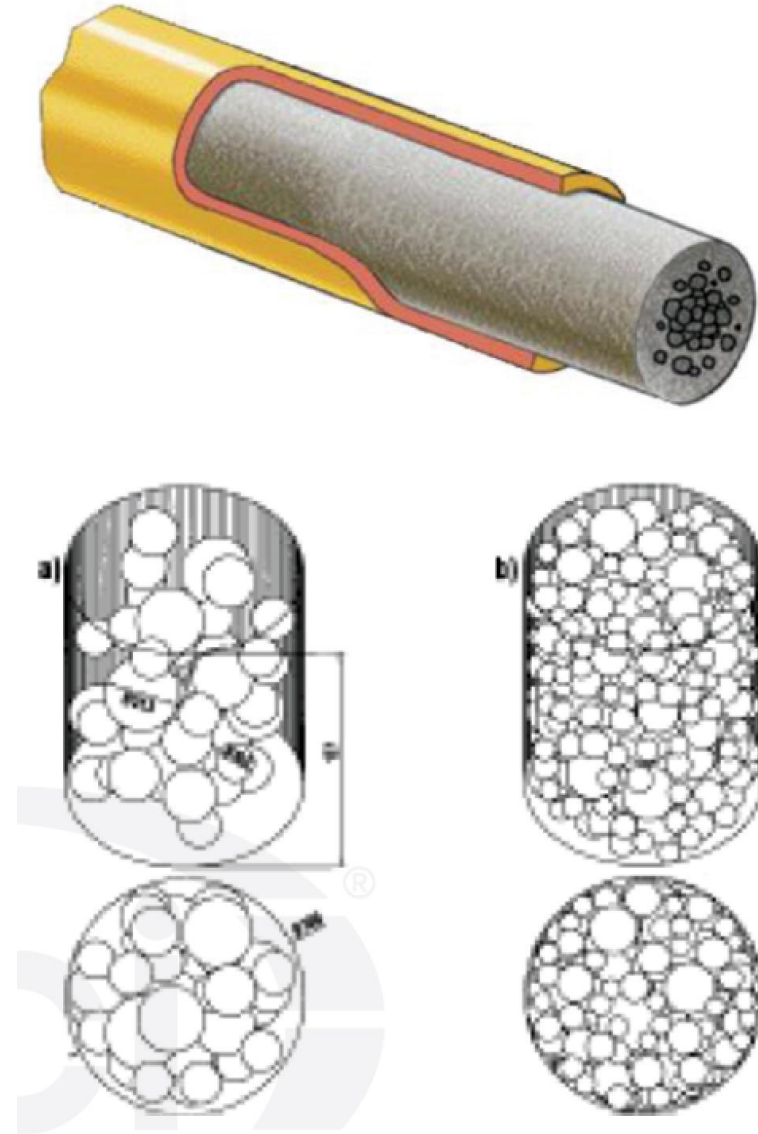
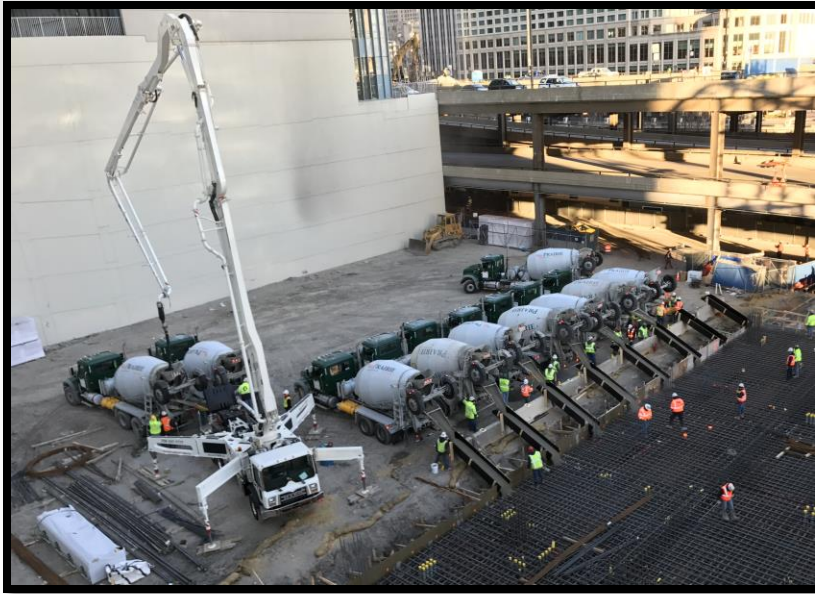


