CHOISEUL ECONOMIC REVITALIZATION PROJECT – PHASE II

SFA2003/SLU/BIT – 010/0812/EMF/LC

ANNEX IIA: TECHNICAL SPECIFICATIONS

SUMMARY

Contents

1.0 GENERAL AND PRELIMINARIES

1.1 Location of Works

The works are located in the community of Delcer and immediate environs in the Quarter of Choiseul.

1.2 Public Safety and Convenience

Protect all obstructions within travelled roadways by ed signs, barricades, and lights necessary for the safety and convenience of the general public and residents along the pipeline. The protection of persons and property is of prime importance and shall be provided for in adequate and satisfactory manner.

1.3 Progress of Construction

It is the intent of these Contract Documents that the work shall proceed in a systematic manner so that a minimum of inconvenience will result to the pub ic in the course of construction.

Cleanup of all construction debris, excess excavation, excess materials and complete restoration of all fences, ditches, culverts, signposts, and similar items shall be complet immediately following the completion of all works.

1.4 Interfering Structures

Take necessary precautions to prevent damage to existing structures whether aboveground or underground. Protect all underground and aboveground existing structures from damage, whether or not they lie within the limits of the easements obtained by the Owner. Where such existing fences, gates, sheds, buildings, or any other structure must be removed in order to properly carryout the construction, restore them to their original condition to the satisfaction of the property owner involved at no additional cost to the Owner. Notify the Engineer of any damaged underground structure, and make sure repairs or replacements before backfilling takes place.

If existing structures are encountered which will prevent the construction of the works, notify the Engineer before continuing with the construction in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor shall fail to so notify the engineer when an existing structure is encountered, but shall proceed with the construction despite this interference, he shall do so at his own risk.

1.5 Field Relocation

During the process of construction, it is expected that minor relocations of the line will be necessary. Such relocations shall be made only by dir on of the Engineer. Unforeseen obstructions encountered as a result of such relocations will not be subject for claims for additional compensation by the contractor to any great extent than would have been the case had the obstructions been encountered along the origin location.

1.6 Scrubs, Plants and Areas of Cultivated Grass

Remove, intact with their root systems, all shrubs, or plants that interfere with the construction of the pipelines which must be reinstated. Upon completion of the pipe laying and backfilling of trench, replant the shrubs, or plants in their origina position. Should any shrub, or plant that has been removed and replanted die within 6 months from the time it was disturbed, it shall be replaced in kind and size by the Contractor at his expense. Replant cultivated grass areas and be responsible for their reestablishment.

1.7 Responsibility for Damage to Existing Structures

Where any existing structure or facility which is intended to remain is damaged by the Contractor during demolition or construction, the Contractor shal promptly repair or replace the damaged portion or facility at no additional cost to the Owner.

1.8 Storage of Materials

Materials shall be stored to insure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooded platforms or other hard, clean surfaced, and not on the ground, and/or they shall be placed under cover. Stored materials shall be located so as to facilitate prompt inspection. Pri ate property shall not be used for storage purposed without the permission of the owner or lessee.

1.9 Access to Works, Working and Storage Areas

The Contractor is advised that the works are being car ed out in a Commercial/residential development area (i.e. in the village of Choiseul). Th He shall therefore take all reasonable steps to maintain the free movement of pedestrian and vehicular traffic on any roads and footpaths used by him to gain access to the Works. All permanent accesses are to be maintained free of any spillage from the Contractor's vehicles.

All necessary facilities will be given by the Employer for the access of the Contractor's employees to the Works and the Contractor shall be res ible for seeing that such employees obey all regulations made by the Employer in regard to conditions of access to and over his property

1.10 Documents

The Engineering Drawings and their specifications, Condition of Contract together with its Supplements, the Building Construction Drawings, Technical Specifications and applicable codes and other pertinent documents are a part of these specifications. *Examine and comply with the conditions of all documents whether in hand or on file at the Engineer's office since omission of Engineering details from Building Construction Drawing shall not form the basis for additional compensation.*

1.11 Drawings

The Drawings indicate the design and general arrangement of the various systems, components and other pertinent works and the limit of the extent of details deemed sufficient for the contractor to install the works to design. Drawings are as accurate as preliminary surveys and planning can determine but exact locations, distances and levels wi be governed by actual field conditions. Review Engineering Drawings and adjust work to conform to all conditions shown thereon. Price as indicted in the form to tender.

1.12 Scope of Works

Except as otherwise specified, the work under this Contract shall consist furnishing all labour, materials and equipment for the complete execution of Delcer Irrigation Project and related work, including reinforced concrete or timber pedestals, storage tank erection, etc. as shown in the accompanying drawings and generally described in these ecifications to the satisfaction of the Engineer and all relevant public authorities.

Notwithstanding specific provisions, the Contractor shall supply samples of materials to be in the works. If the Engineer shall not object to the qualit of the samples supplied, then all materials brought on site shall in the sole and final opinion of the Engineer be of no lesser quality than the samples, the Contractor shall submit samples of alternative sources of materials for the Engineer's review.

The Engineer has the power to reject any materials or rkmanship which in his opinion do not comply with the specification and the Contractor shall promptly replace any such materials or work and shall remove from the site any remaining materials which do not comply.

The non-objection to a sample does not in any way bind the Engineer nor relieves Contractors of the obligation to comply with the requirements of the Contract.

