

RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LIMITED

TECHNICAL SPECIFICATION

FOR

CONSTRUCTION OF GRID SUB-STATIONS

SUPPLY & ETC PROJECT

UNDER SPECIFICATION

RVPN/SE (Proc-I)/XEN-1/A-7 /BN- 9015002003

VOLUME –IV

GENERAL SPECIFICATION FOR CIVIL WORKS

SPECIFICATION

SECTION - CIVIL

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SECTION : CIVIL

1.0 GENERAL

The intent of specification covers the following:

construction of all civil works related to yard AND Control room at sub-station. All civil works shall also satisfy the general technical requirements specified. All civil works shall be carried out in other sections of this specification and as detailed below. They shall be executed as per design and drawing and direction of engineer in charge to the required service conditions/ loads as specified elsewhere in this specification or implied as per National/ International Standards.

as per applicable Indian Laws, Standards and Codes. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

The Bidder shall furnish) labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Owner. However if any additional design, drawing or soil investigation is required, as per requirement, detail shall be submitted by the bidder and approval shall be given by the RVPN

The work shall be carried out according to the design/ drawings **supplied to the Bidder by the Owner enclosed with the tender or supplied thereafter as per work requirement.** For all buildings, structures, foundations etc. necessary layout and details shall be **given to** the Bidder keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Owner. However, the Bidder shall quote according to the complete requirements.

1.1 Water

The Bidder shall make the arrangement of water for constructional activities at his own cost. The sample of water shall be got tested for its chemical analysis and it should be suitable for construction of civil works as per norms of relevant IS codes/ specifications.

1.2 Laboratory Test

- 1.2.1 The laboratory tests shall be carried out progressively during the field work in RVPN lab or Lab approved by the Chief Engineer Civil. The cost of testing is to be deposited by the bidder. Sealed samples have to be transported to RVPN lab by the bidder

- 1.2.2. All samples brought from field, whether disturbed or undisturbed shall be extracted/ prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant I.S. codes.
- 1.2.3. Rock quality designation (RQD), RMR in case of rock is encountered.
- 1.3 If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification of materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.
- 1.4 Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

2.0 SITE PREPARATION:

- 2.1 Site will be handed over as "AS IS WHERE IS" condition.
- 2.2 Site shall be cleared of bushes, trees including removal of roots, any unsuitable materials, demolition of any temporary/ permanent building / structures / foundations and removal of debris / unsuitable material and disposing of un suitable / unserviceable material outside the premises with the permission of Engineer-in-charge. The cost of such work is deemed to be included with other respective civil work and no extra payment on this account shall be made.
- 2.3 Temporary approaches for construction purpose shall be constructed by the bidder at his own cost
- 2.4 Suitable brick muttons shall be constructed at suitable location for marking of center lines and levels as per requirement by the bidder at his own cost
- 2.5 Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.
- 2.6 At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.
- 2.7 **REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION**
The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils the fill materials and other protections etc. to be used under the foundation is to be got approved by the Owner.

3.0 **ANTIWEED TREATMENT & STONE SPREADING**

3.1 Scope of Work

The Bidder shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Owner.

3.2 Earth work in cutting in all type of soil/rock and/or filling so as to attain the require FGL including disposal of excavated soil/rock and/or filling the ground with approved non cohesive soil with all lead and lift, compaction in layers so as attain proctor density of 90 % including cost of soil.

3.3 Providing and laying 60 mm thick M 30 interlocking tile Category A Denated units to key into each other on four faces zig zag shape as per IRC SP 63:2004specification

3.4 Providing and laying 100mm thick layer of granite/basalt/trap jelly(gravel) of 40mm single size shall be spread over the entire switchyard area as per drawing and directions of engineer incharge of the work. The whole switchyard area (excluding buildings pathway road, drainages, cable trenches, equipments/ structures plinths etc.) shall be covered with jelly spreading. The jelly used shall be free from dirt, organic materials and flakes.

3.5 Barricades shall be provided to confine Jelly (gravel), which include Supply and fixing concrete block cement concrete solid blocks of size 60x(20+25)/2x30 cms (l, b, h) jointed with CM 1:4, made from precast M-20 concrete and laid over 100 mm thick base of PCC 1:4:8 including necessary curing etc. complete. The top of concrete block shall be 100 mm above gravel top. The exposed surface of barricades shall be applied with two coat of water proof cement paint.)

3.6 In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments is not possible, the material shall be compacted by hand. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

3.7 Future scope of yard area shall be provided with interlocking tiles without graveling. However yard area which is provided with earthing shall be provided with interlocking tiles, gravelling and concrete barricade.

3.8 The 40mm single size shall pass 100% through IS. Sieve designation 40 mm and nothing through 63.00 mm IS Sieve.

3.9 GENERAL REQUIREMENT

The material required for site surfacing/ stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Owner.

The material to be used for stone filling/ site surfacing shall be uncrushed/ crushed/ broken stone of 40mm nominal size (ungraded single size) conforming to table 2 of IS : 383 - 1970. Hardness, Flakiness shall be as required for wearing courses are given below:

a	Sieve Analysis limits (Gradation) (IS: 383 - Table - 2)	
	Sieve Size	% passing by weight
	63 mm	100
	40 mm	85-100
	20 mm	0-20
	10 mm	0-5
	'One Test' shall be conducted for every 500 cu.m.	
b	Hardness	
	Abrasion value (IS:2386 Part-IV)	Not more than 40%
	Impact value (IS: 2386 Part-IV)	Not more than 30% and frequency shall be one test per 500 cum with a minimum of one test per source.
c	Flakiness Index: One test shall be conducted per 500 cum of aggregate as per IS: 2386 Part-1 and maximum value is 25%.	

3.10 After all the structures/equipments are erected, the area shall be thoroughly de-weeded including removal of roots.

3.11. The Bidder shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts etc. to prevent erosion of material by water.

4.0 ROADS AND CULVERTS

- 4.1 The approach road connecting to main road and road within substation to access to equipment, yard and Control Room building as per approved ELP are in the scope of bidder. Layout of the roads shall be based on General detail & Arrangement drawing for the substation—. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. The extra area of road required for curvature at turning point is deemed to be included in quoted rates, and shall be measured at center line for payments.
- 4.2 All substation roads be constructed so as to permit transportation of all heavy equipment. Approach road shall have minimum 4.0 m with 1.0 m wide interlocking tile shoulder on either side of the road. Other roads shall be with 3.00 m and 0.5 m wide interlocking tile on either side of the road. Interlocking tiles shall be laid over 100 mm thick PCC 1:4:8
- 4.3 Road construction shall be of 150mm thick sub base of quarry rubbish, 100 MM thick base concrete PCC 1:4:8 and top layer with M 30 cement concrete as per IRC standards including anti skid textured finish, cutting horizontal / longitudinal joint 4 to 6 mm wide with diamond bit cutting wheel and filling with bitumen sealing compound 75 mm deep.
- 4.4 All the culverts and its allied structure (required for road/ rail, drain trench crossing etc.) shall be designed for class AA loading as per IRC standard/ IS code and should be checked for transformer/ Reactor loading.
- 4.5 All roads in the scope of contract shall be of concrete road.
- 4.6 The road outside the switchyard fenced area shall have shoulder of 1.00m in case of road width of 6.0 m. Interlocking tiles shall be laid on this shoulder. Kerb stone with channel are to be provided at both the side of the roads. The kerb stone on both side of the roads shall be painted yellow and black alternatively
- 4.7 CC road shall be unreinforced, dowel jointed at expansion an construction joint only plain cement concrete pavement in 150 mm thickness over and including subbase of 150 mm thick quarry rubbish and 100 thick PCC 1:4:8 with M 30 grade cement concrete laid in approved side form work(steel channels , laying and fixing 125 micron thick polythene film wedged, steel plates including leveling the form work as per drawing, spreading using shovels, rakes, compacted using niddle, plate and screed vibrator finished in continuous operation including provision of expansion and contraction and construction joint, applying debonding strips, primer, sealant, dowel bars, curing etc complete including dewatering process with all equipments. work also includes

