

METHOD STATEMENT

FOR

WELL FOUNDATIONS



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1. Purpose

The purpose of this Method Statement is to outline the general requirements for construction of Circular Well Foundation using Jackdown Method.

2. Scope

The scope of this Method Statement is for Well Foundation works in site and includes the following:

- Area Development/River reclamation
- Sheet pile cofferdam
- Cutting edge
- Well Curb
- Well Steining
- Earth anchor
- Sinking (Normal and Jackdown Method)
- Bottom Plug
- False Wall
- Well Cap

3. Reference Documents

- Contract Specifications
- Latest approved good for construction drawings
- MORT & H Specifications-Fifth Revision
- IRC: 78 – 2014
- IS: 2062 –2011 – Steel for General Structural Purpose
- IS:816-1969-Code of practice for use of metal arc welding for general construction in mild steel
- IS: 814 (Part – 2) – 1991 Covered electrodes for Metal arc welding of structural steel for welding sheet.
- IRC 112 -2011- code of practice for concrete road bridges
- IS 1786-2008 High strength deformed bar & wire for concrete and reinforcement
- IS 2502-1963 Code of practice for bending & fixing of bars for concrete reinforcement.
- IS 818-1968 Code of practice for safety & health requirement in electric & gas cutting operation.

4. Roles & Responsibilities

Project Manager

- He shall be responsible to control all the activities for the construction all works.
- Ensures that the project works in his zone are carried out in accordance with company policies and in accordance with the requirements of the project quality plan.
- Ensuring the full compliance of subcontractor operations with corporate quality policies and with the requirements of quality plan.
- Make sure that all the suitable equipment requirement to execute the works according to the construction program are available, in good condition, and provide any additional equipment.
- Coordinate with the Construction Manager, Project Engineer, Safety Engineer, for a safe and proper execution of the works.
- To guide specific attention to all safety measures in co-ordination with the safety officer/engineer.
- Selection of equipment's according to work condition in coordination with plant and machinery team.

Construction Manager

- Report to the Project Manager
- Ensure area is ready and safe to start the works.
- Concrete Mix design shall be submitted to Employer's representative and take approval before use
- Ensure reinforcement / structural steel is ready before start of work.
- Set up necessary equipment and plant through discussion with the Project Manager and Project Engineer/Works Supervisor.
- Ensure the works are carried out according to the specification, quality and approved shop drawings.
- Liaise and coordinate with the project manager for the agreed sequence of works with respect to the construction methodology and program.
- Allocation of required manpower through co-ordination with the PM.
- Ensure the availability of the risk assessments for the works activities in hand.
- Provide sufficient and safe access for operatives, Crain, trucks and pumps.
- Take precautionary measures with regards to protecting works from hot weather, cold, sun and rain etc

HSE Engineer/Officer

Report to the Project Manager

To ensure implementation of all safety measures related to the nature of works being carried out, and in accordance with the Project Safety Plan.

Ensure that all the persons involved in the works are aware of their responsibilities, and that they have enough understanding of the safety procedures.

The safety officer in co-ordination with the Project Manager will ensure that all the implemented safety measures are effective enough to maintain safe working conditions on the site.

To maintain continuous inspections of the site activities, advise and train persons on a daily basis to prevent accidents and personnel injury.

Give special concern to housekeeping, and ensure that the site is well maintained clean and tidy.

To ensure all the relevant safety sign boards for different works are in place.

QA/QC In-charge

- Report to the Project Manager
- Ensuring that Consultant/Client inspection requests are implemented.
- Compilation of all necessary quality control checklists.
- Assisting consultants during the Inspections.
- Coordinating with the third party lab regarding tests and results.

- The control of work performance by means of checking the work before consultants inspection and issuing RFIs, punch lists as necessary.
- Completion of documentation to verify the work performed.
- Controlling all inspection activities on site in line with ITP's.
- Ensuring that all test equipment including surveying equipment is calibrated and is suitable for use on the project site.

Plant In-charge

- Report to the Project Manager.
- Analyze suitability of Plants & Machinery required to execute work, check technical specifications.
- Ensure good working condition of all P&M.
- Regular inspection of P&M along with safety officer to maintain good mechanical condition of P&M.
- Ensure all Third Party Inspections of P&M as per statutory requirements.
- Ensuring suitable and skilled technicians to keep P&M in good working condition and training to workmen using P&M.
- Controlling minimum spares inventory at site to ensure smooth operation of P&M and to tackle breakdowns.
- Controlling storage, allocation of diesel, monitoring consumptions to avoid misuse.
- Monitoring performance, availability, utilization of P&M

Project Engineer

- Report to the Construction Manager
- The engineer will carry out his duties in a manner that will be coordinated by the Construction manager on a daily basis, and will ensure proper distribution of the workforce and equipment at different site locations.
- To be aware of test frequencies related to the work.
- Control disposal of waste excavation material according to the instructions from the project manager/customer.
- Coordinate with the Safety Officer to maintain safe working and proper housekeeping of the site. To comply with the safety measures and ensure that all the HSE team is aware of the same to prevent accident and loss.

Surveyor

- Co-ordinate with the Foreman /Project Engineer and Construction Manager
- To establish benchmarks from agreed reference points, provide required setting out and level markings and follow up with regular checks.
- Co-ordinate with the Project Engineer / Foreman and ensure the approved shop drawings/construction drawings will be implemented properly.
- Maintain survey details and reports, periodically check the progressing works and advise the project manager of any deviation from the drawings.