The Contractor shall provide the specified or adequate test results for all materials to be used on the work at no extra charge. Such tests and materials sha l be clearly and unambiguously identified to the satisfaction of the Engineer. All tests are to be carried out by an approved, independent

laboratory. Where no tests are specifically called fo herein, the relevant British Standard or ASTM Standard test shall be used.

1.13 Protection of Completed Work

The Contractor shall protect completed work from damage during subsequent operation, from the weather or any other cause, including the naturally aggressive nature of the environment in which the works are to be constructed and make good any damage so arising.

1.14 Testing

The Contractor shall provide all staff, labour and equipment necessary for the performance of all tests required, or he may employ an independent testing laboratory approved by the Engineer to carry out all or part of the testing.

1.15 Notice Board

The Contractor shall provide and erect three (3) notice boards of approximate si e 2.4 metres by 1.2 metres in prominent locations, as agreed with the ngineer. They shall be of durable construction, which will resist fading or peeling, and sufficiently sturdy to withstand the local climatic conditions of heat, wind and rain. The appearance of the signs shall be as agreed with the Engineer, and be subject to the Employer's approval. No other notice boards or signs of any description shall be erected unless directed or approved. Smaller signs will be posted at the individual installations utilizing the donor agencies ogos and shall be constructed of similar material as the larger signs.

1.16 Contractor's Transport

The Contractor shall make his own arrangements for the transport, where necessary, of his staff and workmen to and from the site of the Works.

2.0 MASONRY AND STONE PITCHING

2.1 MASONRY

2.1.1 Stone for Masonry

Stone for masonry shall be sound and durable, free fro laws and from soft, weather or decomposed parts. The stone and the quarry from which it is obtained shall b subject to the approval of the Engineer. When required by the Eng neer samples shall be submitted by the Contractor of the stone he proposed to supply a d the Engineer's approval shall be obtained before any work is carried out.

Exposed faces of stones for masonry shall be free from tool marks except such as are inherent in the nature of any dressing that may be spe d. In rock-faced work the rough on the surface shall not project more than 40 mm for stones less than 0.3 square metre face area and not more than 65 mm for larger stones.

2.1.2 Cement Mortar for Masonry

Cement mortar shall consist, unless otherwise specifie of one part by volume of Ordinary Portland Cement and three parts of volume of natural sand or crushed stone or a combination of both as specified in BS 1200: 'Building sands from natural sources'. The consistent materials shall be accurately gauged and mixed in an approved manner.

Cement mortar shall be made in small quantities only as and when required and any mortar which has begun to set or which has been unused for a eriod of more than one hour shall be rejected.

2.1.3 Construction of Masonry

Masonry shall be built to the lines and levels shown o the Drawings. Notwithstanding any local usage, it shall be built in the manner specified below and otherwise as described in **BS 5390 "Code of Practice for stone masonry".** The terms and definitions of which shall be held to apply to this contract.

The stones used shall be selected natural stones from a source approved by the Engineer and satisfying this specification. They shall be clean and must be washed if necessary in the opinion of the Engineer. For the face work of rub le masonry the stones shall be, as far as possible, quarry split and not bull-nosed or hammer dressed although a moderate amount of tooling will be permitted to dress off large projections. The stones shall show a face of not less than 1,200 mm (18 sq. in.) and not more than 130 mm on bed. They shall be selected to give an even distribution of large and small stones so that the face does not present patches of large stone all together and patches of large stones all together.

The stones shall be set in mortar with natural bed as ear as possible to the horizontal or normal to the line of the thrust in case of load bearing structures. Particular care must be given to obtaining a sound bond both longitudinally an transversely and there shall be least one bounder, of length not less than two-thirds of the wall thickness, in each square metre of wall face.

The face joints rubble masonry may vary in thickness f om 15 to 40 mm. Where the masonry is specified to be "unpointed", they shall be ed as a neat weathered joint with mortar while the works proceeds. On completion of the works, all exposed faces shall be left in a neat, tidy and clean condition.

In all cases where pipes or the like are built into walls, the masonry, together with any concrete or brickwork associated therewith, shall be c osely fitted around the pipes so that no water can pass between and the surrounding work.

2.2 STONE PITCHING

2.2.1 Stone

Stone for pitching shall be either natural, rounded co bles or selected rock won from excavation. It shall be naturally occurring dense, so nd, durable, material free from weather, mechanical weakness and chemical decomposition. Stone shall be carefully selected so that only pieces approximately to cubes or spheres are used. Excessively elongated pieces shall not be used.

Individual stones shall fall within the normal size range of 150 to 300 mm with not more than 30% of stones less than 200 mm nominal size.

2.2.2 Mortar

Mortar shall consist of one part of sulphate resisting cement to four parts of sand mixed with just sufficient water to ensure adequate workability. The water/cement ratio shall not exceed 0.05. Mortar shall be used within one hour of e addition of water.

2.2.3 Laying of Stones

Stones shall be laid on a mortar bed of minimum thickn 100 mm, in a tightly knit pattern. The interstices shall be completely filled with mortar as stone laying progress and the mortar finished smooth with a steel trowel 25 to 50 mm below the surface of the stones. The surface of the mortar shall be finished to even falls to facilitate the runoff of the surface water.

3.0 CONCRETE WORKS

3.1 Cement

The cement shall be Portland cement, complying in every respect with B.S.12. It shall be delivered in the sound original packages of the manufa turers, plainly branded and must be stored in watertight sheds on a floor raised at least 6" from the ground. Sufficient quantities must be stored to ensure continuous supplies and any cement damaged by water or found to be otherwise defective must be remov from the site immediately. The cement shall be used as far as possible in the order in which it has been delivered. Any cement which arrives on the site hot from manufacture shall not be used until one week has passed. Any packages in which there are hard d lumps or cakes of cement shall be rejected.

