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Planning, Scheduling and Monitoring Methodology for Construction Practices

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Abstract: The main objective and aim to be achieved through this mini project is to identify a small construction project and collect its documents defining the scope, prepare the work breakdown structure involving activities in the project execution and schedule the project considering duration and resource allotment, activity, working calendar, etc.

I. SCOPE OF PROJECT

A. Type

Rural Water Supply Scheme

B. Location

Budhgaon, Tal. Miraj, Dist. Sangli

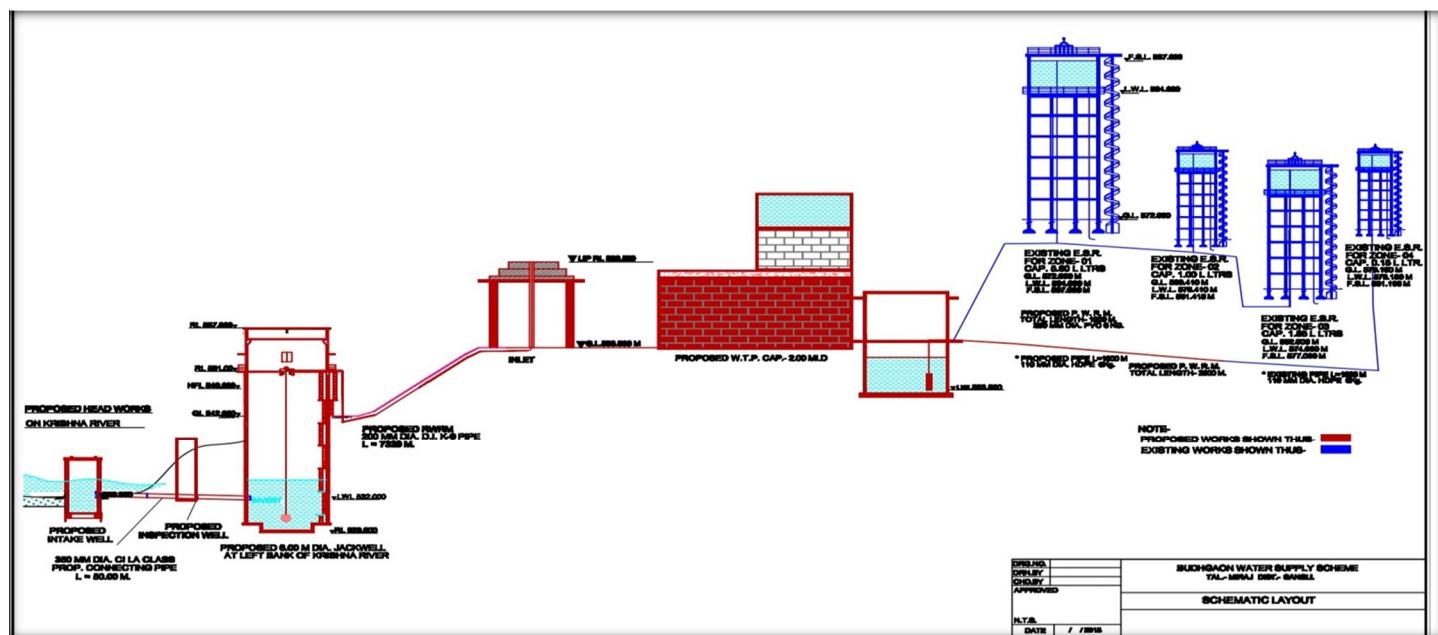
C. Purpose

The project aims to provide an efficient conventional water supply system for rural region of Budhgaon. The project consists of typical components of a water supply/distribution system such as intake well, jack well, connecting pipes, rising main pumping stations, water treatment plant with components, elevated service reservoir, etc. Water from Krishna river is used by the project.

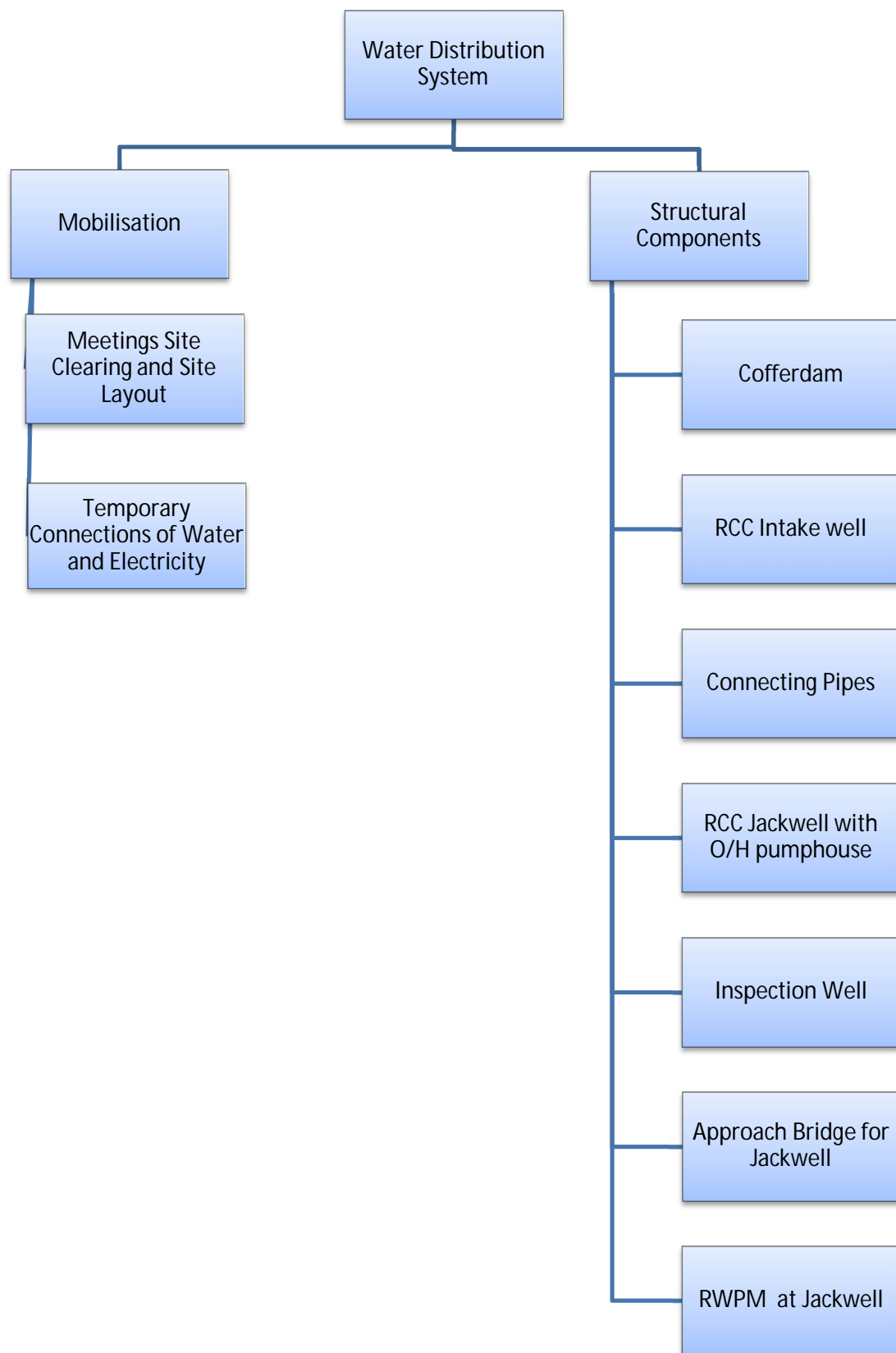
D. Assumptions

The Estimate of this Water Distribution System was procured from regional Zilla Parishad and the duration were deduced from the estimates and thus the duration was calculated based on the various resources and the rate of work through resource allocation. The division of durations of a sub-activity in the project is approximated and is raw and may actually vary slightly. For the updating purpose, it is assumed that the work gets delayed and falls short in following the schedule due to strike of workers for a period of 15 days.