providing and fixing precast cement concrete solid blocks on outer edges of both side shoulder of size 60x(20+25)/2x30 cms (l, b, h) jointed with CM 1:4, made from precast M-20 concrete and laid over 100 mm thick base of PCC 1:4:8 including necessary curing etc. complete. The concrete block top shall be 100 mm above road top. The exposed surface of barricades shall be applied with two coat of enamel paint, painted black and yellow alternately, and Providing and laying 60 mm thick M 30 interlocking tile Category A Denated units to key into each other on four faces zig zag shape as per IRC SP 63:2004specification o shoulders as per approved drawing, specification and direction of engineer incharge. (payment shall be made as per actual length)

5.0 FOUNDATION/RCC CONSTRUCTION

5.1 GENERAL

1. Work covered under this clause of the specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, control cubicles, bus supports, Station transformer, marshalling kiosks, auxiliary equipments & systems buildings, tanks or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.
2. Concrete shall conform to the requirements mentioned in IS: 456-2000 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification

A minimum grade of M20 concrete shall be used for all structural/ load bearing members as pr latest IS 456-2000.
3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.
4. Concrete made with portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.
5. Structure and equipment foundation shall be constructed as per approved drawingd in accordance with SBC of strata.

5.2 ADMIXTURES & ADDITIVES

1. Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the

mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.

2. Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Concrete Admixtures/ Additives shall be approved by Owner.
3. The Bidder may propose and the Owner may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.
4. The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.
5. The water proofing cement additives shall be used as required/ advised by the Owner.

6.0 **CABLE & PIPE TRENCHES**

1. Construction of cable trenches of required size and depths with stone masonry/brick masonry walls, precast ferro cement covers, water stops, stone/brick (fly ash bricks) including the supply of labour, material, cement, reinforcement steel, steel angles, flats for cable racks with holes for fixing battens and providing P.C.C.(1:4:8) below cable trenches, 20 mm thick cement plaster 1:6 inside complete and out side minimum 300 mm depth, 40mm thick CC flooring 1:2:4 with glass strips in joints and 150 mm thick RCC M20 bend on top of masonry with supply and fixing Ferro-cement covers light duty in length from outer to outer of cable trench width, designed for class 'B' road loading with adequate steel reinforcement of required thickness suitable for class 'B' loading lifting hook, additive and admixtures like plasticizer , shrinkage resistance compound, abrasion resistant, suitable for trench width 360 mm to 850 mm. Suitable size angle shall be provided at the corner and junctions of trench for support of covers. 100 mm dia UPVC shall also be provided at 3000 mm c/c on both side of cable trench wall so to entrap the rainy water. a gentle slope of 1 in 500 shall be provided in the flooring til disposal point as per technical specification and approved drawings. (payment shall be made as per actual length).
2. Cable trench covers shall be designed for self weight of top slab and for 'B' class loading
3. Cable trench crossing the road/ rails shall be designed for class AA. Loading of IRC/ relevant IS code and should be checked for transformer/ loading.

4. Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.
5. The top of trenches shall be kept at least ~~400~~ 200 mm above the finished ground level . The top of cable trench shall be such that the surface rain water do not enter the trench.
6. All metal parts inside the trench shall be connected to the earthing system.
7. Cables from trench to equipments shall run in hard conduit pipes.
8. Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
9. The trench bed shall have slope of 1/500 along the run & 1/250 perpendicular to the run.
10. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm thick 1:6 cement sand mortar.
- 11 cable tray's/racks be provided in required tiers to lay the control cables in cable trenches.
- 12 RAINWATER HARVESTING/Sump:

Work shall be got executed as per approved drawing and design and specification.

7.0 BUILDINGS - GENERAL REQUIREMENTS

7.1 GENERAL

The scope include the construction including anti-termite treatment, plinth protection etc complete in all respect as pre approved drawing, design specification guide lines and direction of engineer in-charge, including sanitary, water supply, electrification false ceiling etc. of control room building, buildings shall be of RCC framed structure of concrete of M20 grade minimum.

7.2 FINISH SCHEDULE

The finishing schedule is as per enclosed annexure'A'.

7.3 GLAZING

Minimum thickness of glazing shall be 5 mm as per IS: 2835. Sun film shall be provided on all peripheral windows/ doors.

7.4 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule '**Annexure A**' and tender drawing with the relevant IS, code shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in PWD/RVFN, specification.

7.5 PARTITION

Partition made of anodized aluminum frame provided with 5.5 mm thick clear glass shall be supplied and installed at locations shown in tender drawings.

7.6 PLUMBING & SANITATION

- (i) All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Bidder shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.
- (ii) PVC syntex or equivalent make PUF insulated Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 4 Nos. 500 litres capacity shall be provided.
- (iii) Galvanized pipe of medium class conforming to IS: 1279 shall be used for internal & external piping work for potable water supply.
- (iv) SWR pipes with rubber rings and solvent cement joints conforming to IS: 13592 shall be used for sanitary works .
- (v) Each toilet shall have the following minimum fittings.
 - (a) European WC (Western type wall hung/floor mounted) 390 mm high with toilet paper roll holder and all fittings.
 - (b) Wash basin (550x400 mm) with all fittings.
 - (c) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
 - (d) CP brass towel rail (600 x 20mm) with C.P. brass brackets
 - (e) Soap holder and liquid soap dispenser.

- (f) Geyser, long body tap, shower, mixer for shower and wash basin etc complete as per approved drawing
- (vi) Water cooler **and RO** for drinking water with 200 ltrs PVC loft tank shall be provided and located near control room
- (vii) 1 No. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.
- (vii) All fittings, fastener, grating shall be chromium plated.
- (ix) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.
- (x) Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load.
- (xi) All civil works shall be got executed as per drawing approved by RVPN.

8.0 WELDED MESH FENCES AND GATE

8.1 General:

Fencing shall be provided as per the drawings/ details furnished by the owner.

8.2 Areas Requiring Fencing:

FENCING SHALL BE DONE ALL AREA SEPERATING THE YARD AREA FROM OTHER AREAOF GSS (Excluding outer boundary wall) .