- Ensure reinforcement ready to working as per requirement.
- To monitor and check all activities and ensure that works will be carried out according to specifications, quality and approved drawings.
- To inform the QC Inspector of the areas ready for inspection

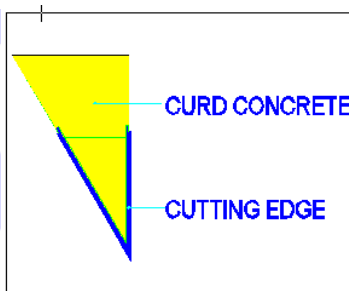
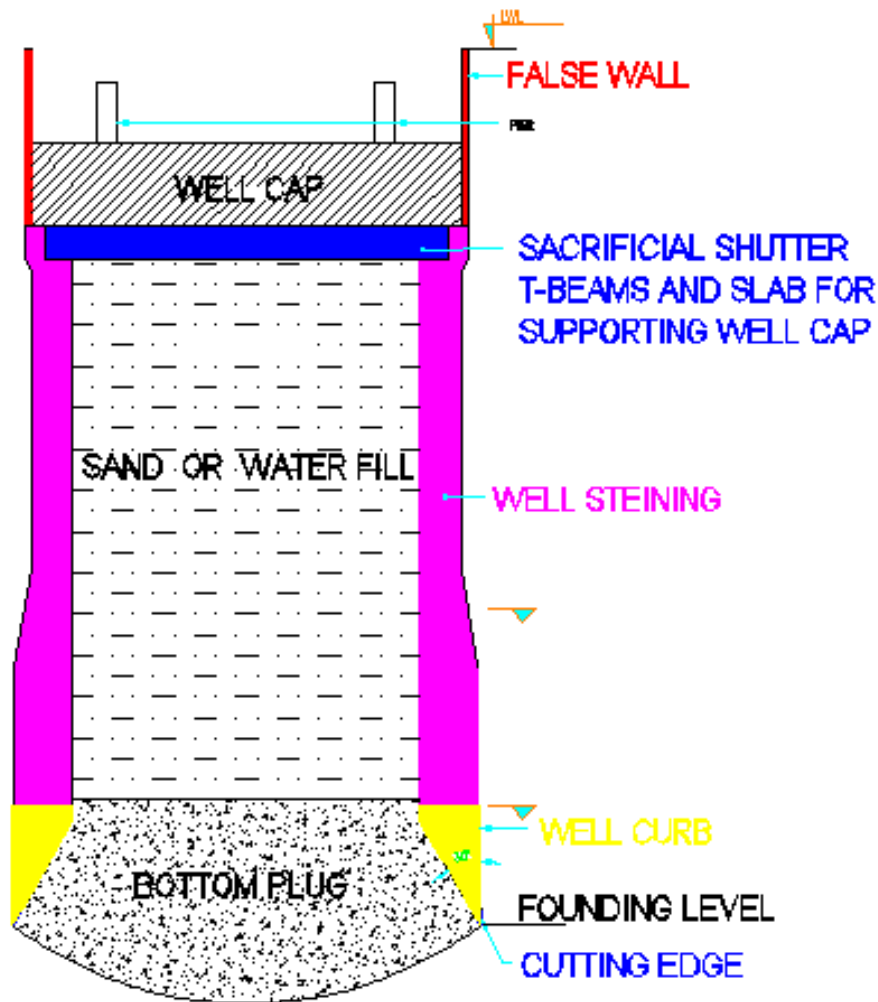
QC Engineer

- Report Site QA/QC In-Charge.
- Shall be responsible for overall control and inspection of QC activities as per checklist and QAP at site during concrete work.
- Shall be responsible for performing all checks and taking slump / temperature tests and accepting / rejecting concrete.

Foremen/ Works Supervisor

- Report to the Project Engineer
- Ensure the work progress inline with the targets and sequence as per the PM directions and orders.
- Liaise with the Project / Construction Manager for the allocation of the work force, ensuring adequate manpower is available.
- Liaise with the site manager to ensure all the plant/materials are available to perform the construction works.
- Full time supervision to ensure the works are in accordance to specifications, quality and IFC drawings.

5. Component Parts of a Well Foundation



1. Cutting Edge

Structure of the well at the bottom is tapered to end in a steel 'cutting edge' which facilitates cutting through soil for the sinking of the well.



2. Well Curb

The tapered portion or steel cutting edge being thin has to be strengthened suitably to take up the heavy loading. This portion is called the well curb. The well curb supports the steining. The curb remains slightly projected from the steining to reduce the skin friction during sinking of well.