3.2 Aggregates

The sand shall be cleaned, hard, sharp, coarse grit pit sand of good stratum and from approved suppliers or sand derived from crushing suitable gravel or stone, and is hall be free from coagulated lumps, soft or flaky particles, shale, crusher dust, silt, alkali, loam, organic matter or other deleterious substances. The grains shall be well graded in size and must pass through a screen with a mesh of 3/16th o an inch square and not more than 10% shall pass through a No. 100 B.S. sieve. It shall be well graded between these limits, and shall be well washed if required by the Engineer.

The coarse aggregate shall be screened pit ballast or crushed hard stone, clean, durable, free from soft, porous, elongated or laminated pieces, crusher dust, alkali, loam, organic matter or other deleterious substances. Aggregate for concrete nominal mixes 1:3:6 and 1:4:8 shall be graded so as wholly to pass a 1 1/2" ga ge mesh and be retained on a 3/8" gauge mesh. Aggregates for concrete nominal mixes 1:1 1/2:3 and 1:2:4 shall be graded so as wholly to pass a 1" gauge mesh and be retained on 3/16th gauge mesh.

If aggregate conforming to the foregoing specified gradings is not reasonably obtainable, the contractor shall supply two or more classes of otherwise satisfactory aggregate but of different maximum size and these separate materials sh be mixed in proportions to be directed by the Engineer without any extra charge by t e Contractor.

3.3 Water

Water shall be clean and free from oil, acid, alkali, arth, vegetable or organic matter or other deleterious substances in suspension or in solution in such amounts as to impair the strength or durability of the concrete or mortar. Water shall be obtained from the public supply and no water taken from a spring, well, river, lake or similar source or from the excavations shall be used for any purpose on the work less approved by the Engineer. If instructed, samples of water collected in an approv d manner shall be submitted for the purpose of analysis or of making concrete tests.

3.4 Proportions of Concrete

The concrete shall be mixed in the following proportions: -

1.:1.5:3	NOMINAL MIX (3,750 P.S.I)
Cement	94 lb.
Dry sand	1.5 cu. ft
Coarse Aggregate	3.0 cu. ft.

In the foregoing, the aggregates are assumed to be measured dry and if wet or damp at the time of mixing consistent with practical workability and shall be varied as required to suit the moisture content of the aggregate and to produce concrete having the specified slump. In no case shall the water/cement ratio exceed 0.50.

3.5 Minimum Strength Requirements of Concrete

Minimum strength requirements are as follows: -

Nominal Concrete Mix	Minimum resistance to crushing (cube strength) in lb. per sq. in.	
	at 7 days	at 28 days
1:1.5:3	2,750	3,750
1:2:4	2,000	3,000

3.6 Mixing Concrete

The 94 lb. bag of cement shall be the basis of the bat and each batch shall contain a whole number of bags. The aggregates shall be measure for each batch in approved gauging boxes properly constructed in timber to the necessary sizes and fitted with lifting handles.

Batching of aggregate by weight will be permitted at the discretion of the Engineer who is to approve the proportions before batching is comme ced.

An approved mechanical batch mixer shall be used unless the quantity of concrete is small, when hand mixing shall be permitted. The mixer and mixing platform shall be suitably protected from the wind to prevent loss of ce nt.

After the materials have been separately gauged in measuring boxes or weighed in an approved weighing apparatus and have been placed in the mixing drum, the concrete shall be mixed for not less than two minutes, and until it is of even colour and of uniform consistency throughout. The concrete shall be discharg from the mixer on to a level, clean and watertight platform or receptacle.

When hand mixing of concrete is permitted the material shall be deposited on clean mixing boards and turned over at least three times and thoroughly mixed in a dry state.

Sufficiently water shall then be added to bring the mass to a proper consistenc the whole being turned over at least twice whilst the wate s added.

Only concrete required for immediate use shall be prep red at any one time. Concrete which has become stale or set or which shows signs of initial setting or has been otherwise damaged shall be used for filling or carted away as directed.

The water for each batch of concrete shall be measured in a suitable tank (Preferably fitted to the mixer which shall have a means of adjust nt for delivering the proper amount of water to be used for each charge.

3.7 Placing Concrete

Concrete shall be used as soon as it has been mixed an shall be deposited directly in the work from proper metal concreting barrows, trucks or any other approved method. It shall not be dropped into its final position from a height of more than 3'0" or 6'0" in columns nor shall it be deposited in water except when and if approved by the Engineer. The mass when completed shall be homogeneous throughout.

The interval between adding the water to the concrete materials a completion of the concrete placing operations shall not exceed 25 minutes.

Concrete shall be thoroughly compacted during the operation of placing, and thoroughly worked around the reinforcement, around embedded fixtures and into corners of formwork. Tampers of suitable approved types shall be sed.

All reinforcement concrete work shall be vibrated mechanically immediately after pouring, and for sufficiently long to ensure adequate mpaction and an even density throughout the mass but not so long as to cause segregation of the mix.

Concrete shall be placed as near as possible to its final position before spreading. Under no circumstances is it permitted to spread concrete with vibrating equipment.