8.3 a) Product Materials:

The minimum requirements are as follows:

1. welded mesh fencing fence fabric in accordance to IS: 4948
2. Size of mesh **25mmX25mmx2.1mm**
3. Width of fencing 1500 mm

b) Posts	Angle section	Spacing
1. Intermediate (angle box)	40x 40 x 5mm	3000 mm
2. Straining posts/ Corner posts	40x 40 x 5mm	30000 mm

3. Stay post 40x 40 x 5mm 30000 mm

All structural steel shall conform to IS:2062 and shall be painted with a coat of approved steel primer and two coats of synthetic enamel paint

welded mesh shall be connected/fixed to the posts by providing **box of two** 40x 40 x 5mm grouted in PCC block of M- 20 and horizontally at the top and) bottom throughout the length of fencing by ISA 40X40X5 mm and MS Flat 40 x 5 mm vertically at every posts. Connection of Angle and MS flat & mesh with the posts shall be with suitable bolts and nuts or Welding as per the direction of the Owner/ Engineer-in-charge of work. Angle iron post shall be grouted in CC M20 block

The bottom of chain link mesh shall rest on **precast CC coping of 1:2:4** to a depth not less than 50 mm over a toe wall of 450 mm height above FGL and having foundation section as per approved drawing

4. Above chain link, 5 rows of galvanized barbed wire, conforming to IS:278 shall be provided in each arm of the 'Y/L' shaped barbed arm at top in a height of 60 cm. The barbed wire shall consist of two splices per reel. The barbed wire shall be formed by twisting two line wires, one containing the barbs. The barbed wire shall be of 12 SWG galvanized steel with its weight 155-136gm/m length of the wire. Distance between two barbs shall be 75 mm. The barbs shall carry four points and shall be formed by twisting two point wires, each two turn tightly round one line wire, making altogether 4 complete turn. The barbs shall be finished in such a way that the four points are set and locked at right angles to each other. The barbs shall have a length of not less than 13 mm and not more than 18 mm. The points shall be sharp and well pointed.
5. With barbed wire above welded mesh fence, the total fence height shall be minimum 2400 mm above finished ground level.
6. Barbed wire arms same as intermediate and straining post.
7. For every 50 reels or part thereof samples of the barbed wire and the individual line wires shall be put to tensile test and in case of failure to conform to the tensile properties given below, two additional tests of each kind shall be made on the samples cut from other reels.

TENSILE PROPERTIES

Minimum breaking load of complete barbed wire: 444 Kg.

On the results of these additional tests, the whole or portion of the barbed wire shall be accepted or discarded by the Owner, as the case may be.

8.4 Installation:

1. Fence shall be installed along lines shown on approved drawings.
2. Post holes shall be excavated by approved methods.
3. Intermediate posts shall be spaced 3.0 m apart measured parallel to ground surface.
4. Straining posts shall be installed at equal interval not exceeding 30.0 M
5. Straining posts shall be installed at sharp changes grade, at corners, at change of direction and where directed.
6. All corner post and every 10th post will have two stay post.
7. Posts shall be set in concrete. Concrete work shall conform to relevant clause. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has set.
8. Fence fabric shall not be installed until concrete has cured a minimum of 10 days.
9. Top and bottom of the fence fabric shall be fixed with ISA 40X40X5 mm
10. Fence fabric shall be laid out with barbed edge on top, stretched tightly and shall be fastened to intermediate, gate and straining post with 40x 5 mm M.S flats(vertical at every post) and horizontal angle 40 x 40 x 5 mm throughout the fence at top and bottom.
11. Fabric shall be fixed to the angle and MS flat by welding or suitable G.I bolts, nuts and washers and at bottom the fabric .
12. Barbed wire shall be stretched to have uniform tension.
13. Barbed wire shall be attached to barbed wire arms with approved metal clips.
14. Gates shall be installed in locations shown on drawings. Next to the main gate, a wicket gate (1.25 m wide, single leaf) shall also be provided.
15. Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism shall be fitted,

16. Drawing for the gate shall be as per the typical sketch furnished.

17. All structural steel shall be painted with two coats of approved synthetic enamel paint over one coat of steel primer.

18 a) For providing fencing over ground:

a 380 mm thick size stone masonry toe wall shall be provided below fencing. Toe wall shall be minimum 450 mm, above and 600 mm (minimum) below finished ground level with 150 mm thick PCC 1:4:8 bed concrete and 50 mm thick precast CC 1:2:4 to rest fencing. All exposed faces of masonry shall be plastered in cement mortar 20 mm thick CM 1:6 and painted with weather coat

b) For providing fencing over retaining wall / protection wall:

The excess quantities of different items of work of construction of retaining wall over and above the quantities applicable for construction of toe wall of security fencing as per drawing and shall be executed as per site requirement and no extra payment shall be made on this account.

19. In case of B.C./Expansive soil and filled up soils, masonry wall shall be strengthened to overcome the effects of soil on foundation and to avoid settlements.

20. for expansive / BC soil, back filling shall be with new earth / murrum.

21. Gates in fencing wall:

1. The Gate frame shall be made of medium duty MS pipe conforming to relevant IS with welded joints.

2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.

3. Gates shall be fitted with approved quality iron hinges, latch and latch catch. Latch and latch catch shall be suitable for attachment and operation of pad lock from either side of gates. Hinges shall permit gates to swing through 180 degree back against fence.

4. Gates shall be fitted with galvanised chain hook or gate hold back to hold gates open. Double gates shall be fitted with centre rest and drop bolt to secure gates in closed position.

9.0 MISCELLANEOUS GENERAL REQUIREMENTS

- 9.1 Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.
- 9.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.
- 9.3 Bricks having minimum 75 kg/cm² compressive strength can only be used for masonry work. Bidder shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm² compressive strength before submitting his offer. Fly ash brick shall be used for construction work as per IS code 12894
- 9.4 Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards
- 9.5 For all civil works covered under this specification, nominal mix by volumetric batching as per PWD specification is intended with relationship of grade of concrete and ratio of ingredients as below:

Mix	Cement	Sand	Coarse aggregate of 20 mm down grade as per IS 383
M 10	1	3	6
M 15	1	2	4
M 20	1	1.5	3

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of PWD specification and approved standard Field Quality Plan. For higher grade of concrete the bidder shall carry out mix design and submit for approval/acceptance. If bidder wishes to use RMC, then same can be permitted on request by the bidder at his cost by the Chief Engineer Civil

- 9.6 Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation.

- 9.7 Construction joints shall be as per IS: 456-2000
- 9.8 All building/ construction materials shall conform to the best quality specified in PWD specifications if not otherwise mentioned in this specification.
- 9.9 All tests as required in the standard field quality plans have to be carried out. Cost of testing is to be paid by the bidder. Tests are to be conducted in RVPN Lab or lab approved by the chief engineer Civil. Sealed samples are to safely transported to RVPN/RVPN approved lab by the bidder at his own cost. Responsibility for preserving/ curing of sample is upon the bidder.
- 9.10 The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.
- 9.11 Items/ components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

10.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/ walls/ floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports / embedments, provision of cutouts etc. shall be the sole responsibility of the Bidder. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

11.0 WATER SUPPLY

- (i) The Bidder shall arrange and carry out all the plumbing/ erection works required for supply of water in control room building and other places
- (ii) Bore wells and pumps for water supply is in the scope of Bidder.

12.0 SEWERAGE SYSTEM

- (i) Sewerage system shall be provided for extended control room building.

13.0 STATUTORY RULES

- 13.1 Bidder shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory Committee. Water Act for pollution control etc.

