

**Drilled Shaft  
Rebar/Concrete Placement**



**CONDON · JOHNSON  
& ASSOCIATES, INC.**  
CONTRACTORS AND ENGINEERS

## OUTLINE

- **Rebar Cage Layout**
- **Rebar Cage Stability**
- **Rebar Cage Hoisting and Support**
- **Concrete Mix Design**
- **Concrete Placement**

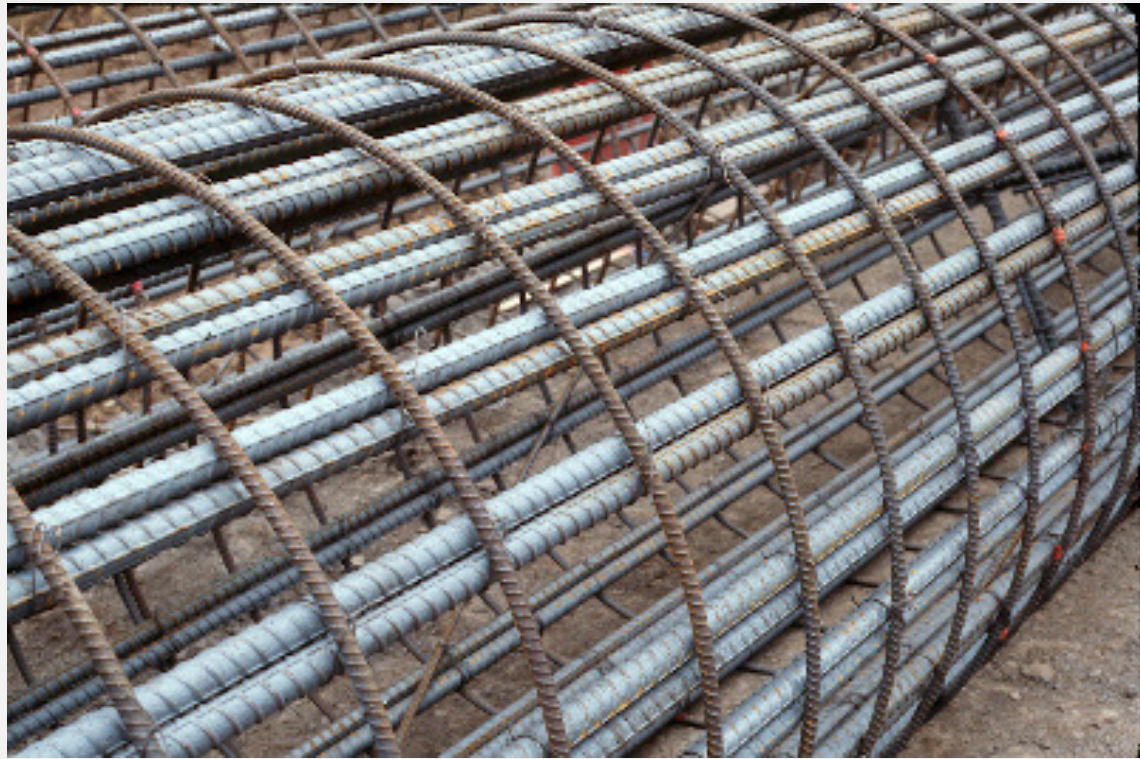


## REBAR CAGE LAYOUT

- Vertical Reinforcing and Hoop or Spiral Clearances:
  - 6" Clearance or Per WSDOT 6" x 6" window.
  - Bundle Bars if Necessary to maintain minimum clearances
  
- CSL Tube Placement:
  - Inside the reinforcement cage as close to the vertical bars as possible.