When it is necessary to stop concreting, the concrete be finished off with a square edge and shall not be allowed to slope away. Before d ing new concrete against that which has set, the surface of the latter shall be cleaned and loose or porous concrete removed and cut back until a solid face is exposed. T surface of the concrete shall then be hosed down, grouted with cement mortar (1:2) a d the new concrete thoroughly rammed against the face.

Column Capitals, haunches and brackets and the whole of the floor system in the vicinity of the head of the column shall be cast in one operation.

The rib and slabs of Tee- and Ell- beams shall be concreted in one continuous operation. Daywork joints shall be made at quarter point in the span of the slabs and beams unless otherwise shown on the drawings or directed by the Engineer.

Allow all separating edges of adjacent slabs or bays with a strip of approved building paper bedded in mastic.

No traffic shall be allowed on the finished surfaces of concrete for at least seven days after completion. The Engineer shall have the right t ase or decrease this period.

3.8 Curing

Measures for the curing of horizontal surfaces exposed to the sun or to drying winds or rain shall be carried out immediately after the concrete has been placed and finished. This shall take the form of approved waterproof paper, or thin polythene sheeting spread

over the entire surface of the concrete. Alternatively, in the case of the concrete surface to which no screed or the like is to be subsequently bonded, a liquid curing membrane of a manufacture approved by the Engineer may be used and shall be applied strictly in accordance with the manufacturer's instructions.

Where the exposed surfaces of the concrete are not subjected to the strong sun or drying winds, the curing may be postponed until the concrete has set. Thereafter, the concrete shall be thoroughly wetted and then covered with approved waterproof paper or polythene sheeting. Alternatively the concrete shall be covered with matting, fabric or similar absorbent material, or a layer of clean sand, either kept constantly damp.

The curing of vertical surfaces shall be continued after removal of the formwork by hanging canvas or hessian over the completed work and keeping wet, or by covering with polythene sheeting.

In each or all of the above, the method of curing shall be continued for at least seven days in the case of concrete made from Ordinary Portland Cement, or for four days in the case of concrete made from Rapid-Hardening Portland Cement.

3.9 Steel Reinforcement

The steel rod reinforcement shall be deformed high yield steel to B.S. 4449. Steel fabric reinforcement shall comply with B.S. 4483. All reinforcement shall be free from pitting, loose rust, mill scale, paint, oil, grease, adhering earth or any other matter which in the opinion of the Engineer may impair the bond between the concrete and the reinforcement of which causes corrosion of the reinforcement or disintegration of the concrete.

All reinforcing rods shall be bent to shape on the site of the works or other place approved by the Engineer. Bends and turns in rods up to 1" in diameter shall be made cold. Rods exceeding this diameter may be heated to a dull red hot but not cooled by quenching. Bending shall be done with an evenly applied force without jerk, in a bending machine of approved pattern. Any rod, which shows signs of cracking at a bend, shall be rejected.

Reinforcement shall be properly braced, supported by tie spacers, chairs, etc. or by mortar pads if directed by the Engineer and held firmly in position so that the placing and ramming of the concrete will cause no distortion or displacement of the reinforcement. All chairs used for reinforcement in suspended slabs and beams shall have plastic tips.

The ties, links or hoops connecting the rods shall be cut so that the rods are properly braced. The inside of their curved parts shall be in actual contact with the rods around which they are intended to fit.

The effective cover to reinforcement shall be in accordance with B.S. 81 unless otherwise specifically noted on the Drawings.

The weights of reinforcement are computed from the sizes and net lengths of the rods shown on the drawings. The actual weights used for each diameter bar are as follows:

Diameter of bar	Weight in lbs. per foot run	Diameter of bar	Weight is lbs. per foot run
1/4"	0.175	3/4”	1.5
3/8"	0.4	7/8”	2.1
1/2"	0.7	1"	2.77
5/8"	1.1		

The prices of all reinforcement shall include for all cutting to lengths and waste, straightening, bending including to special radii, hooked ends, cranking, space bars, cover blocks, tying with and including binding wire an for all other matters necessary for the supply, and fixing of the reinforcement.

3.10 Cover

Unless otherwise shown on the Drawings, the cover to t e reinforcement shall comply with B.S. 8110.

3.11 Formwork

Formwork shall be substantially and rigidly constructed of timber or steel or precast concrete or other approved material and shall be made to the shape and dimensions shown on the drawings.

The Contractor is responsible for the design, supply, tability, striking and removal of formwork.

Timber shall be well seasoned, free from loose knots, nd for shuttering of exposed concrete faces wrought on all faces. Faces in contact with concrete shall be free from adhering grout, projecting nails, splits or other defects that will mar the concrete surface. Shuttering for foundations and other concealed work ma e of undressed timber.

All joints, except as herein below specified shall be s tight to prevent leakage of cement grout and to avoid the formation of fins or other blemishes and all faulty joints shall be caulked. If timber boarding is to be continuo wet throughout the period of use the joints shall not be tight when the shuttering first constructed. Where the appearance of the concrete face is important the posit and direction of the joints shall be as directed.

Openings for inspection and for the escape of wash water, etc. shall be formed in such a way that they can be closed before commencing to place the concrete.

No holes or other cavities shall be cut in any concret work unless approved. The contractor shall ascertain from the drawings, from sub-contractors or from elsewhere particulars of all bolts or other fixings, and of all nings, holes, pockets, chases, recesses and other cavities so that before placing the oncrete all bolts and fixings shall be in position, and any other inserts necessary for forming holes and other cavities shall be fixed to the shuttering.