(Quality Assurance & Inspection Deptt.)
 STANDARD FIELD QUALITY PLAN
 FOR SWITCHYARD CIVIL WORKS
 Section : FOUNDATION MATERIALS

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
CHECKING OF FOUNDATION MATERIALS				
CEMENT				
Fineness Compressive strength Initial & final setting time Soundness Heat of Hydration for low heat cement (Not applicable for OPC & PPC)	One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing	IS:456, IS:269, IS: 8112, IS: 12269, IS: 1489 & RVPN specification	Manufacturer/ approved lab	Review of manufactures test certificates (MTCs) and laboratory test results by RVPN
Chemical Composition of Cement	One sample per lot of 100 MT or part thereof from each source for MTCs	IS: 456, IS: 269, IS: 8112, IS: 12269, IS: 1489 & RVPN specification	Manufacturer	Review of manufactures test certificates by RVPN
COARSE AGGREGATES				
Determination of Particle size (Sieve Analysis) Flakiness index Crushing Value, Specific Gravity*, Bulk Density*, Absorption Value*, Moisture Content* Soundness of Aggregate** Presence of deleterious materials	One sample per lot of 100 cubic meter or part thereof from each source for each size	IS: 383, IS: 2386 & RVPN specification	RVPN approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site	Each source to be approved by RVPN Review and acceptance of test result by RVPN

*Applicable Design concretes only

** Applicable to concrete work subject to frost action

Section : FOUNDATION MATERIALS

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
FINE AGGREGATE				
Gradation/ Determination of Particle size (Sieve Analysis)	One sample per lot of 100 cubic meter or thereof from each source	IS: 383, IS: 456 and IS: 2386, IS: 2386, IS: RVPN specification	RVPN approved lab. However Moisture content test for design mix concrete shall be done on all days of concreting at site	Each source to be approved by RVPN Review and acceptance of test result by RVPN
Specific Gravity and density *				
Moisture content*				
Absorption Value*				
Bulking				
Silt Content Test				
Presence of deleterious materials				
BRICKS				
Dimensional tolerance	As per enclosed Annexure-II	PWD & RVPN specification	RVPN Approved Lab.	Approved by RVPN

	Compressible Strength								
	Water Absorption								
	Efflorescence								
	WATER								
	Cleanliness (Visual Check)	Random	IS: 456, IS: 3025 and RVPN specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials, or other deleterious materials	Bidder	Each source to be approved by RVPN				
	Chemical and physical properties of water for checking its suitability for construction purposes	One sample per source	IS: 456, IS: 3025 and RVPN specification	Bidder/ Approved Lab	Approved RVPN				
* Applicable to design mix concretes only.									

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
REINFORCEMENT STEEL				
Identification & size	Random	IS: 432, IS: 1139, IS: 1786 & RVPN specification	Bidder	Approval by RVPN
Chemical Analysis test	One sample per heat	IS: 432, IS: 1139, IS: 1786 RVPN specification	Manufacturer	Review of manufacturers test certificates by RVPN
Tensile Test Yield stress/ proof stress Percentage Elongation	One sample per lot of 40 MT or part thereof for each size of steel conforming to IS: 1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS: 432. For steel as per IS: 1786 under 10 mm 1 sample for each 25 MT or part thereof. 20 mm 16 mm 1 sample for each 35 MT or part thereof. Over 16 mm. 1 sample for each 45 MT or part thereof.	IS: 432, IS: 1139, IS: 1786 RVPN specification	Manufacturers/ RVPN approved lab	Review of manufacturers test certificates as well as lab test result by RVPN

Section : FOUNDATION MATERIALS

	Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks	
	Bend/ Rebend Test	One sample per lot of 20 MT or part thereof for each size of steel as per IS: 432, IS: 1139. For steel as per IS: 1786 under 10 mm- 16mm 1 sample for each 25 MT or part thereof 10 mm- 16mm 1 sample for each 45 MT or part thereof	IS: 432, IS:1139, IS:1786 RVPN specification	Manufacturers/ RVPN	Review of manufacturers test certificates as well as lab test results by RVPN	
	Reverse Bend Test for HDS wire	One sample per lot of 5 MT or part thereof for each size	IS: 432 RVPN specifi cation	Manufacturer/ RVPN approved lab	Review of manufacturers test certificates as well as lab test result by RVPN	

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS				
Dimensional Check	Random	RVPN specification & approved drawing	Bidder	Checklist to be prepared and signed jointly
Visual Check for damages, rusting, pitting etc.	100%	RVPN specification & approved drawing	Bidder	Checklist to be prepared and signed jointly
Visual check for welding, defects, primer coating and galvanising as applicable	Random	RVPN specification & approved drawing	Bidder	Checklist to be prepared and signed jointly
Physical properties of structural steel	1 sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size	IS: 2062 RVPN specification & approved drawings	Manufacturer/ RVPN approved lab	Review of Mfgs test certificates as well as lab test results by RVPN

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
GANTRY/ EQUIPMENT FOUNDATION/ CABLE TRENCH				
BEFORE EXCAVATION				
Checking of pegs condition as per line and alignment	100% on each location	IS: 4091, IS: 3764 & RVPN approved drawings/ specification	Bidder	Approval by RVPN
Checking of pit making as per drawing & RL	100% on each location	IS: 4091, IS: 3764 & RVPN approved drawings/ specification	Bidder	Approval by RVPN
EXCAVATION				
Dimensional conformity	Each	IS: 4091, IS: 3764 & RVPN approved drawings/ specifications	Bidder	Approval by RVPN (JMC/MB)
Vertically/ slopes & squareness of each pit	Each location	IS: 4091, IS: 3764 & RVPN approved drawings/ specifications	Bidder	Checklist to be prepared and signed jointly
Verification of classification of foundation wherever applicable	Each location	IS: 4091, IS: 3764 & RVPN approved drawings/ specifications	Joint inspection by RVPN and Bidder	Approval by RVPN

	FOUNDATION BOLTS/ MATALLIC INSERTS							
	Check for proper identification of foundation bolts w.r.t. type of foundation	100 %	RVPN specification & approved drawings	Bidder	Checklist to be prepared & signed jointly			
	Visual check for mechanical damage and galvanising painting if applicable for metallic insert	100 %	RVPN specifications & approved drawings	Bidder	Checklist to be prepared & signed jointly			
	Alignment & Level	100 %	RVPN specification & approved drawings	Bidder	Checklist to be prepared & signed jointly			

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
Grouting/ Underpinning of foundation base plate	100%	RVPN specification & approved drawings	Bidder	Checklist to be prepared & signed jointly
P.C.C. Padding	For all locations	IS: 456 and RVPN approved foundation drawings & specification	Joint Inspection by RVPN and Bidder	Approval by RVPN
SHUTTERING (Formwork)				
Check for materials breakage or damage	100%	IS: 456, RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Check for plumb, alignment parallelism, squareness and equidistance from stub	100% casting	IS: 456, RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Dimensional check	100% before casting	IS: 456, RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Check for level & height	100% before casting	RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Check for rigidity of frame/ tightness	100%	RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Cleaning and oiling	100%	RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN

Section : FOUNDATION

Component/ operation & Description of Test	amplifying Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
Diagonal bracing if required as per drawings/ site conditions	100%	RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Checking of joints to avoid undue loss of cement slurry	100%	RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
PLACEMENT OF REINFORCEMENT STEEL				
Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check)	100%	IS: 456 and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN
Check as per the bar bending schedule before placement of concrete	For all locations	IS: 456, IS: 2502 and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN (Pour Card)
Check cutting tolerance for bars as per check list/ drawings. Check whether all the bent bars and lap lengths are as per approved bar bending schedule	For all locations	IS: 456, IS: 2502 and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN (Pour Card)

	Check whether all joints & crossing of bars are tied properly with right guage & annealed wire as per specification		and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN	
	Check for proper cover distance spacing of bars, spacers & chairs after the reinforcement cage has been put inside the form work		and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN	
	Check whether lapping of bars are tied properly by with right guage and annealed wire as per specification		and RVPN specification/ approved drawings	Joint inspection by RVPN and Bidder	Approval by RVPN	