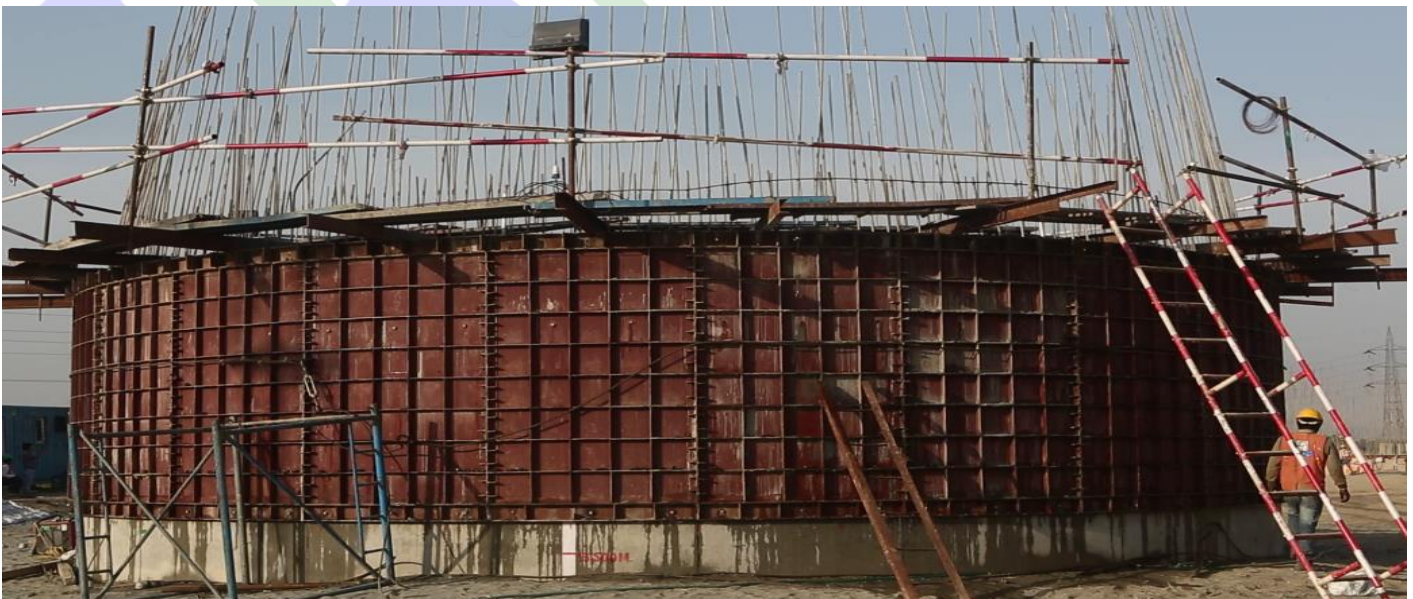


Well curb carries cutting edge for the well and is made up of reinforced concrete using controlled concrete of grade **M25**. The cutting edge usually consists of a mild steel equal angle of side 150 mm. In case blasting is anticipated, the outer face of the well curb should be protected with 6 mm thick steel plate and the inner face should have 10 mm thick plate up to the top of the curb and 6 mm plate further up to a height of 3 m above the top of the curb.



3. Well Steining

It is the wall of well & is built above the well curb. The steining is designed such that it can be sunk under its own weight. Steining is normally of reinforced concrete. Minimum grade of concrete used



in steining is M20 with cement content not less than 310 kg/m³. To facilitate well sinking an offset of 75 mm to 100 mm is provided in well steining at its junction with the well curb.

The thickness of well steining should not be less than 500 mm nor less than that given below.

$$t = KD*(L1/2)$$

Where,

t = minimum thickness of concrete steining, m,

D = external diameter of circular well or dumb bell shaped well or smaller plan dimension of twin D well, m,

L = depth of well in m below L.W.L. or top of well cap whichever is greater,

K = a constant depending on the nature of subsoil and steining material (taken as 0.30 for circular well and 0.039 for twin – D well for concrete steining in sandy strata and 10% more than the corresponding value in the case of clayey soil).



4. Bottom Plug

The bottom plug transmits load from steining to soil below. When sunk to its final depth bottom part is concreted to seal the bottom completely. The bottom plug is made bowl-shaped in order to have an arch action. It acts like an inverted dome supported by the

steining on all the sides and transmits the load to the subsoil and acts as a raft against soil pressure from below.

Minimum grade of concrete used in bottom plug is M15. Thickness of bottom plug should not be less than the half of dredge-hole diameter nor less than the value calculated using following formula.

$$t^2 = \frac{3W}{8\pi f_c} (3 + \nu)$$

Where,

W = total bearing pressure at the base of well,

f_c = flexural strength of concrete in bottom plug, and,

ν = Poisson's ratio for concrete, **0.18 to 0.20**.

5. INTERMEDIATE PLUG

As discussed above, for wells resting on clayey strata, it is not preferable to fill the space inside the well completely with sand. In such cases, sand filling is not done or sand is filled up to the scour level. A concrete plug covering the filling is usually provided, known as intermediate plug. Usually, thickness of intermediate plug is taken as 500 mm.

6. Well Cap

At the top of the well steining, an adequately designed "well cap" is laid which transmits the loads and forces from the substructure (piers or abutments) to the foundations (body of well).

6. Well Foundation-step by step construction sequence

Description

The process flow of well foundation work will be as follows:-



This work consists of construction of well foundation, taking it down to the founding level through all kinds of sub strata, plugging the bottom, filling the inside of the well, plugging the top and providing a well cap in accordance with the details shown on the drawing and as per the specification, or as directed by the Client.

The foundations are Circular wells for all river piers including the end piers. All these wells are to be sunk by the jack down method with thickened steining below scour level.

The wells are cast on the ground and sunk up to full depth, by normal and jack down method. The jack down method is preferred because it is less sensitive to sand blows and helps maintaining improved contact with the ground along the periphery. The wells once sunken to full depth will be plugged, filled with sand as required and capped by a layer of concrete. The well cap and pier are thereafter executed in the normal manner.

The foundations are to be cast in the dry after providing a filled up island or by sheet pile Cofferdam of adequate diameter as per requirement at site. The cofferdam is dewatered, maintained dry and well foundation is sunk upto the design level as indicated on the drawings. Care should be taken to see that the diameter of the cofferdam is higher than that of the well foundation by a suitable margin for construction purposes.

6.1 General

- The process of taking down the well to the founding level is known as well sinking. After reaching the founding level, the hollow inside the well, (“dredge hole”) is plugged at the bottom by concrete (“bottom plug”) upto well curb top level. The dredge hole is then filled with approved filling material upto the level indicated on the drawing and provide well cap at top.
- To facilitate sinking of well, steel cutting edge is fabricated and connected to a concrete well curb of required shape. On top of the well curb, adequate height of the well steining is cast and the process of sinking is carried out. After the portion of well has been sunk, another height of well steining is cast on top of the previous section and further sinking carried out. This process is continued till the bottom level of the well (cutting edge) reaches the founding level.
- At the top of the well steining, an adequately designed “well cap” is laid.
- Controlled blasting shall be resorted in order to facilitate sinking through difficult strata, such a boulders and rocks etc. In case blasting is anticipated, protective/ strengthening measure specified in IRC: 78 shall be taken. In case the borehole data shows the presence of steeply dipping rocks, chiseling shall be resorted to so as to obtain proper seating of foundation.