II. PLAN OF WATER DISTRIBUTION SYSTEM



III. WORK BREAKDOWN STRUCTURE



DETAILED WORK BREAKDOWN STRUCTURE

Subproject	Task	Workpackage	Activity
Mobilisation	Kickoff Meeting		
	Site Cleaning		
	Site Layout		
	Temporary Water Connection		
	Temporary Electricity Connection		
	Labour Huts		
	Completion of		
Coffer dam	Providing impervious /semi-impervious material on both sides of B.C soil (in gunny bags if required) including ramming compacting	Excavation in general soft material and simultaneous lifting up Lead of 150 M including barricading, guarding, disposing off within 0.5km rad	
	Excavation		
	Filling middle position with B.C. soil (gunny bags if required)		
RCC Intake well	Substructure	1. Excavation in soft medium	i) Excavation in general soft material and simultaneous lifting up ii) Lead of 150 M including barricading, guarding, disposing off
		2. Excavation in hard medium	i) Excavation in hard material using controlled blasting and simultaneous lifting ii) Lead of 150 M including barricading, guarding, disposing off
		3. Providing and casting in situ cement concrete 1:1/2:3 in M20 for foundation and bedding	
		4. Providing and casting in situ cement concrete for RCC Raft slab M:30	i) Centering ii) PCC bedding iii) Reinforcing iv) Shuttering v) Casting concrete
		5. Providing and casting in situ cement concrete for RCC Vertical wall & slab & bedding M:30	i) Casting concrete ii) Shuttering iii) Casting concrete
		6. Providing and fixing in position steel bar reinforcement of various diameters for RCC pipes, caps, footings, foundation a. RCC Raft slab 120kg/Cum of Conc	
	Super-structure		
Connecting pipes	1. Providing & supplying ISI mark C.I. S/S pipes		
	2. standard CI flanged/S&S specials		
	3. Excavation in soft medium	i) Excavation in general soft material and simultaneous lifting up ii) Lead of 150 M including barricading, guarding, disposing off within 0.5km rad	
	4. Excavation in hard	i) Excavation in hard material using controlled blasting and simultaneous lifting	

	murum	ii) Lead of 150 M including barmcating, guarding, disposing off within 0.5km rad	
	5. Providing and casting in situ cement concrete for foundation and 6. Lowering, laying and joining SBR rubber 7. Dewatering the excavated trenches 8. Refilling the trenches		
RCC jackwell with O/H pumphouse	Sub-structure	1. Excavation in soft murum	i) Excavation in general soft material and simultaneous lifting up ii) Lead of 150 M including barmcating, guarding, disposing off
		2. Excavation in hard murum	i) Excavation in hard material using controlled blasting and simultaneous lifting ii) Lead of 150 M including barmcating, guarding, disposing off
	Super-structure	3. Providing and laying stones, aggregate for foundation and bedding	
		4. Providing and casting in situ cement concrete RCC footing M30	i) Centering ii) PCC bedding iii) Reinforcing iv) Shuttering v) Casting concrete
		5. Providing and casting in situ cement concrete RCC vertical wall & slab & landing M300	i) Reinforcing ii) Shuttering iii) Casting concrete
		6. Providing and casting in situ cement concrete RCC Beams and lintels M300 and 4. Providing and casting in situ	i) Reinforcing ii) Shuttering iii) Casting concrete
		7. Dewatering in excavated trenches	
		8. Providing and fixing M.S. ladder	
		9. Providing and fixing G.I. pipe railing	
		10. Providing and fixing Steel window C.R.C	
		11. Providing and fixing rolling shutter	
		12. Providing second class burnt brick masonry	i) Providing bricks ii) Constructing Wall
		13. Plastering- Mixing of material and applying on surface.	
		14. Waterproof treatment- Lifting BB at required place and providing waterproof treatment of	
		15. Applying of distemper- Scaffolding and applying 2 coats of oil bound distemper	
		16. Applying 2 coats of waterproof cement paint including cleaning and preparing surface and waterfing for 2 days.	i) Cleaning and Preparing surface ii) Applying two coats iii) Waterfing

		17. Earthing- Excavation for earthing pit and providing and fixing copper wire with copper plate including laying	
		18. Providing mild steel sluice gate	
		19. Providing and laying cement concrete	
		20. Refilling of trenches excavated for pipelines with soft material	
		21. Refilling of trenches with hard material for	
		22. Compaction and leveling of excavated	
Inspection well	Sub-structure	1. Excavation in soft material	i) Excavation in general soft material and simultaneous lifting up ii) Lead of 150 M including baticating, guarding, disposing off
		2. Excavation in hard material	i) Excavation in hard material using controlled blasting and simultaneous lifting ii) Lead of 150 M including baticating, guarding, disposing off
		3. Dewatering of excavated trenches including disposing of	
		4. Providing and laying stones or hard material like trap, granite etc. for foundation, bedding etc.	
		5. providing and laying steel, cement, aggregates etc. on site	
		6. Centering and start of ecc	
		7. Reinforcement of columns	
		8. Shuttering for foundation	
		9. Concreting and curing	
		10. Shuttering for	
		11. Concreting and curing of columns	
		12. Shuttering for beam and slabs.	
		13. Providing and fixing steel for slab, beam, staircase etc.	
		14. Providing and fixing CI Dapur steps	
		15 Applying 3 coats of anticorrosive paints	
		16. Applying 2 coats of anticorrosive paints on inverted J type cowel type ventilators with mosquito top proof	
		17. Fixing of cowel type ventilators	
		18. Refilling of trenches with available excavated stuff with soft	
		19. Refilling of excavated trenches with hard material for 15cm.	
		1. Providing and laying granite, other material for foundation	

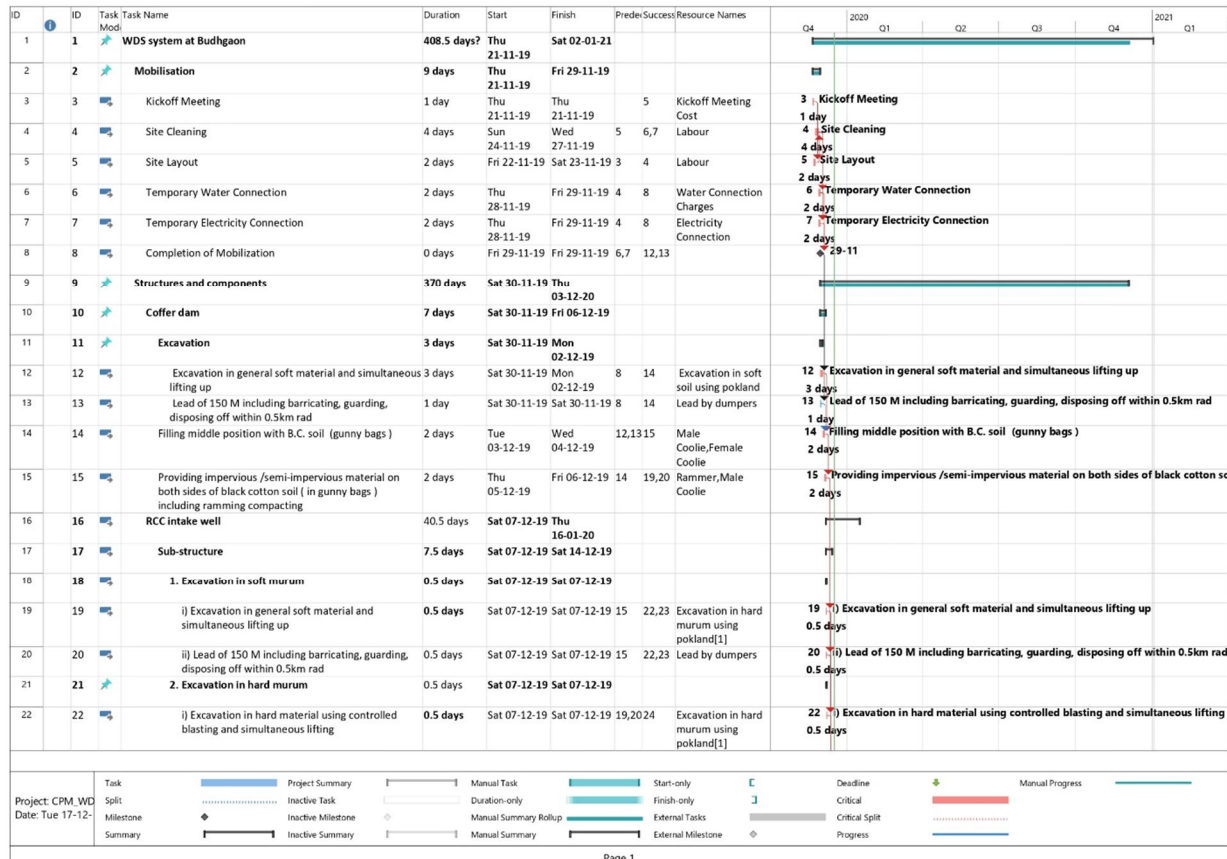
Approach bridge for jackwell	Sub-structure	2. Fixing and centering positions of piles for pile foundation.	
		3. Boaring and installing shell for pile foundation.	Providing and fixing MS bars in Concreting of piles and curing
		4. Laying MS bars (reinforcement) for Pile cap Concreting of Pile cap and curing	
	Superstructure	5. Centering and laying MS bar reinforcement For columns	shuttering of Columns Concreting of columns Curing of columns
		6. Dethuttering of Column formwork.	
		7. Shuttering for slab and beam	
		8. Installation of steel for slabs and beam	
		9. Concreting of slab and beam and curing	
		10. Dethuttering of slab and column.	
		11. Providing and fixing GI pipe railing and painting anticorrosive	
RWPM at jackwell	RCC foundation for pump house	Excavation as per design Providing reinforcement Casting and curing thereafter	
Handover/Close down			