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
CONCRETING				
APPROVAL OF MIX DESIGN	Each Mix.	IS: 456 & RVPN approved drawings and specifications	RVPN approved by lab	Approval by RVPN
BATCHING, MIXING & PLACING OF CONCRETE AND COMPACTING		IS: 456 & RVPN approved drawings and specifications	Joint inspection by RVPN and Bidder	Approval by RVPN
FIXING OF CHIMNEY COLUMN Check for width length squareness, parallelism & equidistance from stub		IS: 456 & RVPN approved drawings and specifications	Joint inspection by RVPN and Bidder	Approval by RVPN
PLACING CONCRETE AND COMPACTING		IS: 456 & RVPN approved drawings and specifications	Joint inspection by RVPN and Bidder	Min gap between boxes and reinforcement bars should be maintained approval by RVPN

Section : FOUNDATION

Component/operation & Description of Test	Sampling with basis	Plan	Ref. Document & acceptance norm	Testing Agency	Remarks
CONCRETE TESTING					
Slump Test	One sample per foundation	IS: 456, IS: 516, IS: 1199 and RVPN specification	Bidder	Approval RVPN by	
Check for quantities for cement, fine aggregate, coarse aggregate and water while batching	100% on all locations	IS: 456, IS: 516, IS: 1199 and RVPN specification	Bidder	Checklist to be prepared and signed jointly	
CONCRETE CUBE TESTING					
Compressive Strength	One sample for every 20 cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength).	IS: 1199, IS: 456, IS: 516 and RVPN specification	RVPN lab	Approval by RVPN cubes must be tested within a week after 28 days curing period and test results should be approved	
CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL		IS: 456, IS: 516, IS:1199 and RVPN specification	Bidder	Approval bY RVPN	

BACKFILLING							
Check for thickness of layer & watering			RVPN specification and approved drawings	Bidder		Approval RVPN	by
Visual check for correction/ ramming			RVPN specification and approved drawings	Bidder		Approval RVPN	by

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
Compaction test (percentage of max. dry density)	foundation 2 samples for each pit. Equipment & other foundation at 20% random	RVPN specification	RVPN approved lab	Review of lab test results by RVPN. Elevation for testing to be decided by RVPN
R.R. STONE/ BRICK WORK				
Mortar mix/ proportion		IS:2250, RVPN specification & PWD specification	Bidder	Approval RVPN
Plumb & Alignment		RVPN specification & PWD specification	Bidder	Approval RVPN
Joints		RVPN specification & PWD specification	Bidder	Approval RVPN

	PLASTERING						
	Plastering thickness and evenness			RVPN specification & PWD specification	Bidder	Approval RVPN	by
	Mortar mix/ proportion			RVPN specification & PWD specification	Bidder	Approval RVPN	by
	CURING FOR CONCRETE, MASONRY, PLASTERING ETC.		in all location	IS: 5613 & RVPN specification	Bidder	Approval RVPN	by

Section : FOUNDATION

Component/ operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norm	Testing Agency	Remarks
SITE SURFACING				
Levelling	100%	RVPN specification and approved drawings	Bidder	Checklist to be prepared and signed jointly
Grading of 40 mm stone	1 sample per lot of 500 cubic metre or part thereof from each source for each size.	IS:383, IS: 2386 and RVPN specification. The grading shall be as per single sized nominal size.	Bidder/ RVPN approved lab	Each source to be approved by RVPN. Review and acceptance of test results by RVPN
Compacted thickness of 40 mm stone layers as applicable	Random	RVPN specification and approved drawings	Bidder	Checklist to be prepared and signed jointly
INTERLOCKING TILES				
	1 sample per lot of 500 Square metre or part thereof from each source for each size.(minimum m 4)	RVPN specification & PWD specification	RVPN	Checklist to be prepared and signed jointly

	CONCRETE ROAD	1. Core cutting sample per lot of 500 Square metre or part thereof from each source for each size.(minimum m 5)	RVPN specification & PWD specification	RVPN	Checklist to be prepared and signed jointly	
	CABLE TRENCH COVER	2% of each size (minimum 3)	RVPN specification & PWD specification	RVPN/RVPN approved lab	Checklist to be prepared and signed jointly	

STANDARD FIELD QUALITY PLAN FOR SWITCHYARD CIVIL WORKS

Section : GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A,B & C including accepting and deviation dispositioning authorities are indicated at Annexure-1
2. RVPN specification shall mean RVPN technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.
3. Acceptance criteria and permissible limits for certain tests are indicated at Annexure--II. For balance tests, site to verify the same with respect to RVPN specification, relevant Indian Standards and/ or prevalent code of practice.
4. It is clarified that the tests indicated at column 2 of the FQP i.e. against column "Component operation & Description of Test", are only generally required to be conducted. However, RVPN reserves the right to carry-out any additional tests at any stage if the situation so warrants.
5. RVPN site representative shall witness all the tests conducted by the Bidder as mentioned in this FQP. However, in case of tests conducted in the RVPN approved lab, it is preferred to witness the tests in the lab itself, if possible.
6. Head of GHO shall approve testing laboratory before accepting the test results from the lab.
7. Head of GHO shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilisation.
8. All the testing & measuring equipments used by the Bidder for testing are required to be calibrated. A copy of valid calibration report shall be retained by RVPN as records.
9. Classification of foundations shall be approved by RVPN based on the joint inspection Report & soil investigation reports.
10. Curing of concrete work should be continued for a minimum period of 10 days.
11. ZONE-IV FINE AGGREGATE
 - 11.1 Zone-IV fine aggregate shall be used for nominal mix reinforced cement concreting work.

- 11.2 Zone-IV fine aggregate shall be avoided for design mix reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval RVPN site.
12. Bricks should be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.
13. CEMENT
- 13.1 in case supply of cement is in the scope of the Bidder, the same shall be procured from sources approved by RVPN site and got tested at site on sample basis for specified acceptance tests as specified in the FQP at a reputed Third Party Lab approved by RVPN site.
- 13.2 The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling. If the cement remains in store for a period of more than six month. All the site tests are required to be repeated before usage.
14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS
- 14.1 In case supply of steel is in the scope of the Bidder, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO OR Rsashtriya ispat Nigam. The steel shall be got tested at site on sample basis for specified acceptance tests, as specified in this FQP at a reputed Third Party Lab approved by RVPN site.
- 14.2 The results of the testing of cement and reinforcement steel referred to in 13.1 and 14.1 above shall be got approved from RVPN site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. RVPN site may authorise the Bidder to use cement and Reinforcement steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the Bidder shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the Bidder by the Project authorities before hand in all such cases.
15. The Bidder shall submit welding procedure specification (WPS) including the type of electrode used for approval of RVPN site before starting the welding work.

16. Approval/ acceptance of individual test results by RVPN in the course of execution of contract, will not relieve the Bidder of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.
17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc. arise due to site conditions, the specific approval of RVPN may be obtained before using the same and all the tests as per relevant standards shall be carried out.
18. All the materials shall be stored by the Bidder in a manner affording convenient access for identificates and inspection at all times. Storage of material shall be in accordance with IS: 4032 (Latest Edition).

ACCEPTING AND DEVIATION DISPOSITIONING AUTHORITIES
FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED
IN FIELD QUALITY PLAN AS WELL AS DEVIATION IN QUANTITY

Category	Type Of Check	100% Checking / Witnessing By	Counter Check / Surveillance Check By	Accepting Authority, If Test Results Are Within Permissible Limits	Deviation Dispositioning Authority for all Civil issues
'A'	Critical	Executive Engineer (Civil)	Superintending Engineer (Civil)	Executive Engineer (Civil)	Chief Engineer Addl. Chief Engineer (Civil)
'B'	Major	Assistant Engineer (Civil)	Executive Engineer (Civil)		
'C'	Minor	Assistant Engineer (Civil)	Executive Engineer (Civil)		

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR
FOUNDATION MATERIALS & CONCRETE.