Formwork is measured to the actual surface in contact h the concrete, and prices are to include for all splayed edges, notchings, allowance for laps and passings at angles, battens, struts, bolts, nails, wedges, striking, easing and remov l. The number of times the formwork may be reused shall be taken in account in pricing.

3.12 Admixtures

No admixtures of any kind shall be used in the concret without the permission of the Engineer. Where such permission is given, the admixture shall be of approved manufacture and shall be used strictly in accordance with the manufacturer's instructions.

The use of non-corrosive additives or admixtures in concrete may be o ered or approved by the engineer according to the circumstances. Such approva will only be given when the contractor has demonstrated to the satisfaction of the engineer that the resulting concrete is no less strong, dense and durable than tha obtainable without the use of additives.

Samples of any additives or admixture proposed by the ontractor shall be submitted for testing at least 60 days in advance of use, which shall require the written approval of the engineer.

When additives or admixture are used in the works very strict control is to be maintained to ensure that the correct quantity is used at all times.

3.13 Construction joints & expansion joints

3.13.1 Position of construction joints

The contractor shall ensure that all construction join s are arranged to minimize the effect of shrinkage of the concrete. Generally, the distance between construction joints shall not exceed 10m.

The positions of all joints shall with the Engineer be ore work is commenced.

Construction joints shall be located preferably in are s of compressive stresses.

Concrete placing shall be carried out continuously between consecutive construction joints.

3.13.2 Treatment of construction joints

Treatment of construction joints shall be agreed with the Engineer.

All construction joints shall be hacked and all laitance and honey-combed concrete removed from the contact face before the adjacent section is concreted.

All loose material shall be removed from the contact face immediately after hacking has been completed.

When work is to be resumed at a construction joint, it shall be swept clean.

All vertical joints the fresh concrete shall be placed directly against the hacked contact face.

Horizontal joint surfaces shall be well brushed with a wet hand-brush and washed off with a spray of water 30 minutes to 1 hour after casing to expose the aggregate and to provide a key for the next lift. Before the next lift s placed, the exposed aggregate surface should be well scrubbed to remove all laitance and loose material. No mortar shall be placed on the treated surface prior to placing the next lift f concrete.

4.0 CONCRETE BLOCKWORK

4.1 CONCRETE BLOCKS

4.1.1 Dimensions

Blocks shall be 2-core or 3-core hollow concrete blocks of approved overall dimens on.

Minimum face shell and web thickness shall be as follows:

Nominal Width	Face Shell Thickness	Web Thickness	Equivalent Web Thickness
150	25	25	56 mm per 300 mm

200	33	33	56 mm per 300 mm

Note:Equivalent web thickness is the sum of the measured th cknesses of all the webs in the unit times 12 divided by the length of the unit.

No overall dimension shall differ by more than ± 3 mm from the specified standard dimensions.

4.1.2 Manufacture

The surface finish of the blocks shall be as specified by the Architect.

Blocks shall be manufactured from dense natural aggregates complying with ASTM C150 or BS 12 with a mix not richer than one part by volume of cement to six parts of combined fine course aggregates.

The drying shrinkage of the blocks shall be determines in accordance with BS 6073 and the average value for three specimens shall not exceed 0.04%.

4.1.3 Strength

The compressive strength of the blocks shall be determined in accordance with the method of testing laid down in BS 6073 or ASTM C140. mum compressive strengths for walls shown on the structural drawings shall be as follows: -

An average gross area: -

Average of 5 units	3.5 N/Sq. mm
Individual unit	2.8 N/Sq. Mm

On average net area: -

Average of 5 units	7.0 N/Sq. mm
Individual unit	5.5 N/Sq. mm

All blocks shall be sound and free from cracks or other defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction.

4.1.4 Testing

Testing of blocks shall be carried out by a testing authority approved by the Engineer. No less than 3 blocks shall be tested from each consignment of 200 blocks arriving on site. The procedure for selecting these blocks shall as directed by the Engineer. Results of tests should be communicated to the Enginee as soon as these are available and no blocks from any consignment may be used without the Engineer's permission.

4.2 MORTAR

4.2.1 Mix Proportions

Mortar shall consist of one part by volume of normal Portland Cement as ASTM C150 or BS 12 to three parts by volume of natural sand to BS 1200 with or without one quarter part by volume of lime complying with the recommendati n of either clause 8.001 or 8.002 of BS 890.

Alternative equivalent mortar mixes utilizing masonry ent or proprietary additives may be used subject to the approval of the Engineer.

4.3 REINFORCEMENT

4.3.1 Vertical Reinforcement

All vertical steel reinforcement shall be High Yield t BS 4449:1988.

4.3.2 Load bearing Blockwalls

Vertical reinforcement in load bearing blockwalls shall be detailed as on the structural drawings.

4.3.3 Non-Load bearing Blockwalls

Vertical reinforcement in non-load bearing blockwalls shown on the architectural drawings shall be 10 mm diameter bars at 800 mm centre and at ends, corners and openings.

4.3.4. Horizontal Reinforcement

All horizontal reinforcement shall be Dur-O-Wal Ladder type made with No. 9 gauge galvanized steel rods or an approved equivalent laid in the horizontal joints of the blockwork.

4.3.5 Load bearing Blockwalls

Horizontal reinforcement in load bearing blockwalls shall be as detailed on the structural drawings.

4.3.6 Non-Loadbearing Blockwalls

Horizontal reinforcement in non-loadbearing blockwalls shall be laid every three courses.