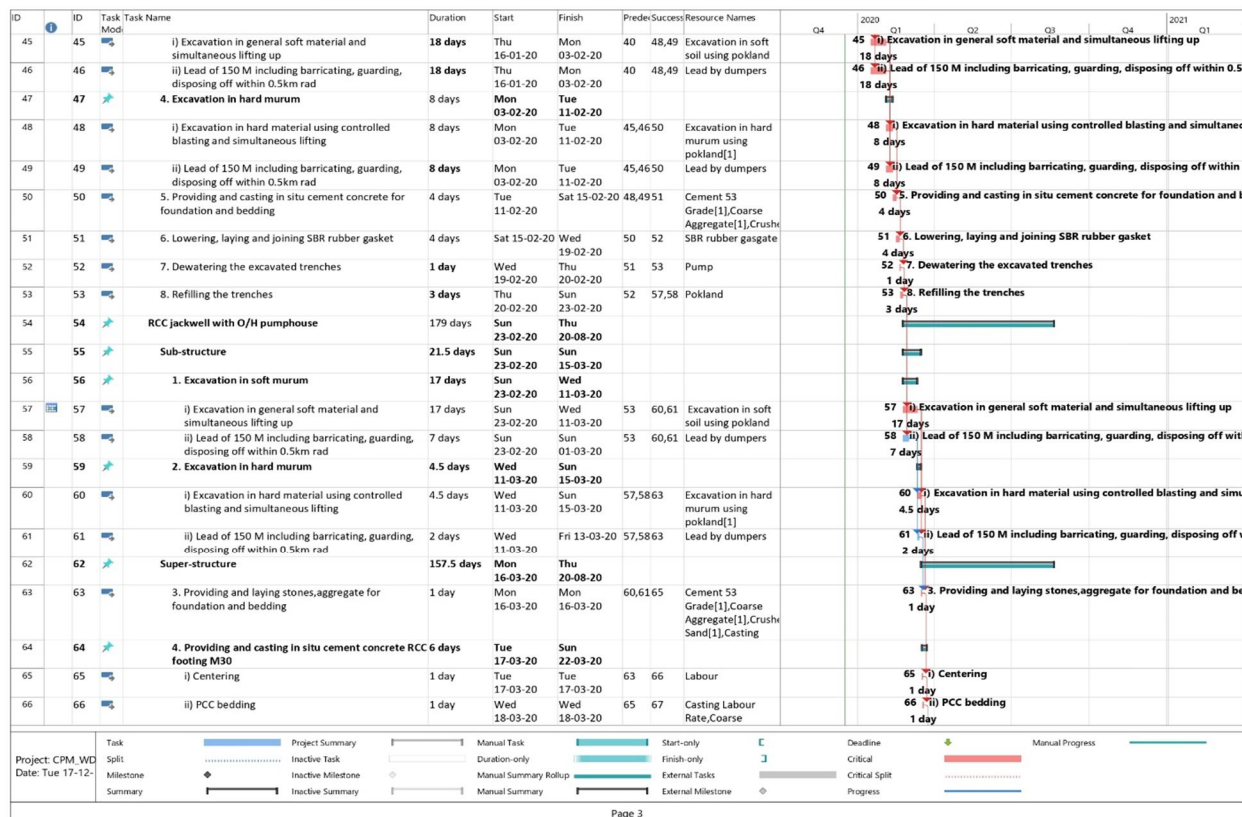
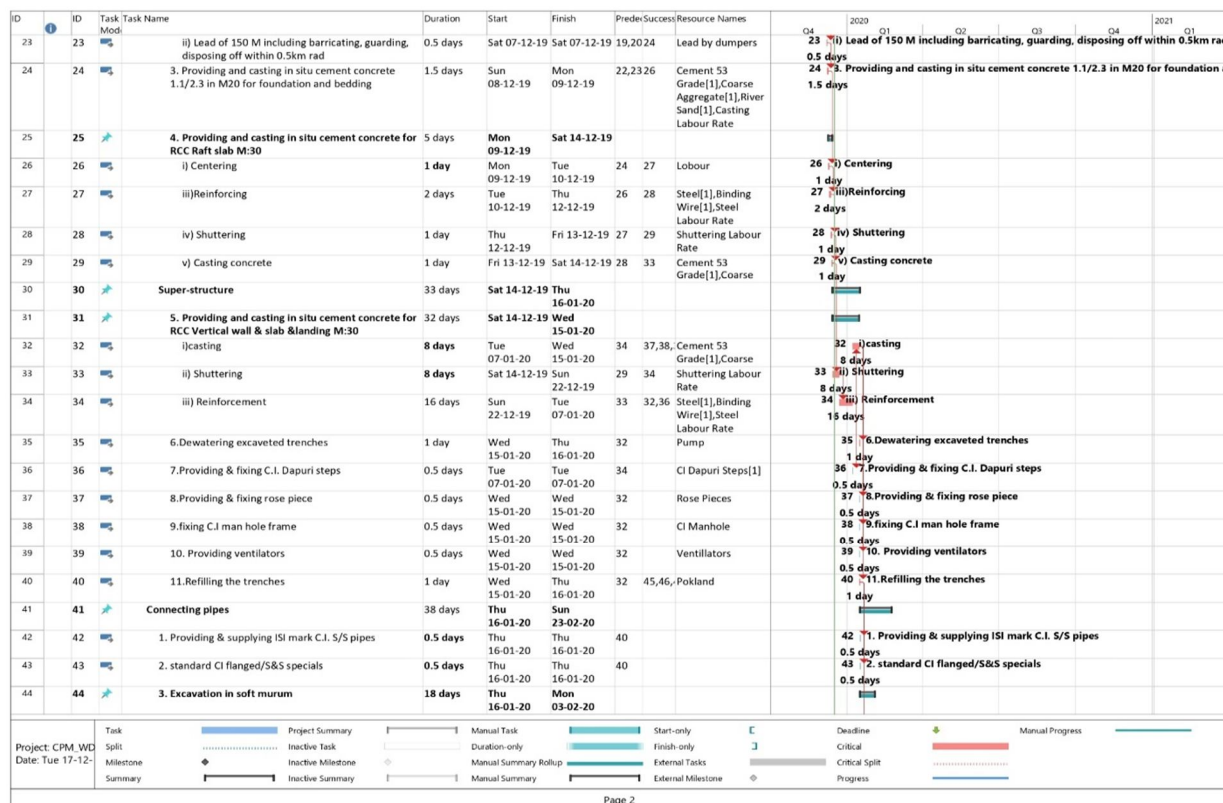
IV. ACTIVITY SCHEDULING