A) CEMENT:

Description of the tests	33 grade OPC as per IS:269	43 grade cement as per IS: 8112	PPC as per IS: 1489	Low heat cement
Fineness (Min.)	225m ² /kg	225 m ² /kg	300 m ² /kg	225 m ² /kg
Compressive Strength (Min.)				
72 ± 1 hours	160 kgf/cm ²	23 MPa	16 MPa	100 kgf/CM ²
168 ± 2 hours	220 kgf/cm ²	33 MPa	22 MPa	160 kgf/cm ²
672 ± 4 hours	-	43 MPa	33 MPa	350 kgf/cm ²
Initial Setting Time (Minimum)	30 Minutes	30 Minutes	30 Minutes	30 Minutes
Final Setting Time (maximum)	600 Minutes	600 Minutes	600 Minutes	600 Minutes
Soundness (Le chatelier Method)	Maximum 10mm expansion	Maximum 10mm expansion	Maximum 10mm expansion	Maximum 10 mm expansion
Heat of hydration (Max.)	-	-	-	Max. 65 cal/ gm for 7 days & max. 75 cal/ gm for 28 days
Chemical Composition	As per IS	As per IS	As per IS	As per IS

B) COARSE AGGREGATE:
 (i) Sieve Analysis

SIEVE DESIGNATION	PERCENTAGE PASSING FOR GRADED AGGREGATE OF NOMINAL SIZE		PERCENTAGE PASSING FOR SINGLE SIZED AGGREGATE OF NOMINAL SIZE	
	40mm	20mm	40mm	20mm
63 mm	-	-	100	-
40 mm	95 to 100	100	85-100	100
20 mm	30 to 70	95 to 100	0-20	85-100
10 mm	10 to 35	25 to 55	0-5	0-20
4.75 mm	0 to 5	0 to 10	-	0-5

ANNEXURE-2
PAGE 2 OF 5

(ii)	Flakiness Index	Not to exceed 25%
(iii)	Crushing Value	Not to exceed 45%
(iv)	Soundness of aggregate applicable for concrete works subject to frost action	Loss of weight after 5 cycle not to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate.
(v)	Deleterious material	Not to exceed 5% of the weight of aggregate when tested as per IS: 2386 Part-II (1963)

(C) FINE AGGREGATE

(i) Sieve Analysis Shall confirm to Zone 1, Zone II or Zone III.

IS Sieve Designation	Percentage Passing for			
	Grading Zone-I	Grading Zone-II	Grading Zone-III	Grading Zone-IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 m	30-70	55-90	75-100	90-100
600 Micron	15-34	35-59	60-79	80-100
300 Micron	15-	8-30	12-	15-
150 Micron	0-10	0-10	0-10	0-15

(iii) For guidance of adjusting sound in mix of concrete, the following table may be used.

Moisture Content %	Building % by volume
2	15
3	20
4	25
5	30

(iii) Silt Content Test : For river sand shall not exceed 3% and for M sand it shall not exceed 8% by volume when tested as per test procedure specified in appendix-D of chapter 3 of 1991-92 CPWD specification

(iv) Deleterious Materials : Total deleterious material shall not be more than 5% by weight.

(D) REINFORCEMENT STEEL : As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for 1:1 ½ :3 (cement : Sand: Coarse aggregate) concrete shall be 200 kg/cm² for 28 days and for 1:2:4 nominal mix. It shall be 150 mg/cm².

(F) Acceptance criteria based on 28 days compressive strength for nominal mix concrete

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength up to 30% than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-charge.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of Bidder. If, however, the Engineer-in-Charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the Bidder.

(G) Acceptance criteria for design mix concrete shall be as per is: 456-2000

(H) SAMPLING PLAN FOR BRICK - WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

No. of bricks in the lot	For characteristics specified for individual bricks		For dimensional characteristics for group of 20 bricks No. of bricks to be selected
	No. of bricks to be selected	Permissible no. of defective in the sample	
(1)	(2)	(3)	(4)
2001-10000	20	1	40
10001-35000	32	2	60
35001-50000	50	3	80

Note: In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

ii) Scale of sampling for physical characteristics

Lote size	Sampling size for compressive strength water absorption and efflorescence	Permissible No. of defectives for efflorescence
(1)	(2)	(3)
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

(1) ACCEPTANCE CRITERIA FOR BRICK-WORK

- (i) Dimensional tolerances: The dimensions of modular bricks when tested shall be within the following limits per 20 bricks.

Length 372 to 388 cm (380 ± 8 cm)

Width 176 to 184 cm (180 ± 4 cm)

Height 176 to 184 cm (180 ± 4 cm) for 90 mm high bricks

- (ii) In case of non-modular bricks, % age tolerance will be $\pm 2\%$ for group of 20 number of class-10 bricks, and $\pm 4\%$ for other class of bricks
- (iii) Compressive strength : The bricks, shall have a minimum average compressive strength as specified in RVPN specification. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified for the purpose of calculating the average compressive strength.
- (iv) Water absorption : The average water absorption of bricks shall not be more than 20% by weight.
- (v) Efflorescence : The rating of efflorescence of bricks shall not be more than moderate.

SPECIFICATIONS (2020) FOR NON-RESIDENTIAL BUILDINGS

(C.R. = Control Room, N.A.= Not Applicable)

S.No.	Item	TYPE OF NON RESIDENTIAL BUILDINGS		Remarks
		CONTROL ROOM	STORE, GARRAGE& GUARD HUT	
1.	2.	3.	6.	7.
A.	BUILDING WORKS			
1.	(a) Base concrete (foundation)	Cement Concrete 1:4:8 using 40 mm crusher broken aggregate	Same as in C.R.	i) Thickness of base-concrete should not be more than 150mm. ii) In case of abnormal soil strata specific treatment shall be given as per approval of S.E. (Civil).
	(b) Base concrete (under floor)	Cement Concrete 1:4:8 using 40 mm crusher broken aggregate (100 mm thickness)	Same as in C.R.	In case of abnormal soil strata specific treatment shall be given as per approval of S.E. (Civil).
2.	Foundation masonry	RR stone masonry in cement sand mortar 1:6	Same as in C.R.	(i) If good quality stone is not available, S.E. (Civil) may permit the use of Bricks/Fly ash bricks masonry. ii) In case of low lying area/ higher plinth level. Possibility of providing plinth beam to support the S/S masonry may be explored to avoid heavy masonry foundation for economy as per standard drawings & designs.
3.	RCC band at plinth level.	M-20 as per approved drawing but not less than 150 mm thickness	Same as in C.R.	i) In case of plastic soils, thickness of RCC band shall be designed accordingly. ii) Integral water proofing compound may be used with permission from SE (civil)
4.	Super Structure Masonry	RR stone/ brick masonry in cement mortar 1:6	Same as in C.R.	i) In case of brick masonry thickness should be 230mm for load bearing walls. ii) Fly ash bricks for masonry may also be used. (iii) C.R. Stone masonry 1 st sort on outer wall and 2 nd sort on inner wall with rock facing may be permitted by S.E. for important buildings as per local practice.
5.	Lintel/ sun sheds	RCC lintel/ chhajjas in M-20 grade	Same as in C.R.	Integral admixture may be used with permission of S.E. (Civil).
6.	Roofing	RCC roofing in M-20 grade	Same as in C.R.	(i) Integral water proofing compound/admixture may be used with permission of S.E. (Civil).
7.	Flooring/Skirting/Dado			
(a)	Rooms passages etc.	i) Vitrified tiles flooring ii) Green marble on steps	Polished Kota Stone	i) In case of extension Of C/R Bldg. in 220/132 KV, flooring of vitrified tiles should be used and existing floor may be replaced with vitrified tiles also as per site condition with permission from SE (Civil) ii) Granite may be used in steps at 220 KV & 132 KV S/S in Urban Area with permission of SE (Civil)