4.3.7 Corners and Junctions

All blockwork junctions, openings and corners shall be reinforced as detailed on the structural drawings.

4.4 CONCRETE FILING TO BLOCKWORK

4.4.1 General

Concrete filling to blockwork shall consist of a course grout of fluid consistency that can be poured or pumped with segregation.

Grout shall have a minimum strength of 15 N/Sq. mm at 7 days, or as shown on the drawings, and the minimum ratio of cement, sand and aggregate shall be one part cement to 3 parts sand to 2 parts pea gravel by weight.

The maximum size of the gravel aggregate shall be 8 mm unless otherwise indicated on the drawings.

4.5 WORKMANSHIP

4.5.1 General

Blocks should be laid dry or wetted only as necessary adjust suction on faces in contact with mortar.

Blocks shall be laid in true and regular courses in half bond.

Walls and partitions shall be bonded to each other at ngles and junctions, and closer blocks used at ends, jambs and junctions.

Blocks are to be cut neatly.

4.5.2 Joints

Horizontal and vertical mortar joints are to be of an erage thickness of 10 mm exclusive of any key in the jointing surfaces of the blo ks.

All joints are to be finished flush unless described otherwise in the drawings and/or specification.

Horizontal and vertical mortar joints shall have full tar coverage on the face shells and on all webs.

Vertical head joints shall be buttered well before the blocks are placed together, and these joints shall be shoved tightly so that the mortar bonds well to both units.

Where blocks are to be concrete filled, care is to be aken to avoid mortar dropping into the cavities and all projecting mortar is to be removed.

4.5.3 Chasing

No horizontal chases for services will be permitted in walls. Vertical chases or openings are only to be formed with the approval of the Enginee and the Architect.

4.5.4 Mixing of Mortar

Mortar shall be mixed in an approved mechanical mixer for not less than three minutes.

Mortar may be re-tempered with water where it has dried out but not used more than 1 1/2 hours from the initial mixing time.

4.5.5 Reinforcement

Foundation dowel bars shall not be cranked more than 1 in 6 to correct misalignment.

Splices shall be a minimum of 3 6 diameters and bars shall be wired together.

Vertical bars shall be held in position at top and bot and at intervals not exceeding 192 diameters and shall have a minimum clearance of 12 mm from masonry.

The longitudinal bars horizontal reinforcements shall be completely embedded in mortar or concrete. Reinforced mortar joints shall be at lea twice the thickness of the reinforcement.

Horizontal wire reinforcement shall be lapped at least 150 mm at splices and shall contain at least one cross wire of each piece of reinf rcement in the lapped distance.

4.5.6 Erection of Loadbearing Blockwalls

The following procedure shall be carried out for the erection of loadbearing blockwalls.

a. Blockwork shall be constructed to a height of 1.4 m approximately or less.

b. Holes shall be made in one face only of the blocks at the bottom of the voids to be filled.

c. Each void to be filled shall be cleaned out thoroughly by rodding or other approved means and the debris, etc, removed from the holes at the base of the voids.

d. The holes shall then be formed in order to retain the grout.

e. The vertical reinforcement as scheduled shall then be inserted into the voids.

f. Grout as specified shall then be poured into each void to be filled. The pour shall be stopped 35 mm below the top of a course to form a key at the joints.

5.0 PIPE INSTALLATION

5.1 DESCRIPTION

The work to be carried out under this heading shall consist of furnishing all material, equipment and labour for installing and testing water , gate valves, stop cocks, air valves, house connections and fittings at the locations shown on the Drawings or as directed by the Engineer.

The work shall include excavation, disposal of excess materials, dewatering, elected backfilling and construction of thrust restraints and oncrete anchorages as shown on the Drawings or as ordered by the Engineer, and all other rk not specifically mentioned, but which is necessary for the completion and operation of the above escribed works.

5.2 MATERIALS

5.2.1 Pipes

Pipes shall be plastic Class 200 SDR21 gasketted PVC. pe joints will be made in strict accordance with the manufacture's instructions.

5.2.2 Sluice Valves

To BS 5,163, soft face wedge, sq. top, clockwise closing, double flanged NP16 and epoxy coated.

5.2.3 Tees

Ductile Iron reducing tee, all flanged NP16, cement lined inside and bitumen coated outside.

5.2.4 Flange Adaptors

Universal Flange Adapters, Rilsan coated, NP16

O/D100mm - 108 - 124mm

O/D150mm - 159 - 179mm

5.2.5 Gaskets

NP16 Gaskets, FF, in EPDM Rubber.

5.2.6 Bolts & Nuts

2½" x 5/8" BSW. MS Hex nuts/bolts/washers, zinc plated fully threaded.

5.2.7 Air Valves

Double orifice, plastic, screwed BSP.

5.2.8 Ball Valves

Brass ball valves, chrome plated, female BSP ends, centre lever.

5.2.9 Saddle Straps

Gunmetal saddle straps, C/W Oring rubber seal and s/st el nuts/bolts; predrilled/tapped. BSP.

5.2.10 Covers & Frames

Figure 5422B, ductile iron, 600 x 600mm clear opening, double triangular, 12.5 tonne loading, hack coated with WASA logo and badged with locking bolts and safety grids.

5.2.11 Ferrule Straps

Combined gunmetal saddle / self-tapping swivel ferules; saddles to suit PVC mains and c/w oring seal add s/steel nuts/bolts. Ferrules with female BSP screwed outlets.