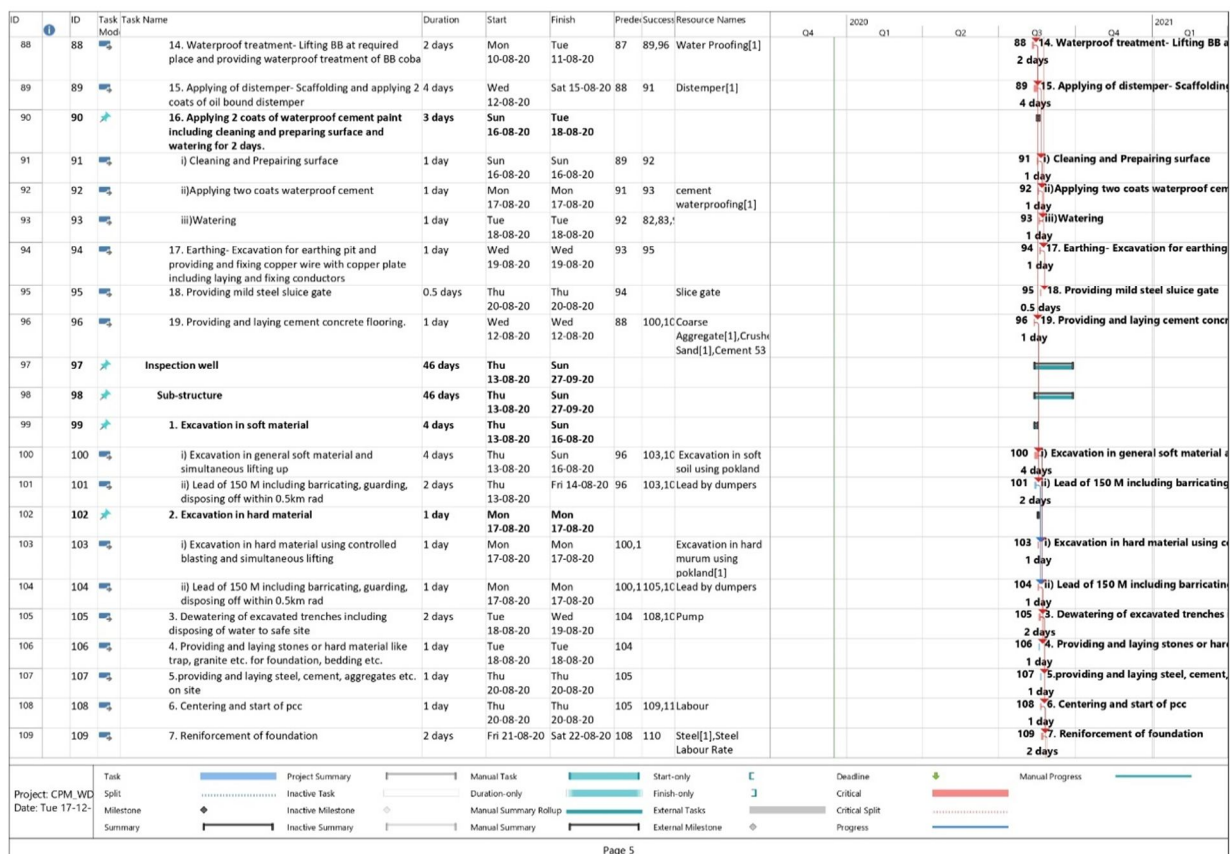
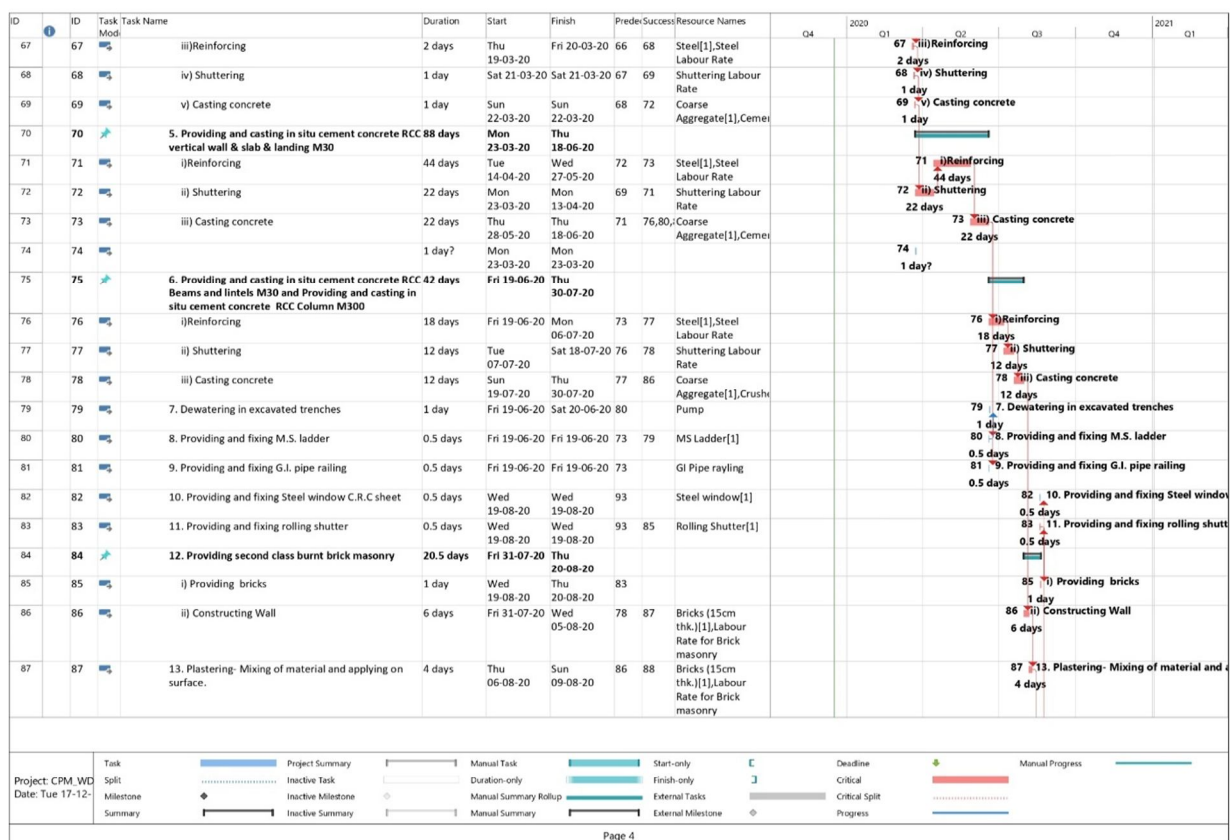
Activity Schedule								
Sr. No.	Activity	Quantity	Unit	Resource	No.	Productivity	Duration	
1	MOBILISATION	Kickoff meeting					1	
		Site cleaning		excavator	1		4	
		Site layout		Engineer	1		2	
		Temporary Connections		Labour	2		5	
2	COFFER DAM and RCC INTAKE WELL	Excavation	Cum	Engineer	1		1	
				Labour	2	8 cum per day		
				Excavator	2	25 cum per hr	1	
		Filling BC Soil at middle and rammer	Cum	dumper	1			
				Male Coolie, Female Coolie	1	8 cum per day	4	
				Centering labour	2		1	
		Cement Concreting	Cum	Shuttering Labour	2		8	
				Mixer	1			
				Casting labour	5	8 cum per day	8	
		Steel	MT	Steel Labour	2	100 kg steel per day	16	
3	CONNECTING PIPES	Excavation	Cum	Engineer	1			
				Labour	2			
				Excavator	1	25 cum per hr		26
		DI pipes	RM	dumper	2			
				Labour	2	8 m per day	4	
		Cement Concreting	Cum	Mixer	1			
				Casting labour	5	8 cum per day	4	