## REBAR CAGE LAYOUT



**BUNDLED BARS**



## REBAR CAGE LAYOUT



**BUNDLED BARS AND HOOPS**



## REBAR CAGE LAYOUT



**TRIPLE BUNDLED BARS**



## REBAR CAGE LAYOUT



**AVOID HOOKS AT TOP OF CAGE**



## REBAR CAGE LAYOUT





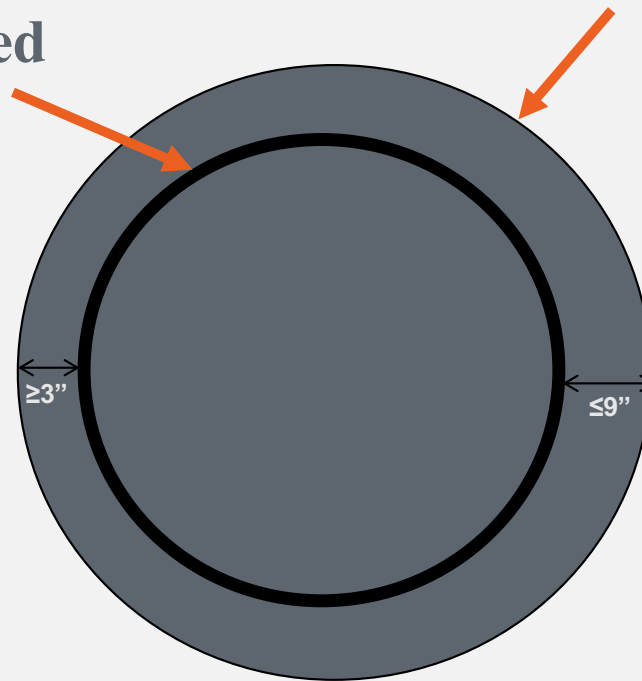
## REBAR CAGE LAYOUT

- Concrete Coverage
  - WSDOT 3”, 4” or 6” depending on Pile Dia.
- Locate Splices As Deep As Possible
  - Stagger Splice Locations.
  - Use couplers instead of lap splices for greater stability.



## REBAR CAGE LAYOUT

**With 6" Designed Cover:**  
CIDH Cage can be moved  
3" in any direction and  
maintain 3" minimum  
cover



**Shaft Tolerance:**  
3" on location

**BENEFIT OF 6" DESIGN COVER**



# REBAR CAGE LAYOUT



## REBAR CAGE LAYOUT



## REBAR CAGE STABILITY

- Drilling Subcontractor is typically the last to touch rebar cages. We now inherit all responsibility
- Rebar suppliers tie cages to “Industry Standards” but there is no agreement on what that should be.
- Each cage needs to be analyzed to determine tie and bracing requirements.



## REBAR CAGE STABILITY

- Typical minimum requirements :
  - Tie all reinforcement intersections with double wire on at least 4 vertical bars of each cage equally spaced around the circumference.
  - Tie at least 25% of remaining intersections in each cage with single wire ties. Stagger tied intersections from adjacent ties.
  - Provide bracing to avoid collapse of the cage during assembly, transportation, and installation.



# REBAR CAGE STABILITY

## INTERNAL BRACING



**SQUARE**



**TRIANGULAR**



## REBAR CAGE HOISTING AND SUPPORT

### PICK PLANS

- Educate Superintendent/ Foreman as to jobsite requirements
- Perform a job specific hazard analysis.
- Determine cage pick point locations and number of vertical bars to pick and provide to Rebar Supplier.
- Review the rebar fabrication shop drawings for each pile as they apply to pick points, bracing, etc.





## REBAR CAGE HOISTING AND SUPPORT

### PICK PLANS

- Check the capacity of the crane – review the load chart with the Foreman, Superintendent, and Crane Operator.
  - Include all rigging in Load Calculation
- An engineer should evaluate the “pick”
- Is it a “Critical Pick”
  - 2-Cranes
  - Over 75% of Cranes Capacity



## REBAR CAGE HOISTING AND SUPPORT

### WORKING PLATFORM

- Confirm that the working platform is capable of supporting the cranes under load. This is important also for drilling.
- Working platforms are typically the responsibility of the General Contractor. It is important that the equipment and pick plan information is communicated to the General Contractor well in advance so that the working platform can be properly designed and constructed.