5.2.12 Valves

Unless otherwise ordered, each gate valve that is buried underground shall be provided with a cast iron surface box or concrete vault.

The upper section of the box shall be fitted with a heavy cast iron cover

Each valve shall have plainly marked in cast letters on the sides of the cases or on the covers, the manufacturer's identification, the size of the valve, the working pressure where necessary, the direction of flow.

Concrete anchorage for pipes, fittings and valves shal conform to the requirements of the Specification for Concrete.

5.3 CONSTRUCTION REQUIREMENTS

(a) Excavation for Pipe laying

The width of trench excavated for any size pipe shall he minimum required for efficient working after allowance has been made for timbering an strutting, if necessary, and shall be approved by the Engineer.

The bottom of the trenches as excavated shall be even uniformed and shall be free from stones or other projections.

Holes cut out at the joints shall be dug to within 150 of its formation and proper grade pegs shall then be set in the bottom of the trench by the Contractor for the accurate taking out of the rest of the excavation. I the ground becomes weathered prior to the laying of the pipes, the Contractor shall remove the weathered soil and replace it with approved selected fill compacted to the original formation level.

If any part of a trench or foundation is in error, excavation deeper and/or wider than is required, the extra depth and/or width shall be filled up with approved selected fill compacted to original formation level.

If the ground in which the trench is dug is full of st s or otherwise unsuitable material, the pipe trench shall be excavated to a depth of 100 mm below the invert of the pipe and be refilled with suitable material free from stones and w rammed in order to provide a smooth bed for the pipes.

(b) Refilling of Excavations

All refilling of excavations and trenches shall be thoroughly compacted in layers not exceeding 150 mm thickness and by means which will not damage the works.

(c) Backfilling of Pipe Trenches

The soil filled around and for 300 mm over the top of pipes shall be free from stones to the approval of the Engineer, the soil being screened if necessary to excl e material which

would damage the pipes, and shall be compacted by approved hand rammers in layers not exceeding 150 mm compacted thickness. Particular atte on shall be paid to the filling in of joint holes and at the sides of the pipes to obtain the eatest possible compaction and solidity.

The remainder of the trench may be filled in by hand or alternatively by mechanical equipment if approved by the Engineer. Where trenches are filled in by hand, the material shall be thoroughly compacted using hand rammers approved by the Engineer. Where trenches are filled in by mechanical equipment, the ma ines employed shall be to the approval of the Engineer and particular care shall be taken to avoid damage to any part of the works.

In areas where the pipe passes under the roadways or structures, backfilling of pipe trenches shall be carried out in lifts not exceeding 150 mm compacted 95% of Standard Proctor density as determined by AASHTO T99. The method of compaction shall be to the satisfaction of the Engineer.

The Contractor in excavating for trenches shall ensure at material suitable for backfilling around and over pipes as described above shall be set aside for this purpose. Material set aside for future use, as backfill should be screened to ensure that it is free from stones. This backfill must be approved by the Engineer before reuse. Where the material excavated from the trench is unsuitable for backfilling, this shall be removed from the site and suitable material imported.

Trench backfill above the pipe zone will be divided in o the following classes: -

CLASS A: Backfill the entire depth of the trench above the pipe zone with the trench excavated material place din 6-inch layers. Compact every layer by means of mechanical tampers or vibratory compactors to 95 pe cent maximum density as determined by ASSHTO T99, bring the fill to the required surface grade, and compact so that no settlement will ccur.

CLASS C: After completion of backfilling the pipe zone, excavated trench material may be pushed back into the trench by mechanical means The requirements for topsoil shall apply to all trenches in lawn and garden areas.

Where **class C** backfill is used in untravelled areas on private or public street or road rights-of way, leave the trench with the backfill material neatly mounded not more than 6 inches above the existing ground for the full width of the trench. When class C backfill is us d under travelled portions of streets and lawn or garden areas, the trench shall be backfilled and maintained level with the existing grade. In all cations where class C backfill is used, the Contractor shall make hi own estimate of the amount of backfill material required at the trench so at after normal settlement has occurred, the finished surface will mee the existing grade. Neatly windrow the material over the trench, and remove all excess. Any excess or deficiency of backfill material which becomes apparent after settlement and within the warranty period shall be corrected by regrading, disposal of excess material, and adding additional mat ial where required.

. **CLASS B**: Backfill the entire trench above the pipe zone with gr nular backfill material in lifts not exceeding 8-inch loose depth and compact each lift to 95 percent maximum density as determined by AASHTO T99, with mechanical vibrating or impact tampers.

Maintain the surface of the backfilled trench level wi the existing grade with a single layer surface dressing until the permanent pavement replacement is completed or the entire project is acce ed by the owner.

CLASS D: Backfill the trench above the pipe zone with excavated aterial to a depth of 9-inches below the ground surface. Place a minimum of 9-inches of 3/4" granular backfill material as specified over the entire trench surface and compact to 95 percent maximum density as determine by AASHTO T99.

(d) Opening and Reinstatement of the Surfaces

If the work of reinstatement as carried out by the Contractor is not to the satisfaction of the Engineer and/or the responsible Authority and should the Contractor not remedy the defect forthwith any remedial work considered necessary may be undertaken by the Engineer and/or responsible Authority.

If at any time any trench becomes dangerous, the Engineer shall be at liberty o call on the Contractor to restore it to a proper condition at thre hours' notice.

(e) Taking Delivery of and handling Pipes, etc.