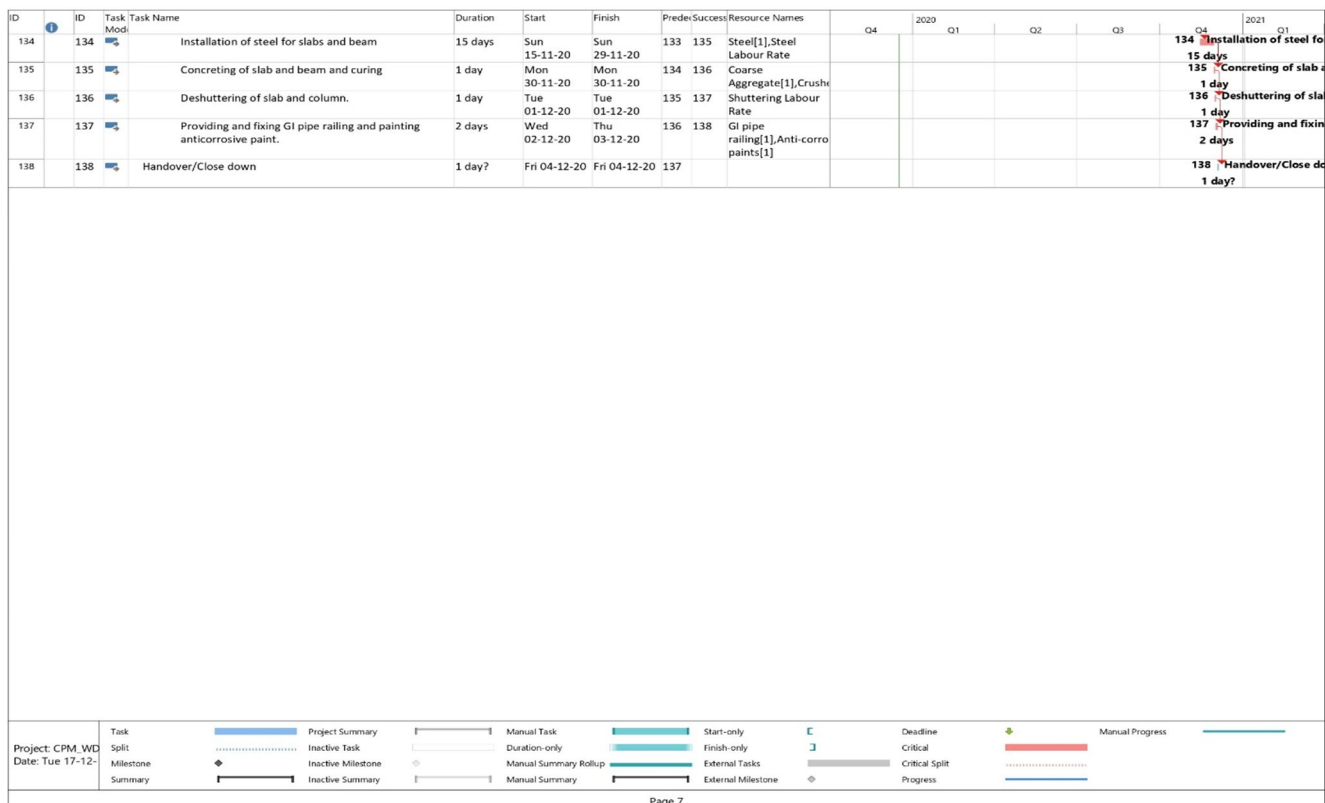
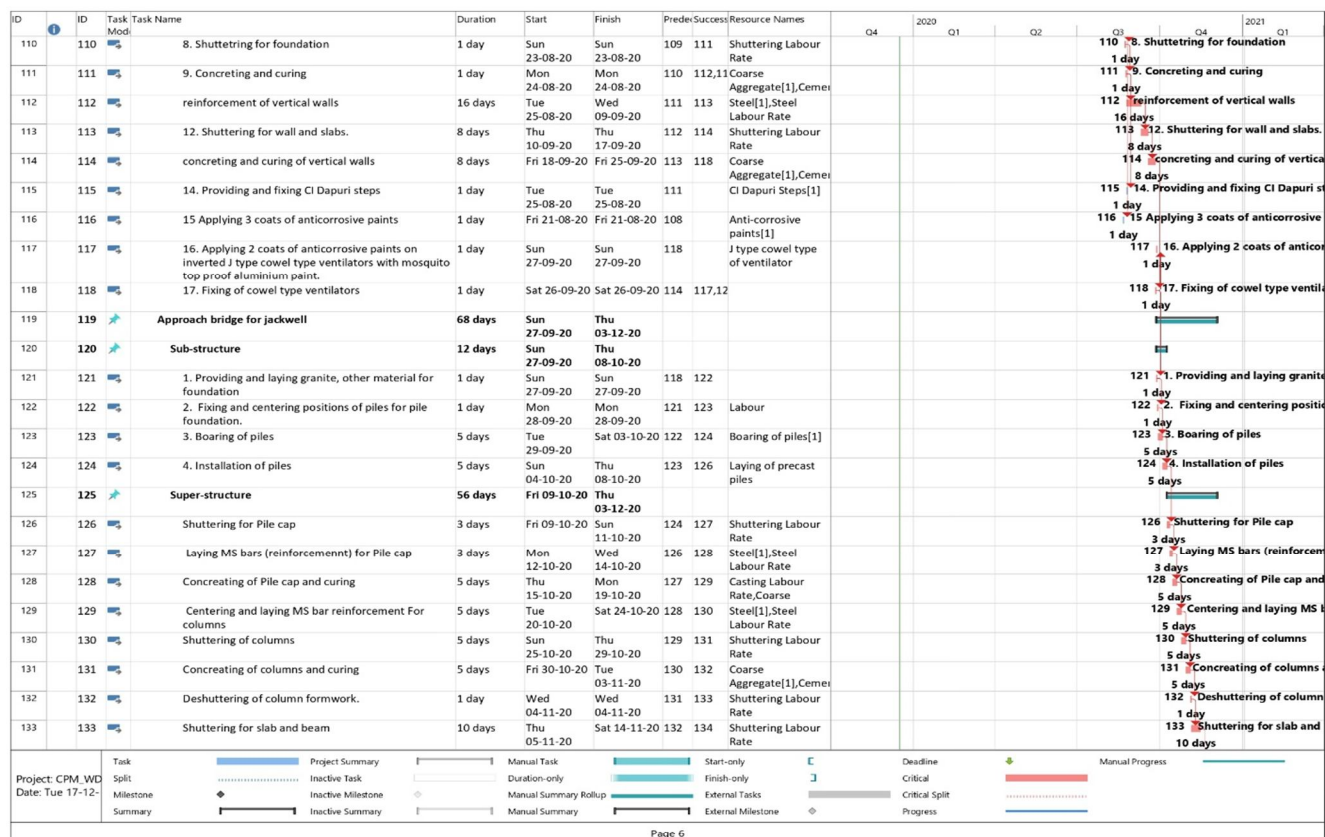
4	RCC JACKWELL WITH O/H PUMP HOUSE	Excavation	2640.00	Cum	Engineer	1		
					Labour	2	8 cum per day	
					Excavator	1	25 cum per day	22
					dumper	2		
		Dewatering	13650.00	bhp/hr	Pump	1		1
		Providing ladder	29.00	RM	MS ladder	1		1
		Brick masonry	19.00	Cum	Mason	2	1 cum per day	6
					Labour	1		
		Cement Concreting	14.00	Cum	Centering labour	2		8
					Shuttering Labour	2		45
5	INSPECTION WELL				Mixer	1	8 cum per day	
					Casting labour	5		34
					Steel Labour	0		62
		Plastering	221.00	Sqm	Mason	3	8 sqm per day	4
					Labour	3		
		Waterproofing	35.00	Sqm	Labour	2	8 sqm per day	3
		Excavation	236.00	Cum	Engineer	1		
					Labour	2	8 cum per day	6
		Dewatering	4000.00	bhp/hr	Pump	1	20 HP	1
					Centering labour	2		8
6	APPROACH BRIDGE				Shuttering Labour	2		
					Mixer	1	8 cum per day	
					Casting labour	5		
		CI Dapuri steps	36.00	no.	Steel Labour	2	100 kg steel per day	1
					Labour	1		
		CI cowel Ventilators	3.00	no.	Labour	1		
		Centering, Casting	20.00	RM	Casting labour	3		11
					Steel Labour	3		
		Providing Casing, RCC Foundation, RCC Column, Beams, Slab,	2086.00	Kg	Shuttering Labour	2		20
			15.13	Cum	Steel Labour	2	100 kg steel per day	23
			36.00	RM	Casting labour	6	1.5 cum per day	11
					GI Pipe railing	3		2

V. MICROSOFT PROJECT SCHEDULING









VI. SAFETY MANAGEMENT PLAN

A. Introduction

- 1) *Management Commitment:* Safety and health issues will be addressed on site by continuous evaluation of contractor/subcontractor work methods, equipment and work areas.
- 2) *Contractor Employee Involvement:* All contractor employees are expected to perform their duties safely and comply with all applicable laws and regulations (local, state and federal). Employees are encouraged to freely discuss their safety concerns with their immediate. All employees are charged with personal responsibility for safe behavior. Unsafe acts will not be tolerated.
- 3) *Training Safety:* Training is an integral part of safety program. Contractors are expected to educate their employees on the basic elements of this manual as well as other applicable regulatory requirements.
- 4) *Injury Management/Early Return-to-Work:* All contractors/subcontractors are expected to return any injured employee to a productive environment as soon as possible after an injury. Contractors must evaluate each lost-time injury and review the restrictions placed on each injured employee by his/her medical provider. If modified work can be found within the assigned restrictions on site, contractors/subcontractors must provide employment within those restrictions. The University of Rhode Island's Claims Representatives will work closely with each injured employee's treating physician and rehabilitation specialist, which in return will enable a program of this nature to be successful.

B. Safety Orientation

- 1) *General Requirements:* All contractors shall ensure that their employees receive safety orientation prior to starting work on this project. Each contractor shall maintain, and make available for inspection, records of such safety orientation and training. The orientation shall consist of the written format specified on the attachment on the next page in addition to any job specific information. All contractors shall ensure that each employee receives a copy of this orientation and signs the acknowledgement page at the end.
- 2) *Contractors/Subcontractors shall Ensure That*
 - a) The coordination of all proposed procedures and implementation plans within their assigned work areas.
 - b) All implementation requirements are fulfilled and documented.
 - c) Availability of their manual to their employees and subcontractors.
 - d) All affected employees are trained on new/revised policies, practices and procedures.
 - e) Tracking the implementation of each procedure or policy.