# REBAR CAGE HOISTING AND SUPPORT



# REBAR CAGE HOISTING AND SUPPORT



## REBAR CAGE HOISTING AND SUPPORT



**HANG CAGE ON FRAME**



**HOLD CAGE WITH CRANE**



## CONCRETE MIX DESIGN

- **For Dry Hole Placement – 4”-7” Slump**
- **For Placement Under Slurry –7”-9” Slump**
  
- **Nominal Maximum aggregate size shall be 3/8”**
- **Water cement ratio not to exceed 0.44**
- **Retarding admixture is required**



## CONCRETE PLACEMENT

- Verify Concrete Slump Characteristics Prior to Using.
  - How long does the mix stay fluid?
- Check Slurry Properties
- Slurry Displacement Method.
  - Use of Tremie Pipes for Concrete Placement.





# CONCRETE PLACEMENT

## SLUMP TEST



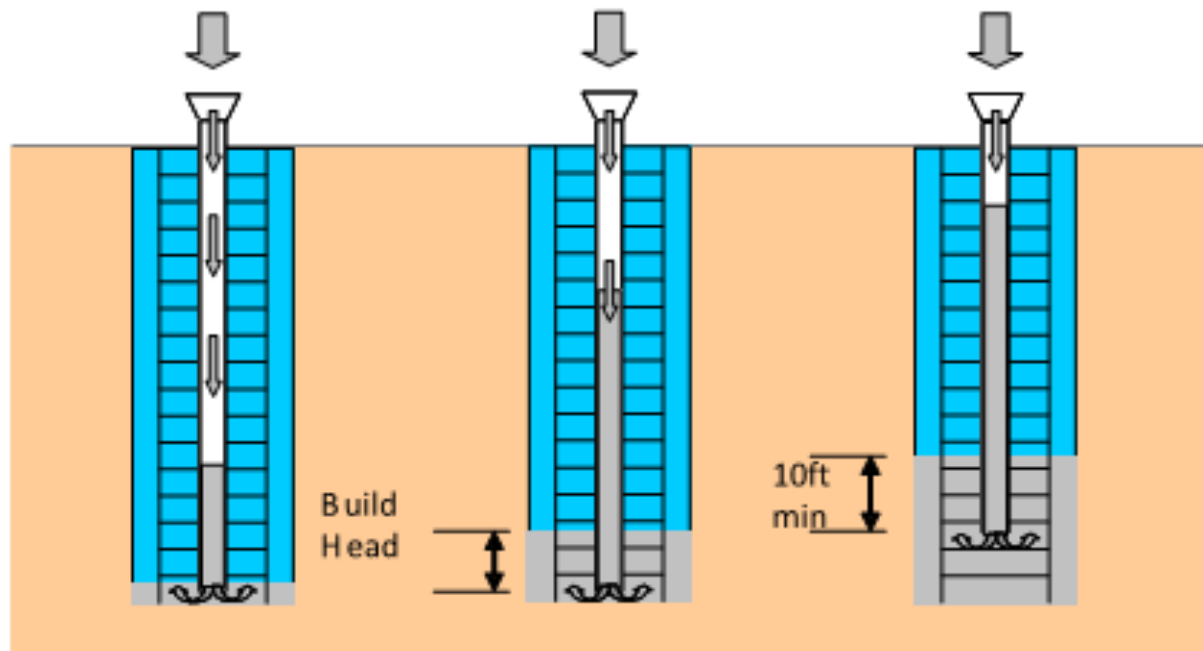
# CONCRETE PLACEMENT

## DRY HOLE PLACEMENT



# CONCRETE PLACEMENT

## WET HOLE PLACEMENT



a) Establish flow

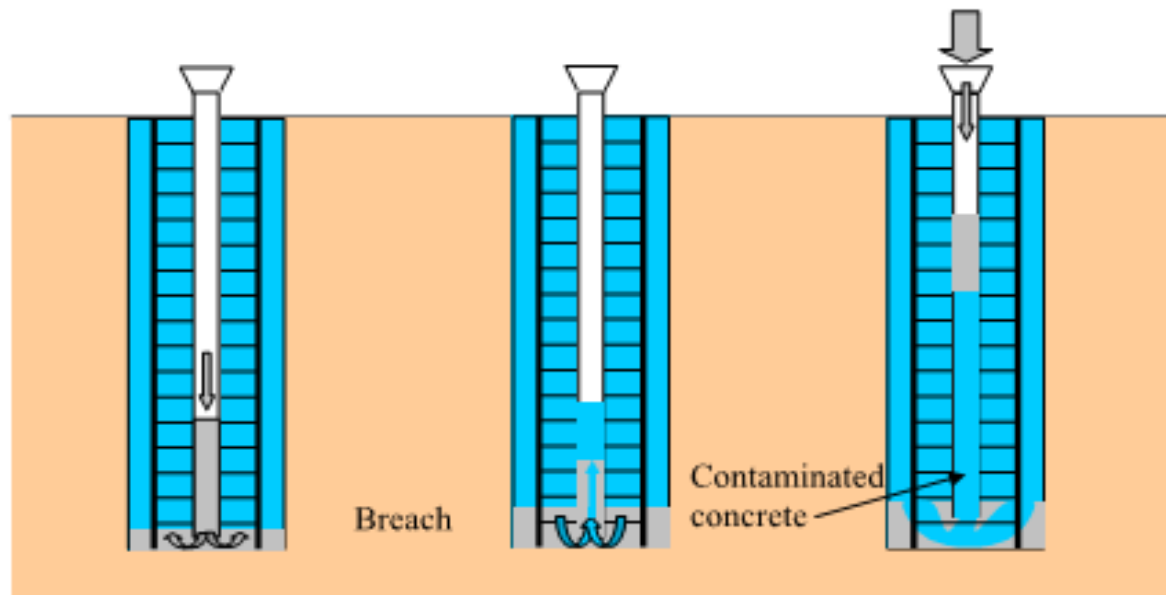
b) Establish head of concrete

c) Maintain head of concrete



# CONCRETE PLACEMENT

## WET HOLE PLACEMENT



a) Initial charge of concrete without continuous supply

b) Insufficient head of concrete inside tremie, water surges in

c) Concrete delivered into water-filled tremie