6.2 Area Development / River Reclamation, Setting out and preparation for sinking

- Prior to start of work the total site shall be cleared.
- Reference pegs are to be made permanent and kept clear of all obstruction. A base line will be fixed by the Client and agency would make use of this base line for fixing the centerline of the piers.
- Necessary reference points shall also be fixed, away from the zone of blow-ups or possible settlement resulting from well sinking operations. Such reference points shall be connected to the permanent theodolite stations with the base line on the banks. The center of the individual wells shall be marked with reference to these stations. The distance wherever practicable, shall be checked with the help of accurate tapes and precision survey instrument.
- A temporary benchmark shall also be established near the well foundation, away from the zones of blow-ups or possible settlement. The benchmark shall be checked regularly with respect to the permanent benchmark established at the bridge site.

6.3 Equipment

Jack down method of controlled sinking on wells to ensure that the tilts and shift are within acceptable limits. The reaction system and jacks required for the jack down method, cranes with grab buckets, pumps, compressor, diving helmets and other items including that normally used for reinforced concrete operations required for this project will be arranged.

6.4 Sheet Pile Cofferdam

General

- Site Establishment & Setting out- Good firm access will be provided to allow safe passage of plant and equipment throughout the construction area.
- Adequate hard & all weather platforms will be provided and maintained for the execution of the driven of sheet pile operations.
- Flow of water shall be controlled/diverted using suitable bund/hume pipes.
- Using guide frame & suitable capacity crane sheet pile shall be carried out in the sequence & direction as listed below.
 - 1) Alignment survey shall be carried out.
 - 2) Guide piles shall be driven at the marked locations.
 - 3) Brackets for placing the guide frame shall be fixed.
 - 4) Guide frame shall be placed over the guide piles.
 - 5) The sheet piles shall be started driving.
 - 6) All the sheet piles shall be driven in clockwise direction.
 - 7) After driving all the sheet piles waler shall be placed as per requirement.
 - 8) The cofferdam shall be filled completely till sheet pile top.

- Timber shall be placed at exact location & cutting edge placement & curb assembly shall be carried out.
- Reinforcement, shuttering shall be placed & concreting shall be carried out for curb & steining lifts stage by stage.
- The well shall be started sinking.
- Ground anchors shall be installed & further sinking shall be carried out with jack down system & grabbing with crane if required.
- A tentative drawing of sheet pile arrangement & procedure for installation is at end of the statment.

Sheet Pile -Step by step details

Sheet Pile positioning-



- Interlocking U Section sheet pile will be lifted using a service crane with adequate wire rope sling and a D-Shackle fixed to the hole (2 to 3 m below the top) in the sheet pile and erected over the exact location set out to the reference lines.
- The clamping head of Vibro hammer shall be attached from the 75T crawler crane and other end will be firmly clamped to the sheet pile.
- The D-shackle and sling of the service crane will be released 2m above the ground. After the erection of sheet pile it will be checked for its correct position orientation and verticality.
- Any fine-tuning required for position, orientation and verticality will be carried out to make the Sheet pile correctly positioned, oriented and truly vertical before starting to drive.

Verticality of Sheet Pile.

- Top of crane should exactly be at the top of Sheet Piles while positioning the Sheet Piles for driving.
- One signal man will be provided to guide crane to maintain the sheet pile verticality while positioning / driving the sheet pile.

- Hand levelling device (spirit level) will be used regularly to check the verticality of the sheet pile in both directions during driving.

Driving of Sheet Pile

- Vibro hammer shall be attached to the crane by a hoist line and correctly centered on top of the sheet pile.
- Care has to be taken to drive the sheet pile in perfectly plumb position.
- Once this segment of sheet pile is drive inside the ground, start with the other segment and drive it one after the other and cover all the area.

Sheet pile supporting arrangement

- The brackets shall be fixed at outer face of the sheet piles, above which fabricated Wallers are placed.
- Wallers are connected at the both the ends in all directions.
- All this operation shall be carried out with crane & care shall be taken while lowering the assembly at lower level as not to touch assembly at upper level.
- This may cause serious accident.
- In dismantling the procedures are reversed with the removal of each level of strut taking place when the RC structure is completed below the corresponding level of the strut & acquired adequate strength. Remove the strut, waller, runner beam & brackets one by one & stage wise.

6.5 Cutting Edge

Fabrication

- Concrete/Steel platform shall be made in the fabrication yard for making the layout of cutting edge.
- Plan of the cutting edge layout shall be marked over the platform.
- Fabricate the template according to the curvature of the cutting edge.
- Place the plate over the leveled platform.
- Mark the cutting line as per the dimension for the outer plate, splice plate, inner bottom and top plate respectively.
- Cut the plate as per marking using flame cutter. Holes will be using power drill machines where ever required as shown in the drawing
- Cutting edge shall be fabricated in 4 to 5 pieces. Bend the plate using plate-bending machine as per the template made for curvature.
- Weld inner side plates together and check the slopes at every 600 mm intervals.
- Place the outer plate over the zig made at fabrication platform. Verticality of the plate and outer diameter of the unit will be checked.
- Entire unit shall be welded except the connection locations shown in drawing. The inner plates shall be placed inside the already welded outer plate by leaving the connections. Fix the temporary tie angles on the top of outer plate. Connect the bottoms of both the plates by tack weld.

- Check the diameter, height and width. If all the dimensions are as per cutting edge drawing weld entire joints. After completion of welding recheck the dimensions once again.
- Fixing of stiffener plates and their welding shall be done as shown in the drawing. The parts of cutting edge shall be numbered for easier assembly.
- The assembly shall be got checked from engineer in-charge.
- Individual parts shall be marked with paint before dismantling and transporting to the actual location.