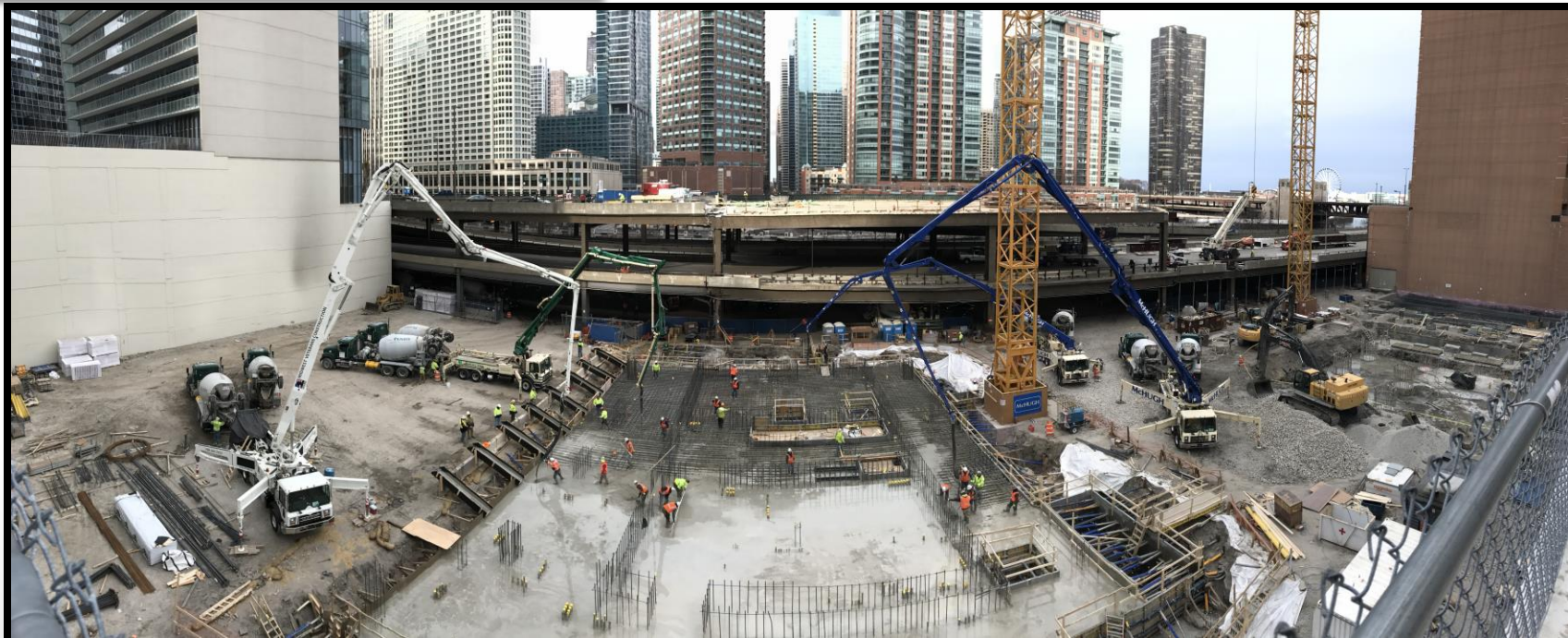
Fig. 3.1.2—Mixture component spatial arrangement.

Vista West Mat Pour

James McHugh Construction Co.



3600 cy poured in 10 hours
Max Rate of Placement 800cy/hr



McHUGH

James McHugh Construction Co.

McHUGH

QUESTIONS?

THANK YOU!!