(b)	Toilet	Floor- Mat finished Ceramic tile Dado- Glazed Tile	Same as in C.R.	Height of wall tiles shall be as under. i)Toilets attached with chamber: 1500 mm ii)In WC:900 mm iii)In general toilet and rest room toilets : lintel level iv) Pantry : 600mm above platform
(c)	Battery room	Acidproof/resistant tiles of grey colour in floor and upto lintel height on wall dado.	N.A.	Rest area including ceiling of Battery room shall be painted in Grey colour (Acid proof/resistant).
8.	Window / Ventilator sill	Green Marble	Kota Stone	
9.	Almirah Shelves	Polished Kota Stone Machine cut with equal thickness	Same as in C.R.	
10.	Kitchen/ Pantry plate form	Green Marble (Kesriaji)/ Black Marble (Bhainslana) top with stainless steel sink having size 37"x18"x7" with drain board	Polished Kota Stone platform with stainless steel sink having size 22"x18"x7" in Guard Hut without drain board	(i) Other local polished stone may be used in guard hut and store with approval of SE (Civil)
11.	Coping	M15(1:2:4) 50 mm thick	Same as in C.R.	
12.	Plinth Protection	Cement concrete colored chequered cement tile over base concrete 100 mm thick 1:4:8	Same as in C.R.(if required)	
13.	Finishing work			
(a)	Plaster (i)Inner/Outer Walls (ii)Ceiling	20 mm thick plaster in cement sand mortal 1:6 followed by POP on inner walls & white cement putty on outer walls 12 mm thick plaster with cement mortar 1:4 followed by POP	20 mm thick plaster in cement sand mortal 1:6 12 mm thick plaster with cement mortar 1:4	(i)In case of false ceiling, Plaster & white cement putty on ceiling is to be avoided for same area. (ii) In case of brick masonry, 12 mm plaster should be allowed for one face.
(b)	Exterior finish	Weather Proof Paint	Same as in C.R.	
(c)	Interior surface finish	Oil Bound Distemper	White wash	
(d)	Doors & Windows	Enamel Paint	Same as in C.R.	
14.	Wood Work			
(a)	Door Shutter	30 mm thick flush doors with commercial veneer both sides	Same as in C.R.	(i) Aluminum Grill with door to be provided in water space (C.R.Buildings) (ii) In case of flush door in toilets inner surface may be provided with aluminum sheet up to 900 mm height.
(b)	Curtain roads.	20 mm dia C.P. Curtain Roads with C.P. brackets	N.A.	
(c)	Almirah / Wardrobe shutter	CRC Sheets 20 SWG shutters with locking arrangement	Same as in C.R. for Guard Hut	Almirah/wardrobe shutters be provided up to lintel level only.
15.	WINDOWS/VENTILATORS			
(a)	Windows	i) Aluminum window as per approved design with provision of wire gauge shutter in hall portion.	Steel section window as per approved design with plain glass panes and wire gauge.	(i) Frosted glass panes to be used in Rest rooms and toilets. (ii) If required, Joint between wall and frame to be sealed with weather silicon sealant.

		ii) Hollow steel section Windows & Shutters with glass & wire gauge as per approved design with plain glass panes and wire gauge shutters and 10mm square safety bars in Admn. Block		
(b)	Door Frame	Metal Pressed Doors Frame/M.S. Rolled Steel Tube	Metal Pressed Doors Frame/T-Iron section	AS per approved drawing profile C for single paitam & D for double paitam.
(c)	Stair case head room door shutters.	MS Sheet 20 SWG shutters with angle Iron frame	N.A.	
(d)	Stair case railing	S/S Railing	N.A.	
16.	Roof Treatment	Mosaic tile terracing with under base of CC 1:3:6	CC (1:2:4) grading with water proofing compound	(i) Average thickness of CC grading should not be more than 90 mm. (ii) Integral water proofing compound/ synthetic fiber may be used with permission from SE(Civil) (iii) In Jodhpur Zone, item of Glazed Tile Tukri/ Mud Puska may be allowed by SE(Civil) as per local practice prevailing in PWD.
17.	Rain water pipes	Rigid PVC Pipe (Approved Make)	Same as in C.R.	
18.	False ceiling	Only in Hall, PLCC&XEN/AEN Chamber	NA	Gypsum false ceiling to be provided; In case of locations with heavy rainfall, gypsum false ceiling may be replaced by PVC/ Glass fiber reinforced Gypsum tiles false ceiling with approval from ACE(Civil)
19.	Partition wall	AEN/JEN room	NA	(i) 12 mm thick pre-laminated three layer medium density particle board Grade -I upto sill level and glazing using 5 mm thick float glass panes and height as per drawing.
B.	SANITARY WORKS			
1.	W.C.Seat	Orissa Pan & EWC as per drawing	Orissa Pan in guard hut	(i) Only PVC Cistern & Jet spray shall be provided with WC.
2.	Wash Basin	WVC of size 550mm x 400 mm	WVC of size 450mm x 300 mm in guard hut	
3.	Mirror	Mirror with size 500x400 mm (approx)	Same as in C.R.in guard hut	
4.	Sanitary Fittings	C.P. Brass	Same as in C.R.	
5.	Pipeline	GI pipe "B" Class as per (approved make)	Same as in C.R.	(i) CPVC water pipeline may be used in case of saline water or rusting prone area for internal work. (ii) On outlet of geyser GI pipe to be used up to tap. (iii) HDPE pipe line may be used for water distribution system after approval of ACE Civil concerned
6.	Sewer pipe	100 mm dia UPVC (As per respective BSR)	Same as in C.R.	

7.	Water Tank	500 L PVC water tank with white enamel paint on outer surface.	300 L PVC water tank with white enamel paint on outer surface in guard hut	To be placed over masonry Plate-form as approved drawing.
8.	Man Hole Cover	Ferro Cement Concrete	Same as in C.R.	
C.	ELECTRICAL WORKS			
1.	Wiring work	i) PVC insulated copper wiring in PVC recessed conduit	Same as in C.R.	i. Group-2 wiring to be used. (ii). Modular accessories may be permitted in control room with approval of ACE(Civil) concern.
2.	Wiring for A.C.	AC wiring to be provided in Hall, PLCC, Rest Rooms, XEN/AEN chambers (as per drawing)	N.A.	
3.	Light Fixtures & accessories	As per approved drawing. Energy saving fixtures as per BSR . LED/5 star rating.	Same as in C.R.	All accessories and fixtures shall be of Group-2 make
4.	Earthing	Earthing with G.I. earth plate 600x600x6mm as per IS 3043 and relevant BSR.	Same as in C.R.	
5.	MCB & Distribution Board	MCB & Isolators of suitable rating with steel sheet distribution board.	Same as in C.R.	Group-2 MCB/DB to be used
6.	Water cooler & Water Purifier	Water cooler of 40 liter and purifier (R.O.) of 15 liter capacity.	N.A.	
7.	Ceiling fans	As per approved drawing	Same as in C.R.	Energy saving 1200mm sweep fans as per prevailing BSR to be provided. (5 star rating)
8.	Geysers	Rest Room Toilets	N.A.	Energy saving 15 L geyser as per prevailing BSR to be provided (5 star rating)
9	Fresh air Fans	300 mm sweep fans with louvers to be provided in Toilets	N.A.	Group 1 fresh air fans to be used(5 star rating)
10	Exhaust Fan	450 mm sweep in battery room with louvered shutter, as per approved drawing		Group 1 fresh air fans to be used(5 star rating)