Placing and Assembling of Cutting Edge

- All the parts of the fabricated cutting edge shall be erected on a level firm ground at the relevant location. Temporary supports shall be provided to facilitate the erection and maintaining the assembly in true shape as per drawings and specifications.
- The platform on which cutting edge shall be placed shall be leveled and well compacted uniformly to preclude possibility of settlement during curb concreting.
- 300mm thick wooden planks (750mmx300mm) shall then be placed on leveled ground at 500 to 600 mm c/c intervals in zigzag manner to facilitate easy removal of the same during sinking of curb.
- The cutting edge shall be placed on the compacted platform at existing ground level as per site condition. The level of the platform on which the cutting edge is assembled shall be recorded.
- The planks are numbered to track the same during grounding, so that no plank remains below cutting edge after grounding. Before placing the cutting edge on the wooden planks, the layout of the cutting edge (on wooden planks) and the center point of the well shall be marked as per the alignment / drawings.
- Each piece of cutting edge shall be lifted and placed in position as per the numbering sequence with the help of crane. The loading/unloading, lifting activities shall be carefully handled under expert supervision such that the curvature & profile of cutting edge parts are not deformed.
- The inner and outer diameter shall be checked with reference to the centre point and adjust accordingly. Tack welding shall be done for the cutting edge parts to fix them in position.
- Minor adjustments shall be done in leveling of the cutting edge by providing shim plates between the cutting edge and timber planks, if required.



- The following parameters shall be checked before permanent welding.
 - Accuracy of the center
 - Dimensions of the cutting edge
 - Rigidity of the connections between the plates
- The parts of the cutting edge shall be welded permanently to true alignment and as per the drawings. The cutting edge shall be laid at or around low water level and then sunk as indicated in the activity schedule.

6.6 Well Curb

Inner Shuttering & Supporting Arrangement

Reinforcement Fixing

- The bar bending schedule shall be prepared as per the latest revised drawing, submitted and approved by engineer in-charge. The approved BBS shall be circulated to site engineer.
- Cutting and bending the reinforcement steel bars at yard shall be as per the approved bar bending schedule. The rebar shall be treated with inhibitor slurry of 1Kg cement & 600 CC inhibitor solution as per specification.
- The cut & bend rebar's shall be shifted to site for fixing. The rebar shall be fixed at site as per the spacing mentioned in the drawing. Welding of anchor will be done with the cutting edge as shown in the drawing.
- The bars shall be tied by 18 SWG binding wire. The Laps shall be provided as mentioned in the drawings or by mechanical splicing as suited at site.



Outer Shuttering & Supporting Arrangement

- The outer shutter shall be fabricated as per drawing.
- The shutter shall be fixed at the outer face after fixing the reinforcement
- 75mm clear cover shall be maintained from the outer most reinforcement
- After fixing of shutters, proper supporting arrangement shall be done as mentioned in the drawings. Checking of the shutter for verticality shall be done and approved by engineer in-charge prior to start of concrete.

Concreting:-

- Working platform shall to be at inside and outside area and position all vibrators and needles at required locations
- Concrete of specified grade shall be mixed in the batching plant and shall be shifted to site by transit mixers.
- Concrete shall be poured in layers of 300mm thick in clockwise & anticlockwise to avoid tilting of well by using boom placer or crane and bucket. Slump of concrete, temperature

shall be checked at batching plant and site as required and the cube moulds shall be filled as specified in the agreement.

Dismantling Of Inner/Outer Supports:-

- Removal of the outer supporting arrangement shall be after 24 hours of concreting and inner supporting arrangement after 3 days.
- Marking of gauge lines on four sides of the well shall be done.

6.7 Grounding the Curb

- The bottom level of cutting edge shall be checked.
- At least Four Gauges, two in traffic direction and two normal to the traffic direction are to be made on the outer periphery of the well curb by 100 mm wide strip painted on the well, with every meter mark shown in black paint. The gauge shall start with 50mm at the bottom of the cutting edge. Marking shall be done with steel tape.
- Checking shall be done for the pre-sinking shift and tilt of curb. For measuring the tilt reduced levels of the gauge marks painted on the well surface shall be taken. Then the level of cutting edge shall be calculated by deducting the gauge height from the reduced level.
- For measuring the shift, the position of well center and steining center points are to be checked with actual coordinate points. The difference between the actual and site positions gives the horizontal displacement, which is the shift.
- The sleepers from bottom of the cutting edge shall be removed. Always it has to be ensured that sleepers are removed alternatively as well as diagonally.
- Manual excavation of the earth material from the dredging portion of the curb shall be done allowing the curb to sink. This operation will be carried out till the curb is sunk for at least 1.00m.
- Check to be made for the tilt and shift and shall be corrected by excavating the dredge hole by crane and grab.

6.8 Well Steining & Falsewall

- The dimensions, shape, concrete strength and reinforcement of well shall strictly conform to those shown on the drawings.
- Reinforcement fixing same as fixing of reinforcement mentioned above.
- Water jetting and air jetting arrangement shall be provided to inner & outer faces as mentioned in the drawing for sinking of well till top of steining. A tentative drawing of water & airjetting arrangement is been attached here for your reference.

Shutter Fixing

- Well steining of 2.50 m height shall be cast except tapered portion where steining thickness gets reduced and same procedure will be followed as curb shuttering.

- Recess box shall be left in the inner face final lift of steining so as to accommodate sacrificial beams and slabs. These beams & slabs act as shuttering arrangement for well cap.
- False wall of required thickness and height shall be casted above the steining to accommodate empty sinking of well.

Concreting

- Same procedure will be followed as well curb concreting.