C. Construction Safety Checklist

City/Address _____

Observer _____

Date Observed _____

Checklist Completed: Check ☒ boxes that apply

☐ Offsite before or after work

☐ Onsite

Every section of the audit should have a check ☒

Instructions:

Yes = Observed and in compliance

No = Observed and not in compliance

D. Subcontractor Site Safety Representative:

Provide the name(s) of those person(s) onsite who are capable of identifying existing and predictable hazards in the surrounding or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them. The subcontractor shall ensure that the Site Safety Representative(s) listed have been appropriately trained as applicable:

Site Safety Representative:	
Site Safety Representative:	

E. CAL/OSHA Competent & Qualified Person(s):

Provide the name(s) of those persons onsite who by possession of a recognized degree, certification, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems relating to the subject matter, the work, or the project. The subcontractor shall ensure that each qualified and competent person listed has been trained in the following areas as applicable:

Asbestos Competent Person:	
Lead Competent Person:	
Crane Competent Person:	
Confined Space Entry Supervisor:	
Demolition Competent Person:	
Electrical LOTO Qualified Person(s):	
Energized Electrical Qualified Electrical Worker(s):	
Excavation & Trenching Competent Person:	
Fall Protection Competent Person:	
Fall Protection Qualified Person:	
Ladder Competent Person:	

Personal Protection Equipment – PPE		Yes	No
1	Head Protection		
	Supplied by employer		
	Worn when required		
2	Boots		
	Supplied by employer		
	Worn when required		
3	Hearing Protection		
	Supplied by employer		
	Worn when required		
4	Eye Protection		
	Supplied by employer		
	Worn when required		
5	Respiratory Protection		
	Supplied by employer		
	Worn when required		
	Training Provided		

Ladders			
1	Correct size for the job		
2	Firm foundation for ladder feet		
3	Proper climbing procedures		
4	Three-point contact rule followed		
5	Free from obvious defects		
6	Workers stand below top		

Scaffolds		
1	Fall protection used if over 10 feet tall	
2	Set up on level, stable footing	
3	Platform is appropriate width for type of scaffold	

Fall Protection		
1	Fall protection provided for heights 6 ft. or more	
2	Harness is worn properly and attached to secure anchorage	
3	Slide guards are installed across full width and all sides	

Fire Protection		
1	Has a fire protection program been developed?	
2	Is firefighting equipment conspicuously located?	
3	Is firefighting equipment periodically inspected and maintained in operating condition?	
4	Has an educational program to familiarize employers with the general principles of fire extinguishers use and the hazards involved been provided?	
5	Will work include the use of open flames such as torches, welders, grinders, tar pots or any other tool or process/procedure that could cause sparks or open flames?	
6	Is at least one portable fire extinguisher with a rating of not less than 20-B:C located within 75 feet of each pump, dispenser, underground fill pipe opening and lubrication or refueling service area?	

Signs, Signals and Barricades		
1	Are accident prevention signs and tags visible at all times when work is being performed and/or removed or covered promptly when the hazard no longer exists?	
2	Is signaling by flaggers?	
3	Are barricades used for protection of workers?	

Stocking and Handling of Materials		
1	Are materials which are stored in tiers either stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse?	
2	Are materials stored more than 6 feet from any hoist way or inside floor opening and more than 10 feet from any exterior walls that do not extend above the top of the stored materials?	
3	Are waste materials disposed of properly?	

Hand and Power Tools		
1	Will the work involve the use of electrically powered tools?	
2	Will the work involve the use of pneumatically powered tools?	
3	Will the work performed on this project involve the use of powder-actuated tools?	

Hand and Power Tools			
1	Will the work involve the use of electrically powered tools?		
2	Will the work involve the use of pneumatically powered tools?		
3	Will the work performed on this project involve the use of powder-actuated tools?		

Welding and Cutting			
1	Are frames of all arc welding and cutting machines grounded?		
2	Are employees instructed in the safe means of arc welding and cutting?		
3	Will the work involve welding/cutting stainless steel?		
4	Subcontractor will submit the following items for welding or hot cutting on non-lead containing surfaces (new steel construction): - Respiratory Protection Program - Qualitatively fit tested ½ mask negative pressure respirator with fit test records - Medical approval to wear respirators - Respiratory protection training records		
5	Subcontractor will submit the following items for welding or hot cutting on lead containing surfaces (where lead paint exists or has been abated): - Respiratory Protection Program - Quantitatively fit tested full face-piece Powered Air Purifying Respirator (PAPR) and fit test records - Medical approval to wear respirators - Blood lead baseline sample results (excluding employee SSNs) - Documentation that workers have received lead awareness training. - Respiratory protection training records		
6	Subcontractor will submit the following items for welding or hot cutting on stainless steel: - Respiratory Protection Program - Quantitatively fit tested, full face-piece negative pressure respirator and fit test records. - Medical approval to wear respirators - Documentation of hexavalent chromium training. - Respiratory protection training records		

Electrical Protection			
1	Does the employer examine all electrical equipment to ensure that recognized electrical hazards		
2	Is sufficient working space provided to permit safe operation and maintenance of electrical equipment?		
3	Do all pull boxes, junction boxes, and fittings have covers?		
4	Are all cabinets, cut out boxes, fittings, boxes, panel board enclosures, switches, circuit breakers, and switchboards located wet or damp locations enclosed in weather proof enclosures.		
5	Is all electrical equipment used in hazardous locations either approved for the location or intrinsically safe?		

Excavation and Trenching			
1	Will this work scope involve any excavation up to 5 feet deep?		
2	Will this work scope involve any excavation deeper than 5 feet?		
3	Will this work scope involve sanitary sewer line repair or replacement?		
4	Will this work scope involve storm sewer line repair or replacement?		
5	Subcontractor will submit the following items for Excavation and Trenching: - JHA detailing Shoring Plan - Training Records		

Concrete Construction			
1	Is all protruding reinforcing steel, onto or into which employees could fall, guarded to eliminate the hazard of impalement?		
2	Is all form work for cast-in-place concrete designed, fabricated, erected, supported, braced, and maintained so that it will support without failure all loads that may be anticipated?		
3	Is erected shoring equipment inspected immediately prior to, during and immediately after concrete placement?		

Steel Erection and Assembly			
1	Is steel erection part of this work scope?		
2	Subcontractor will submit the following items for Steel Erection and Assembly: - Site-Specific Erection plan - Fall protection work plan (per ANSI/ASSE Z359)		
3	Has the controlling contractor provided in writing to the steel erector that the concrete has cured properly before steel erection begins and any repairs, replacements and modifications were conducted?		

Cofferdams			
1	At cofferdams, are warning signals for evacuation of employees in case of emergency developed and posted?		

Blasting and Use of Explosives			
1	Are only authorized and qualified persons permitted to handle explosives?		
2	Is every vehicle or conveyance used for transporting explosives marked on both sides, front, and rear with placards reading "EXPLOSIVES" in red letters not less than 4 inches high on white background?		
3	Are explosives and related materials stored in approved facilities?		

Heavy Equipment			
Identify heavy equipment that will be used on this project below:			
1	Backhoe		
2	Transit Mixer		
3	Earth Compactor		
4	Hyva Tipper		
5	Mucking Machine		
6	JCB		
7	Other		

VII. RISK MANAGEMENT PLAN

A. Constructional Requirement

- 1) Changes in the work
- 2) Late drawings and instructions
- 3) Availability of resources
- 4) Accidents (such as collision, fire and so on)
- 5) Damage to persons or property
- 6) Defective design
- 7) Actual quantities of work
- 8) Equipment commissioning

B. Financial and Economic

- 1) Inflation
- 2) Funding

C. Performance

- 1) Productivity of labour
- 2) Productivity of equipment
- 3) Suitability of materials
- 4) Defective work
- 5) Labour disputes

D. Contractual And Legal

- 1) Delayed dispute resolution
- 2) Delayed payment on contracts and extras
- 3) Change order negotiation

E. Technical Risks

- 1) Design process
- 2) Owner involvement in design
- 3) Inadequate and incomplete design
- 4) Errors in completion of structural / geotechnical / foundation

F. Construction Risks

- 1) Work permissions
- 2) Delayed deliveries and disruptions
- 3) Worker and site safety
- 4) Unsuitable equipment and materials
- 5) Environmental risks (such as projects close to a river, floodplain, coastal zone, high habitat sensitivity, and so on)

G. External Risks

- 1) Political factors change (political interference)
- 2) Political climate
- 3) Economic instability
- 4) Market condition

H. Organizational Risks

- 1) Inexperienced staff assigned
- 2) Losing critical staff at crucial points of the project
- 3) Insufficient time to plan
- 4) Priorities change on existing program

I. Project Management Risks

- 1) Project purpose definition, needs, objectives, costs, deliverables are poorly defined or understood
- 2) No control over staff priorities
- 3) Too many projects
- 4) Consultant or contractor delays
- 5) Estimating and/or scheduling errors
- 6) Communication breakdown with project team
- 7) Lack of coordination / communication
- 8) Inexperienced workforce / inadequate staff / resource availability

J. Accidental Risks

- 1) Unanticipated damage during construction is a
- 2) Any type of accidents on construction site like machineries accidents, overexertion, accidental falls etc. can be disastrous for the project.

K. Uncertain market condition

- 1) Price inflation
- 2) As this risk is usually unavoidable, clients should choose an appropriate type of contract; while contractor should always avoid using fixed price contracts to bear the risk.

L. Time/Funds

- 1) Time and cost are always closely correlated, a lengthy schedule will undoubtedly wreck the project cost benefit.
- 2) Correlation between time and cost is a quantitative risk

M. Utilities

- 1) Shortage of these utilities would create problems on site.