Note:

- (i) For Guest House & Office buildings, specifications shall be approved by CE (Civil) office separately.
- (ii) The above guidelines shall be adopted for repair & maintenance works also as per availability of budget.
- (iii) A GLR of 15000 L capacity with required pump & pipe line shall be constructed at each substation as per standard drawings.
- (iv) The water pipe line for colony area and Control Room area must be separate to avoid transfer of potential.
- (v) Rain water harvesting scheme may be developed after obtaining necessary permission from local authorities.
- (vi) Tube well may be provided after obtaining feasibility report & NOC from district collector. If tube well is not feasible, water supply may be sought from PHED.
- (vii) The provision of inaugural stone of size $3' \times 2 \frac{1}{2}'$ be kept at entrance foyer.
- (viii) Feasible & economic Scheme for development works in GSS shall be approved by the concerned ACE (Civil).
- (ix) Clarifications & variations, if any, may be brought to the notice of this office.
- (x) Rain water harvesting may be taken in the work of control room as per approved drawing, (Approval for GWD, Rajasthan)**
- (xi) Item of anti-termite treatment may be executed separately, in termite prone areas from the licentiate agencies with 2years guarantee with the approval of SE civil Concerned however provision may be taken in consolidated Estimate. If required**

SPECIFICATIONS (NEW) FOR OTHER CIVIL WORKS (2020)

S.No.	Name of work	Revised specification	Remarks
1.	Cable Trenches		
	A) Base Concrete	100mm thick C.C. 1:4:8	
	B) Masonry	i)RR stone masonry in cement sand mortar 1:6	(I)Height of masonry shall be kept as per depth of trench (ii)RCC cable trench with its design may be permitted in area of filling zone after comparing of cost from masonry trenches by ACE (Civil) concerned.
	C) Finishing	12/20mm thick plaster in cement mortar 1:6, as per type of masonry	i) 150 mm thick RCC band of M-20 grade over the masonry shall be taken outer to outer edge of walls . ii) Heavy duty covers for road crossing to be provided. iii) 'D' type trenches be replaced by 300 mm cement pipes with inspection chambers.
	D) Trench Covers	End to end (on complete wall) covers may be provided with a 150 mm RCC bend at top in view of letter issued by SE (Design) & approved drawing(as per respective BSR item)	Drawing of cable trenches issued by this office shall prevail
E) Flooring	40mm thick C.C. flooring (1:2:4) with glass strips		
2.	Boundary wall / Toe wall		
	a) Base concrete	150 mm thick C.C. 1:4:8	
	b) Foundation Masonry	RR stone masonry in cement sand mortar 1:6	(i) If good quality stone is not available, S.E. (Civil) may permit the use of Bricks/Fly ash bricks masonry. ii)In the case of Expansive soil RCC columns with Plinth beam at NGL for foundation with its RCC design is to be provided after approval of ACE(Civil) concerned.
	c) S/S Masonry	i) RR stone/brick masonry in cement mortar 1:6 and pillar masonry in CM 1:4 with pillars at interval of 3.00Mtr (approx.) c/c and at every step up/down in the Boundary wall.. ii) Expansion joints to be provided at 30.0Mtr (approx.) interval and at every step up/down in the Boundary wall.	(i) Fly ash bricks for masonry may also be used.
d) Finishing	(i) 12/20mm thick plaster in cement mortar 1:6 (ii) Weather coat paint applied on exposed pillars and edges of coping of B/Wall (iii)Colour washing/ white washing shall be done in remaining area.	(i) Boundary wall in front of C.R. 2' height railing may be provided. (ii)The width of gate for transformer track only shall be 6 meter wide excluding side wicket gate.	

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e) Residential Quarters Boundary Wall.	(i)Foundation-RR stone masonry.	(i)If good quality stone is not
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		(ii)S/S-Brick partition wall with brick masonry pillar in between. (iii)Wall to be finished with 12/20 mm plaster (iv) Color washing including provision of light duty M.S. Gate with steel section pillar encased of masonry.	available, S.E. (Civil) may permit the use of Bricks/Fly ash bricks masonry for foundation. (ii) Fly ash bricks for S/S masonry may also be used. (iii) Gates light may be provided as per approved drawing.
3.	Structure foundation		
	a) Base Concrete	100 mm thick CC 1:4:8	For all type of foundations.
	b) foundation work	M20 grade RCC	As per approved drawing and SBC
4.	Cement Concrete Road (if total road length incl. colony and inspection path etc. is upto 1.500 km)		
	Sub Base	150 mm thick Quarry Rubbish/Morrum/ Granular sub base	Width of road as per Electrical layout. Upto 60 cm wide berm to be provided on each side and berm shall be strengthened with Granular sub base/quarry rubbish as per availability of material followed by interlocking tiles/brick on edge. Kerb stones may also be provided on main roads
	Base Concrete	100 mm thick 1:4:8	
	Top layer	150 mm thick cement concrete pavements of M-30 Grade. with 43 grade cement as per clause 602.2, unreinforced dowel jointed at expansion and construction joint using approved mix design, as per respective PWD road BSR item	i) Mix design should preferably be got executed in RVPN lab on payment basis.
5.	Bitumen Road (if total road length incl. colony and inspection path etc. is more than 1.500 km)		
	a) Sub Base	150 mm thick Quarry Rubbish/Morrum/ Granular sub base	Width of road as per Electrical layout. Upto 60 cm wide berm to be provided on each side and berm shall be strengthened with Granular sub base/quarry rubbish as per availability of material followed by interlocking tiles/brick on edge. Kerb stones may also be provided on main roads
	b) Base	Water Mix Macadam in two layers of 100 mm each	As per prevailing BSR
	b) Top layer.	25 mm thick Bituminous Macadam	As per prevailing BSR
5.	Fencing		
	a) Yard fencing	(a) Toe wall to be constructed in R.R. stone masonry, having thickness not more than 380 mm. (b)Welded mesh of size 25x25x2.1 mm/ chain link fencing in 1500 mm height & with barbed wire fencing (one side) in angle Iron post at top.	As per drawing

	b)Internal fencing	Same as above with provision of M.S. Railing in place of barbed wire	As per drawing
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		fencing at top.	
6	Grading work	<p>a) For clay & sandy soil in yard where vegetation growth may occur 50mm(min.)thick M30 grade Interlocking tiles be provided below gravel after antiweed treatment,strictly in the areas where it is technically required in consultation with S.E.TCC concerned.</p> <p>b) For soft & hard rock strata: in such yard a leveling course not more than 100mm thick of lean concrete i.e.M10 (1:3:6)be provided below gravel only in the areas where gravelling is required in consultation with S.E.TCC concerned.</p> <p>c)For strata not prone to vegetation ;For strata such as gravel mix hard soil etc.there is lesser possibility of vegetation ,the gravelling work be done directly on leveled ground in required area in consultation with SE(T&C)concerned.</p>	
7.	Gravelling work	100 mm thick layer of 40 mm thick single size crushed stone aggregate.	

Note :(i) the above guidelines shall be adopted for repair & maintenance work also.

(ii) Clarifications & variations, if any, may be brought to the notice of this office.