Deshuttering

- Remove the shutter after 24 hours of concreting.
- Curing shall be done continuously and gauge marking shall be done on four sides of the well
- Laitance formed on the top surface of the lift shall be removed to expose coarse aggregates before setting of concrete at the proposed construction joints. As far as possible construction joints shall not be kept at the location of laps in the vertical steining bars.
- The height of steining shall be calibrated by making at least 4 gauges (preferably in traffic and in a direction normal to traffic direction) distributed equally on the outer periphery of the well each in the form of a 100mm wide strip painted on the well, with every metre mark shown in black paint. The gauges shall start with zero at the bottom of cutting edge. Marking of the gauges shall be done carefully with a steel tape.
- After reaching the founding level, the well steining shall be inspected to check any damage or cracks. The Client will direct and the agency shall execute the remedial measures before acceptance of the well steining.

6.9 Well Sinking

General:

- The well shall be sunk true and vertical within the tolerance limits, through all types of strata by the Jack down method.
- Sinking of well shall be commenced only after the steining has been cured for at least 48 hours or as specified in the drawings.
- No well shall be permitted to be placed in a pre-dredged hole.
- The well shall be sunk by excavating materials uniformly from inside the dredge hole. Use of water jetting, explosive and divers may be adopted for sinking of wells through difficult strata with prior approval of the Client.



- Sinking history of the well shall be maintained in the format given in MORTH Specifications for Road and Bridge works (Appendix 1200/1).

Normal Sinking:

- Levels of the cutting edge at such four positions (i.e Grid and Axis.) shall be taken by level instrument.
- The pre-sinking tilt & shift in both directions shall be taken with help of auto level and total station respectively from survey control stations.
- The sump position at eight equidistant locations along dredge hole sides and at well center are taken, and recorded. The dredge hole water level is also recorded.
- Vertical reinforcement of steining shall be bent and tied properly to facilitate the grab movement during sinking operation. 75T crane with double drum is placed on platform near well, strengthened with sand bags and sleepers.
- Sinking crew shall take respective positions; skilled khalasis on the ground for controlling the grab movement, when the grab is above the well top (during muck disposal and reentry of empty grab into the dredge hole), and one signalman on well top.
- The soil below the inclined portion of well curb (where grab cannot be reached) shall be removed manually and deposited in the dredged hole for grabbing.
- Grabbing process shall commence normally with grabbing at the above designated sounding positions; the sinking engineer/foreman shall vary the pattern depending on the tilt and pre -sump positions.
- Levels shall be noted daily and tilt and shift shall be calculated and recorded.
- If the well is not sinking after reasonable amount of grabbing is done, say after two rounds of grabbing, the sump position shall be checked, and accordingly, in combination with the tilt position, the grabbing pattern shall vary. The sump should not normally exceed 1.75meters average; Jack down sinking shall be done.
- The sinking operation shall be done in two shifts, day and night. In normal course, the sump and dredge hole water levels shall be observed twice in each shift (one at mid shift and one at the end of the shift), and the cutting edge reduced level (CERL) shall be checked by level at the four positions at the end of the shift.
- The shift shall be taken at the end of the sinking cycle and recorded.
- Leaving the well with considerable sump shall be avoided after completion of a sinking cycle. The well top should be at around half meter above ground level on completion of the cycle.



- This operation shall be continued till the cutting edge reaches the founding level mentioned in the drawing.

Jackdown Sinking:

- Jack down sinking is basically transferring the forces exerted by the hydraulic jacks on the earth anchors through the heavy duty pressurization girders resting on the steining top on stools. The earth anchor pairs are placed such that two girders systems, both crossing the well sides, can be positioned, with hydraulic jacks at the ends of the girder, located such that they are directly above the centre of the earth anchor pair.
- The area where earth anchoring is done shall be excavated and the cables are brought out.
- The anchor head consists of holes to accommodate the HT strands. The HT strands are bolted to the anchor head.
- The anchor head shall have an opening at centre for fixing of gripper rods which are connected to hydraulic Jacks at top.
- Supporting stools are then placed on the steining to suit the location of the anchors.
- Pressurization girders are then erected over the stools and pressure plates fixed on top of the girders at ends.
- Sufficient capacity hydraulic jacks along with upper gripper attachments are erected and the gripper rods are fixed by locking the upper gripper attachment.
- Gripper rod is fixed with the adjustment rods at required height and held in position by locking the lower gripper assembly.
- All jacks are aligned and leveled properly. The pressure hoses are connected with power pack and jacks. Loading is applied with power pack.
- After lifting of ram by about 40 to 100mm wedges are placed on bearing plates on either side of the anchor couplers.
- The lower gripper assembly is locked and upper gripper assembly is released.
- Ram is brought to its original position and upper gripper assembly is locked.
- Lower gripper assembly is then unlocked.
- Now pressure is applied on the jacks and after lifting of about 400mm the above 5points is repeated. In case of Jacks Set No 1 the above locking and releasing will be automatically done after initial setting of the Gripper rods.
- A tentative drawing of jackdown arrangement is at end of the statement



Load Application:

- Each Jack has separate Control valve for application of pressure. The adjustment wherever required will be maneuvered by closing or releasing the control valve.
- The jacks placed on upper side of the tilted well shall be given with additional load than that of the lower side.
- Releasing of pressure on any one jack shall be done with proper care. In case of tilting of the girder on any side due to releasing of pressure, then releasing shall be done on both the jacks placed on the said girder.
- To cater for additional safety precautions against lifting of girder in case of any failure of grips or larger uneven loading the girders shall be arrested to additional rebar placed in the steining. 25 mm dia. Bar shall be placed in the steining during concreting on each supporting stool.