## CONCRETE PLACEMENT



**PUMP DIRECTLY INTO TREMIE**



**USE HOPPER ON TOP OF TREMIE**



# CONCRETE PLACEMENT

## REMOVING TEMPORARY CASING





## CONCRETE PLACEMENT

### PROTECTION AGAINST VIBRATION

- Freshly placed concrete shall not be subjected to excessive vibration or shock waves until the concrete has reached a minimum 2,000psi compressive strength.
  - Drilling equipment is classified as Low Vibration
- After 5hrs following concrete placement, the Prescriptive Safe Distance method, or Prescriptive monitoring must be used





# CONCRETE PLACEMENT

## PRESCRIPTIVE SAFE DISTANCE METHOD

Minimum Compressive Strength, f'c	Safe Horizontal Distance <sup>1</sup>	
	Equipment Class L <sup>2</sup>	Equipment Class H <sup>3</sup>
< 1,000 psi	75 feet	125 feet
1,000 to < 1,400 psi	30 feet	50 feet
1,400 to 2,000 psi	15 feet	25 feet



# CONCRETE PLACEMENT

## MONITORING SAFE DISTANCE METHOD

Minimum Compressive Strength, f'c	Maximum PPV
< 1,000 psi	0.10 in/sec
1,000 to < 1,400 psi	1.0 in/sec
1,400 to 2,000 psi	2.0 in/sec

**PEAK PARTICLE VELOCITY (PPV)**



# CONCRETE PLACEMENT

## MONITORING SAFE DISTANCE METHOD



TYPICAL VIBRATION MONITOR



**THANK YOU**

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