VIII. QUALITY ASSURANCE OF MATERIALS

A. Cement(OPC-43 GRADE) IS:8112-1989

Test	Frequency	Ref Codes	Acceptance/Standard
1) Chemical Tests (i) Loss on ignition, percent by mass (ii) Magnesia (Mgo), percent by mass (iii) Sulphuric anhydride (So3) Percent by mass (iv) Insoluble material, percent by mass	Once for every source approval Once for every lot Once for every 3 months	As per IS: 4032-1985	i) 5.0 % max ii) 6.0 max iii) 3.0 % max iv) $x + 4.0(100-x)/100$ where x is the declared % of flyash in the given Portland pozzolona cement
2.) Physical Tests (a) Setting Time (i) Initial (ii) Final (b) Soundness (Le-Chatelier Expansion)	Once for every source approval Once for every lot		i) Min. 30 min. ii) Max. 600 min. 10mm (max.) 0.8% (max) by Autoclave method
(c) Compressive Strength (i) At 72±1 hr (ii) At 168±2 hrs (iii) At 672±4 hr (d) Fineness (e) Drying shrinkage	Once for every 3 months		Not less than 16 MPa strength Not less than 22 MPa strength Not less than 33 MPa strength Specific surface shall not be less than 300 M ² /kg Not be more than 0.15%

B. Cement (OPC-43 GRADE) IS : 8112-1989

Test	Frequency	Ref Codes	Acceptance/Standard
1. Chemical Tests Chlorides (as Cl) Ratio of Alumina to that of Iron Oxide Magnesium (MgO) Total Sulphur content (SO ₃) Loss on Ignition Insoluble residue Lime saturation factor	Once for every source approval Once for every lot Once for every 3 months Once for every source approval Once for every lot Once for every 3 months	As per IS: 4032:1985 As per IS : 4031-1988	0.05 % max 0.66 % min 6.0 % max 3.0 % max 5.0 % max 2.50 % max 0.66- 1.02
2. Physical Tests (a) Setting Time (i) Initial (ii) Final (b) Soundness (Le-Chatelier Expansion) (c) Compressive Strength (i) At 72±1 hr (ii) At 168±2 hrs (iii) At 672±4 hr			Not less than 30 min. Not less than 600 min 10mm (max.) and 0.8% (max) by Auto clave method Not less than 23 MPa strength Not less than 33 MPa strength Not less than 43 MPa strength
(d) Fineness (Blain's air permeability method) By sieving on 90μ sieve	225 M ² /kg Minimum Residue not to exceed 10 %		

C. Aggregates

1) Test for Fine Aggregate

Test	Frequency	Ref. of Codes	Acceptance/Standard				
1. Particle Sizes (a) Sieve Analysis	Once for every source approval Once in a month	IS: 383-1970 IS: 2386 (Part I) – 1963 IS : 1542-1992 IS : 2116-1980	Fine aggregates should be grading for as given below				
			IS Sieve Designation	Percent by weight passing for			
				Zone I (High Strength conc.)	Zone II (Standard conc.)	Plaster (IS:1542)	Masonry (IS:2116)
			10mm	100	100	100	
			4.75mm	90-100	90-100	95-100	100
			2.36mm	60-95	75-100	95-100	90-100
			1.18mm	30-70	55-90	90-100	70-100
			600µm	15-34	35-59	80-100	40-100
			300µm	5-20	5-20	20-65	5-70
			150µm	0-10	0-10	0-15	0-15

2) Silt Test

Not more than 8% by weight in natural sand.

Not more than 10% by weight in case of crushed stone sand.

a) Organic Impurities

A colorless liquid indicates a clean sand free from organic matter.

A straw colored solution indicates some organic matter but not enough to be seriously objectionable.

Darker color means that the sand contains injurious amounts and should not be used unless it is washed, and a retest shows that it is satisfactory.

b) Bulkage of Sand

Test	Frequency	Ref. of Codes	Acceptance/Standard	
1. Deleterious Materials	Once for every source approval Once in a month	IS: 383-1970 IS: 2386 (Part II) – 1963	Deleterious Material	Percent by weight (Max.)
			Coal and lignite	1
			Clay and Lumps	1
			Material finer than 75 micron IS sieve	3
			Soft Fragment	-
			Shale	1
			Total % of all.	5
2. Silt Content	Once for every source approval Once daily		Maximum 8% or as specified in Agreement	
3. Specific Gravity and Density	Once for every source approval Once every 3 months	IS: 383-1970 IS: 2386 (Part III) – 1963	Test is required for maintaining uniformity of material brought from the source	
4. Water Absorption	Once for every source approval Once Daily	IS: 383-1970 IS: 2386 (Part III) – 1963	Test required for adjusting the water content in the mix design before starting any concrete mixing	
5. Soundness	Once for every source approval Once every 3 months	IS: 383-1970 IS: 2386 (Part V) – 1963	Maximum average loss of weight after 5 cycles (i) Tested with Sodium Sulphate - 10% (ii) Tested with Magnesium Sulphate - 15%	

3) Test for Coarse Aggregate (Stone Grit)

a) Sieve Analysis & Fineness Modulus Test

Test	Frequency	Ref. of Codes	Acceptance/Standard
Particle Size (a) Sieve Analysis	Once for every source approval Once in a week	IS: 383-1970 IS: 2386 (Part I) – 1963	According to IS code
(b) Flakiness Index and Elongation Index		IS: 2386(I) – 1963	35% Maximum value of combined Elongation and Flakiness Index
2. Deleterious Materials (crushed aggregate)	Once for every source approval At every change of source	IS: 383-1970 IS: 2386(II) – 1963	
3. Specific Gravity and Density	Once for every source approval Once in a fortnight	IS: 383-1970 IS: 2386 (Part III) – 1963	Test is required for maintaining uniformity of material brought from the source
4. Mechanical properties (a) Aggregate Crushing Value (b) Impact Value (c) 10 percent Fines (d) Abrasion Value	Once for every source approval Once for every source approval	IS: 383-1970 IS: 2386 (Part IV) – 1963	45% maximum by Weight 45% maximum by Weight Not less than 5 tonnes 50% maximum by Weight
5. Soundness	Once for every source approval	IS: 383-1970 IS: 2386 (Part V) – 1963	Maximum Average Loss of weight after 5 cycles (i) Tested with Sodium Sulphate - 12% (ii) Tested with Magnesium Sulphate - 18%
6. Surface Moisture content	Once for every source approval At every change of mix design	IS: 383-1970 IS: 2386 (Part III) – 1963	Test required adjusting the water content in the mix design before starting any concrete mixing.
7. Alkali Reactivity	Once for every source approval	IS: 383-1970 IS: 2386 (Part VII) – 1963	Innocuous Aggregate

D. Concrete

1) Slump Test

Sl. No.	Placing Conditions	Ref. codes	Degree of workability	Slump in mm
1	Blinding concrete; Shallow sections; Pavement using pavers	IS: 456 – 2000 IS : 1199 – 1959	Very low	< 25
2	Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strp footings		Low	25 - 75
3	Heavily reinforced sections in slabs, beams, walls, columns; Slip form work; Pumped concrete		Medium	50 – 100 75 – 100
4	Trench fill;		High	100 – 150
5	In-situ piling Tremie concrete		Very high	> 150

2) Compressive Test

Group	Grade Designation	Compressive strength on 15 cm cubes for work test In N/mm ²	
		Min at 7 days	Min at 28 days
Ordinary Concrete	M 10	7.0	10
	M 15	10.0	15
	M 20	13.5	20
Standard Concrete	M 25	17.0	25
	M 30	20.0	30
	M 35	23.5	35
	M 40	27.0	40
	M 50		50
	M 55		55
High strength Concrete	M 60		60
	M 65		65
	M 70		70
	M 75		75
	M 80		

E. Steel

1) Test of Steel For Reinforcement IS : 1786-2008

Test	Frequency	Ref Codes	Acceptance/Standard
1. Chemical Tests Carbon Sulphur Phosphorus -(Sulphur+ Phosphorus)	Once for every source approval Once for every lot Once every 3 months	IS : 228 (1-24)-1987 IS: 1786: -1985 IS : 1608-2005 IS :1599-1985 IS :1786-2008	0.30 Max. 0.06 Max. 0.06 Max. 0.11 Max. 10% more than the actual 0.2% proof stress but not less 485 MPa
2. Physical Test Ultimate tensile strength 0.2% proof stress % Elongation Bend Test Re-bend Test Mass per meter run (kg)	Once for every source approval Once for every lot Once every 3 months		Min. - 415 MPa Min.- 14.5 % To be satisfactory To be satisfactory 6.31 \pm 3% for 32 mm Dia, 4.830 \pm 3% for 28 mm dia., 3.85 \pm 3% for 25 mm dia., 2.470 \pm 3% for 20 mm Dia, 1.580 \pm 5% for 16 mm Dia, 0.888 \pm 5% for 12 mm Dia, 0.617 \pm 7% for 10mm dia, 0.395 \pm 7% for 8mm dia, 0.222 \pm 7% for 6 mm dia.