Sinking Procedure

- In sandy clay strata first sump condition shall be made to the extent of 1.5 to 2 meters and then loading shall commence with initial 50 MT per Jack and gradually in increments of 25 MT till well starts sinking. The intensity of loading shall be kept constant till appreciable sinking is achieved and well is not further going down. Thereafter sump / hump will be checked and loading shall be released in case of hump / or less sump to resume grabbing once more.
- In sandy strata each jack shall be loaded to 100 MT and then grabbing operation is started. The loading shall be kept at 100 MT till sinking of well starts. After appreciable sinking is over and with the above loading the sump / hump of the well is checked, and grabbing with the above loading is continued.

6.10 Inspection

- Check for the tilt and shift during and after sinking shall be done. Sinking shall be recorded in Sinking history register.

Tilts and Shifts

- The inclination of well from the vertical is known as tilt and horizontal displacement of the centre of well at the founding level from its theoretical positions is known as shifts.
- Necessary precautions shall be taken at site such that tilt of any well shall not exceed 1(horizontal) in 100 (vertical), and the shift at the well base shall not be more than $D/40$ or 150mm in any resultant direction whichever is less.
- Tilts and shifts shall be carefully checked and recorded in the format as per Appendix-1200/I- I & Appendix -1200/II of MOST specifications for Road & Bridge works regularly during sinking operations. For the purpose of measuring the tilts along the two axis of bridge, reduced level of the marks painted on the surface of steining of the well shall be taken. For determination of shift, location of the ends of two diameters shall be precisely measured along the two axes, with reference points.
- Whenever any tilt is noticed, adequate preventive measure like placing eccentric kentledge, pulling, strutting, anchoring or dredging unevenly and depositing dredge

material unequally, putting obstacles below cutting edge, water jetting etc. shall be adopted before any further sinking. After correction, the dredged material shall be spread out uniformly.

- A pair of wells close to each other has a tendency to come closer while sinking. Timber struts may be introduced in between the steining of these wells to prevent tilting.
- Tilts occurring in a well during sinking in dipping rocky strata can be safeguarded by suitably supporting the curb.
- In the event of a well developing tilt or shift beyond the specified permissible values, the contractor shall have to carry out, at his own cost, suitable remedial measures to the satisfaction of the Client to bring the tilt and shift within permissible values, as far as practicable.
- If the resultant tilt and/or shift of any well exceed the specified Permissible values, as defined in earlier para, the well so sunk shall be regarded as not conforming to specifications and a substandard work. The Client in his sole discretion may consider accepting such a well at reduced rates provided, calculations for foundation pressures and steining stresses, accounting for the actual tilt and shifts furnished by the contractor show that the well is safe. Any remedial measure required to bring the stresses within permissible values (such as increase in the dimension of the well cap, provision of dummy weight on the well cap etc.) shall be carried out by the contractor without claiming for any extra cost. Further any reduction in cost decided by Client shall be binding on the contractor.

6.11 Use of Water & Air Jetting

- Water and air jetting shall be employed for well sinking wherever necessary.

6.12 Use of Explosives

- Mild explosive charges under controlled condition may be used as an aid for sinking of the well only with prior permission of Client. This shall only be resorted to when all other methods of well sinking have been exhausted. Controlled blasting of any sort shall only be done in the presence of the Engineer-in-Charge and not before the concrete in the steining has hardened sufficiently and is more than 7 days old. When likelihood of blasting is predicted in advance, protection of the bottom portion of the well shall be done as per these specifications. After blasting operations are completed, the well curb and steining should be examined for any cracks and remedial measures taken.
- If blasting has been used after the well has reached the design foundation level, normally 24 hours shall be allowed to lapse before the bottom plug is laid.
- The charges shall be exploded well below the cutting edge by making a sump so as to avoid chances of any damage to curb or to the steining of the well. A minimum sump of 1 meter depth should be made before resorting to blasting. Use of large charges, 0.7 kgs or above may not be allowed except under expert direction and with the permission from the Client. Suitable pattern of charges may be arranged with delay detonators to reduce the number of charges fired at a time. The burden of the charge may be limited to 1 metre and spacing of holes may normally be kept as 0.5 to 0.6 metre. All prevalent laws

concerning handling, storing and using of explosive shall be strictly followed during the blasting operation.

- All safety precautions shall be taken as per IS: 4081 “Safety Code for blasting and related drilling operations”, to the extent applicable, whenever blasting is resorted to.
- There should be no equipment inside the well nor there any labour in the close vicinity of the well at the time of exploding the charges.
- If rock blasting is to be done before seating of the well, the damage caused by flying debris should be minimized by covering blasting holes by rubber mats before blasting.

6.13 Use of Divers

- Use of divers may be made both for sinking purpose like removal of obstructions, rock blasting and for inspection. All safety precautions shall be taken as per any acceptable safety code for sinking with divers or any statutory regulations in force.
- Only person trained for the diving operations shall be employed and shall be certified to be fit for diving by an approved doctor.
- They shall work under expert supervision. The diving and other equipment shall be of acceptable standard and certified to this effect by an approved independent agency. It shall be well maintained for safe use.
- Arrangement for ample supply of low pressure clean cool air shall be ensured through an armoured flexible hose pipe. Stand-by compressor plant shall be provided in case of breakdown.
- Separate high pressure connection for use of pneumatic tools shall be made. Electric lights where provided shall be at 50 volts (maximum). The raising of the diver from the bottom of wells shall be controlled so that decompression rate conforms to the rate as laid down in appropriate regulations.



6.14 Precautions during Sinking

- When the wells have to be sunk close to each other and clear distance between them is not greater than the diameter of wells, Sinking shall be taken up on all wells and they shall be sunk alternately so that sinking of well proceeds uniformly. Simultaneous and even dredging shall be carried out in the wells in such a manner that the difference in the levels of sump and cutting edge in the adjacent wells does not exceed half the clear gap between them. Plugging of all the well shall be done together

- Bore chart shall be referred to constantly during sinking for taking adequate care while piercing different types of strata. The types of soil as obtained during the well sinking should be compared with bore chart so as to take prompt decisions.
- Before seasonal floods all wells on which sinking is in progress shall be sunk to sufficient depths below the designed scour level. Further, they shall be temporarily filled and plugged so that they do not suffer any tilt or shifts during the floods.
- All necessary precautions shall be taken against any possible damage to the foundations of existing structures in the vicinity of wells, prior to commencement of dredging from inside the well.
- The dredge material shall not be allowed to accumulate over the well. It shall be dumped and spread, as far away as possible, and then continuously and simultaneously removed, as directed by the Client. In case the river stream flows along one edge of the well-being sunk, the dredged material shall not be dumped on the dry side of the bank but on the side on which the river current flows.
- Very deep sump shall not be made below the well curb, as it entails risk of jumping (sudden sinking) of the well. The depth of sump shall be generally limited to one-sixth of the outer diameter/least lateral dimension of the well in plan. Normally, the depth of sump shall not exceed 3.0metres below the level of the cutting edge unless otherwise specifically permitted by the Client.
- In case a well sinks suddenly with a jerk, the steining of the well shall be examined to the satisfaction of the Client to see that no damage has occurred to it.
- Dewatering shall be avoided if sand blows are expected. Any equipment and men working inside the well be brought out of the well as soon as there are any indications on sand-blow.
- Sand blowing in wells can often be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.

6.15 BOTTOM PLUG

- For bottom plug, the concrete mix for --- grade shall be designed to attain the strength as mentioned on the drawing. However, the total cement content shall not be less than 330
- kg/cu.m of concrete with a slump in the range of 150 mm to 200mm. Admixture may added to impart the required characteristics indicated herein.
- Underwater concreting shall be done by 250mm dia tremmie pipes and hopper at the top. Concreting shall be done upto 300mm above the curb as mentioned in the drawings. Tremie concrete when started shall be continued without interruption for full concreting in the bottom plug.

- Proper platform shall be provided above the steining for sounding check and for concreting.
- Before commencing plugging, all loose material from the bottom of the well shall be removed.
- Concreting shall be done in one continuous operation till the dredge hole is filled upto the required height and thereafter sounding shall be taken up to ensure that the concrete has been laid to the required height.
- Least disturbance shall be caused to the water inside the well while laying concrete in the bottom plug.
- In order to check any rise in the level of the bottom plug soundings should be taken at the close of concreting and once every day for the subsequent 3 days.
- Water rise test shall be done after 7 days from the day of casting. The soundness of the bottom plug may be tested by dewatering the well by 5 metre below the surrounding water level and checking the rise of water. The rate of rise shall preferably be less than 10 cms per hour. In case the rate is higher, suitable remedial measures as directed by the Client shall be taken.



6.16 Water filling in well

- After completion of water rise test, the well shall be filled up with water upto the bottom level of well cap.
- Place the sacrificial beams & slabs in the pockets/opening left in the final lift of the steining
- Start filling water in the well through the opening sacrificial slabs using a pump of suitable capacity till the bottom of the well cap and get it checked & approved by the Engineer in-charge



- After getting approval, seal the beam & slab arrangement and start fixing the reinforcement for well cap.

6.17 WELL CAP

Reinforcement Fixing:

- The layout shall be marked for the bottom reinforcement position and pier reinforcement as per drawing.
- The reinforcement shall be cut & bent at yard as per the approved bar bending schedule (BBS).
- Fixing of the reinforcement for well cap shall be as per the latest approved drawing
- Fixing of bottom layer reinforcement with necessary cover blocks to be done. The bottom layer rebar shall be checked with engineer in-charge.
- Fixing of chairs and spacer bars will be provided at appropriate location to maintain the desired depth and position of rebar.



Concreting:

- False wall shall act as a shuttering arrangement for well cap.
- Concrete of Grade M__ shall be used for casting of well cap.
- Concrete shall be prepared at batching plant as per design mix and shall be transported by transit mixers.
- Boom placer shall be used for concrete placement, Crane & concrete bucket shall be kept as a standby.
- Electric vibrator 2 No's shall be used and 1 No. Diesel vibrator shall be kept as a stand by.
- 60 mm & 40mm Diameter needles (4 to 8 m long) shall be used according to the depth of well cap. 40 mm Ø of needles also shall be kept as a stand by.
- Air compressor with hosepipe shall be used for cleaning the well cap before concrete starts.
- Sufficient number of Concrete cube moulds shall be used for concreting according to the specification.
- Slump and temperature of concrete shall be checked and concrete shall be poured layers of 300 mm to 500mm with proper vibration.
- The pier starter shall also be casted and the concrete surface shall be roughened on top for proper bonding.

Curing and Deshuttering:

- Initial curing shall be done over shuttering.
- De-shuttering shall be done after 24 hrs of completion of concrete.

6.18 TOLERANCE

For the well steining and well cap the permissible tolerance shall be as follows

- Variations in diameter :+ 50mm,-10mm
- Misplacement from specified position in plan :15mm
- Surface unevenness measured in plan with 3m straight edge: 5mm
- Variation of levels at the top : ± 25mm

6.19 Test And Standards Of Acceptance

The materials shall be tested in accordance with the specification and shall meet the prescribed criteria. The work shall conform to these specifications and shall meet the prescribed standard of acceptance.

6.20 Tests And Control Plan:

- History of well sinking shall be updated regularly and shall be submitted after total sinking is completed.
- Final tilt & Shift report of the well shall be submitted after sinking is completed.
- Non Destructive tests shall be conducted at welding joints and reports shall be submitted to engineer in charge.
- Cubes cast during concreting shall be tested for 7 days & 28 days in presence of engineer in charge.

Records

- Concrete Pour
- Checklist-Reinforcement
- Checklist-Formwork
- Checklist-Concreting Work
- Format for Well Sinking History
- Format for Tilt & Shift

For sheet pile