F. Mild Steel (Structural)

Test	Frequency	Ref Codes	Acceptance/Standard							
1. Chemical Compositions	Once for every source approval Once in a project for each source	IS:2062-2006	Grade	Designation	C	Mn	S	P	Si	Carbon value max.
			A	Fe410 WA	0.23	1.5	0.05	0.05	0.04	0.420.41
			B	Fe410 WB	0.22	1.5	0.046	0.045	0.04	0.39
			C	Fe410 WC	0.20	1.5	0.040	0.04	0.04	

Tensile strength of structural steel

Sl. No.	Test	Standards
1	Yield strength	250 MPa
2	Ultimate strength	400 MPa
3	Density	7.8 g/cm ³

G. Water For Construction Purposes

Test	Frequency	Ref. Codes	Acceptance/Standard
1. Chemical Analysis (a) PH value (b) Chlorides (as Cl)	Once for every source approval Every Quarterly Chemical tests daily in the site Laboratory with testing kits	IRC: 21-2000 IS: 3025 (Part 32) - 1987	a) Minimum 6 b) 2000mg/L for concrete not containing embedded steel and 500mg/L for RCC and PSC
(c) Sulphates (as SO ₃) (d) Neutralization with NaoH (with phenolphthalein as indicator)		IS: 3025 (Part 28) -1987 IS: 3025 (Part 22) -1987	c) 400mg/L d) Max. 5 ml of 0.2 normal NaOH to neutralize 100 ml. sample of water
2. Physical Analysis (a) Suspended Matter (b) Organic Matter (c) Inorganic Matter	Once for every source approval Every Quarterly	IS: 3025 (Part 23) - 1987 IS: 3025 (Part 17) IS: 3025 (Part 18) IS: 3025 (Part 19) - 1987	a) 2000 mg/ l max. b) 200 mg/ l max. c) 3000mg/l max.

H. Checks And Tests Of Finished Works

Sl. No.	Name of material	Test	Reference Codes	Frequency	Mini. Samp. size	Check level	Standards
1	2	3	4	5	6	7	8
1	MORTAR						
1.1	Water	(i)PH value (ii)Limits of Acidity (iii)Limits of Alkalinity (iv)Percentage of solids (a)Chlorides (b)Suspended matter (c) Sulphates (d)Inorganic solids (e)Organic solids	IS : 3025-1987	Water from each source shall be got tested before the commencement of work and thereafter once in every 3 months till the completion of work. Water from municipal source need be tested once in 6 months. Number of tests for each source shall be 3	One liter	I&IIA	> 6 Max. 5 ml of 0.02 NaoH in 100 ml water. Max. 25 ml of 0.02 H2SO4 in 100 ml water a)2000 mg/l PCC 500 mg/l RCC b)2000 mg/l Max. c)400 mg/l d)3000 mg/l Max. e)200 mg/l

1.2	Cement	(a)Physical requirement (i)Fineness (ii)Soundness (iii)Setting time(Initial & Final) (iv)Compressive strength (v)Consistency of standard cement paste	IS : 4031-1988	Every 10 tonnes or part thereof. Each brand of cement brought to site shall be tested as per this frequency.	10 Kg	I&III	i)Not > 10% ii)10mm Max. iii)Initial 30 mint. minimum Final 600 mint.Max. iv) > 43 Mpa
1.3	Sand	(a)Organic impurities (b)Silt content (c)Particle size distribution (d)Bulking of sand	IS : 2386-1963	Every 20 cum or part thereof or more frequently as decided by EIC	2 Kg	I&IIA	As per IS : 383-1970 Max. 8% As per IS : 383-1970
2	CONCRETE WORK						
2.1	Stone aggregate	(a) Percentage of soft or deleterious material (b)Particle size (c)Organic impurities (d)Surface moisture (e)Determination of 10% fine value (f)Specific gravity (g)Bulk density (h)Crushing strength (i)Impact value	Is :2386-1963	Every 40 cum or part thereof or more frequently as decided by EIC	6.5 Kg	I,IIA&II B	a)Max .5% As per IS: 383 - 1970 e)Not less than 5T h,i) 45% Max. 30% for wearing surface
2.2	Concrete	Slump test	IS :516-1959	15 cum or part thereof	As directed by EIC	I&IIA	As per grade
3	R.C.C. Work						
3.1	Concrete	(a)Cube test (b)Slump test	IS :516-1959	1-5 m ³ - 1 sample 6-15 m ³ - 2 sampl 16-30 m ³ - 3 sampl 31-50 m ³ - 4 sampl As and when reqd.	As directed by EIC	I&IIA	As per Grade.
3.2	Steel	(a) Physical (i) Ultimate tensile strength (ii) 0.2% proof stress (iii)% Elongation (iv)Bend Test (v)Re-bend Test (vi)Mass per metre run (kg) (b) Chemical	IS: 1608-2005 IS: 1599-1985 IS: 1786-2008 IS: 1786-2008 IS: 228- (1-14) 1987	Under 10mm 1 sample for each 25T 10-16mm 1 sample for each 35T Over 16mm dia. 1 sample for each 45T	3 pieces of 100 cms. for each size.	I&III	i)485Mpa min. ii)410Mpa min. iii)Minim. 14.5% C = 0.3 P = .06 S = .06 P&S = 0.11 Max

I. Checklist

Name	Yes	No	Need Changes
Cement (PPC)			
1 Physical Tests			
2 Chemical Tests			
Cement (OPC)			
1 Physical Tests			
2 Chemical Tests			
AGGREGATE-			
Fine Aggregate			
1 Particle Sizes			
2 Silt Test			
3 Bulkage of Sand			
4 Organic Impurities			
Coarse Aggregate			
1 Sieve Analysis & Fineness Modulus			
2 Deleterious Materials			
3 Specific Gravity & Density			
4 Mechanical properties			
5 Soundness			
6 Surface Moisture Content			
7 Alkali reactivity			
Concrete			
1 Slump Test			
2 Compressive Test			
Steel			
1 Test of steel for reinforcement			
2 Tensile Strength of structural steel			
Water			
1 Chemical Analysis			
2 Physical Analysis`			

J. Bricks

Visual	
All Classes for masonry	Over Burnt for road
Shall have a uniform deep cherry red color, and shall be thoroughly burnt and not over burnt. The bricks must give a clear ringing sound on being struck. They may be free from cracks, chips, flaws and stones lumps of any kind.	Shall have a deep copper color, and shall be over-burnt and regular in shape. The bricks should emit a clear ringing sound when struck. The bricks must be free from cracks, chips, flaws and stones or lumps and spongy matter.

Dimensions			
All Classes Non Modular Bricks (In mm)			
Length	4600 \pm 80	Standard size of one brick	
Width	2200 \pm 40	Length : 230 mm	
Height	1400 \pm 40 for 70 mm high	Width : 110 mm	
	600 \pm 40 for 30 mm high	Height : 70 mm or 30 mm	
Straight Over Burnt Bricks			
Length	177.5'' to 182.5''	Standard size of one brick	
Width	85'' to 87.5''	Length : 8 7/8''	
Height	52.5 to 55.0''	Width : 4 1/4''	
		Height : 2 5/8''	
Modular Bricks			
Length	3800 \pm 80 mm	Standard size of one brick	
Width	1800 \pm 40 mm	Length : 190 mm	
Height	1800 \pm 40 cm for 90 mm high	Width : 90 mm	
	\pm 40 for 40 mm high	Height : 90 mm or 40 mm	
Water Absorption			
Sl. No.	Class	Ref. codes	Limit
1	For Masonry	IS : 3495(II)-1992	Not more than 20% by weight
2	Straight over burnt for road work		Not more than 10% by weight

Efflorescence			
Sl. No	Standard	Definition	Ref. code
1	Nil	When there is no perceptible deposit of efflorescence	IS : 3495(II)-1992
2	Slight	When not more than 10% of area of the brick is covered with a thin deposit of salt.	
3	Moderate	When there is a heavier deposit than under slight and covering up to 50% of the brick surface but unaccompanied by powdering of flaking of the surface.	
4	Heavy	When there is a heavy deposit of salts covering up to 50% or more of the brick surface but unaccompanied by powdering of flaking of the surface.	
5	Serious	When there is a heavy deposit of salts accompanied by powdering and for flaking of the surface and tending to increase with repeated weathering of the specimens.	



Compressive Strength			
Class Designation	Average compressive strength not less than		Ref. IS codes
	N / mm ²	Kg / cm ²	
35	35	350	IS : 3495 (I) – 1992
30	30	300	
25	25	250	
20	20	200	
17.5	17.5	175	
15	15	150	
12.5	12.5	125	
10	10	100	
7.5	7.5	75	
5	5	50	
3.5	3.5	35	



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