Pipe covers, wooden discs and other transit projections fixed by the pipe and other manufacturers shall be retained in place until the pip fittings, etc. are inspected shortly before they are laid.

(f) Proprietary Joints and Couplings

The contractor shall make himself and his employees acquainted with and comply with the instructions issued by the manufacturers of the various types of proprietary joints and couplings supplied for incorporation in the works. The Contractor shall be responsible for obtaining copies of any such instructions, which are n issued to him by the employer.

(g) Examination of pipes prior to Laying

After taking delivery of pipe fittings, etc. and befor being laid, the contractor shall carefully examine each pipe fittings, etc. as detailed in the fo lowing sub-clauses to ascertain damage or defect revealed by this examination shall be remedie to the satisfaction of the Engineer of his Representative.

All metal and PVC pipes and fittings which are severel dented or similarly damaged shall be discarded unless, in the opinion of the Engineer's Representative, a portion of such pipe or fitting may usefully be salvaged in which case the ontractor may cut off and discard the damaged portion only.

The Contractor shall at his own expense carry out such repairs as are approved by the Engineer's Representative. Immediately prior to the laying, the ontractor shall afford facilities to the Engineer's Representative to examine all pipes, fittings, etc.

(h) Pipe laying Levels, Gradients, Etc.

All pipes, etc. shall be careful lowered to their final positions. Pipes shall be laid true to alignment curve and gradient. The minimum gradient of and a minimum cover to the pipes shall be as shown on the drawings or as otherwise agre upon.

Where gradients are slack or where invert levels are shown on the drawings, the pipes shall be boned to even gradients.

Pipes laid underground in trenches shall be laid and be solidly bedded on an even and uniform bed, and if considered necessary by the Engine r's Representative, fine screened material shall be placed and consolidated in the trench bottom and shall be as all as possible and shall be filled in compactly after pressure-testing and before the refilling of the trench is completed.

The Contractor shall take all steps necessary including pumping to ensure that the trench is kept reasonably dry during pipe laying and that no dir y water or other extraneous matter entering the pipes, the contractor shall immediately carry out the necessary cleaning as may be directed by the Engineer's Representative.

(i) Valves and Valves Boxes or Vaults

Valves and other fittings shall be securely fixed. Th y shall be tested for ease of operation and water tightness. The valve glands shall be re-packed where necessary. Any damaged protective coating shall be made good and it shall be left clean in all respects.

Each gate valve buried underground will be provided with a surface box of suitable size to allow for satisfactory operation. This valve box will be placed directly over the gate valve with its top surface level with the finished ground level.

All valves installed on the water mains will be enclosed in a suitable chamber as detailed in the Drawings. Excavation and backfill will be in accordance with the Specifications or as otherwise agreed upon. The top slab of the chamber will consist of a 100 mm precast concrete slab with a cost iron surface box centred dir ctly over the valve. Valve boxes for Fire Hydrants will be installed as specified by the manufacturer.

(j) Concrete Anchorage

All plugs, caps, tees and bends shall be provided with a reaction backing which ma be a thrust block or anchorage to prevent the movement of f tings or joints as shown on the Drawings or as specified herein or as directed.

Backing shall be placed between solid ground and the fittings to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown on the drawings or as directed by the Engineer. The backing shall be so placed that the pipe and fitting joints will be accessible for repair. In all instances, the concrete anchorage shall be placed against undisturbed ground and the contractor will be held res sible for furnishing and placing additional concrete which may result form unauthorised or improper excavation.

(k) River and Stream Crossings

Before any work may be performed in any river or stream, the method of operation and the schedule of such work shall have the prior written approval of the Engineer.

Mechanised equipment shall enter streams only when necessary and within the immediate work area.

Stream flows shall be diverted around the work by means of a coffer-dam and culvert or other suitable alternate means, approved by the Engine r, which allows for a minimum of stream downstream of the construction site.

(l) Tests for Water Piping

The piping system will be pressure tested before all such work is concealed. The contractor testing a system or a section thereon will: -

1. Conduct the test at a water pressure not less than 1½ times the working pressure.

   Ensure that all air is expelled from the system before the outlets are closed nd that all outlets thereafter are tightly closed.

2 Subject the system to the test pressure for 24 hours a d ensure by visual examination and gauge test that no water is leaking or eeping out from any pipe, joint or fitting.

3. After all equipment and fixtures are set and connected, the contractor shall adjust the various supply valves, so that the proper delivery is obtained at all fixtures.

6.0 PAVEMENT REPAIR

6.1 Description

The work under this section includes the repair to all existing paved roads and the materials and methods of construction of curbs and drain.

6.2 Materials

The materials for the sub-base/base course/surface shall be obtained from approv d borrow areas, quarries and rivers.

The Contractor shall provide to the Engineer all such amples, test results and other information as may be required well in advance of the excavation of such material and also during the construction of the works. The Contractor s all use only such material as approved by the Engineer.

6.3 Aggregate For Base Course And Surfacing

Aggregates shall be obtained from sources approved by the Engineer. Crushed rock shall be produced from sound unweathered rock. Samples of s nd and stone shall be obtained for specified tests to be carried out before any quarried are opened up or the main orders are finally placed. Laboratory check tests shall be made of the aggregates from time to time to confirm their suitability. The aggregates shall confirm in all respects with the requirements of BS 882: 1983 "Aggregates from Natural ources for Concrete."

The aggregate shall be subjected to 5 alternations of AASHTO Sodium Sulpha e Soundness test T104. The weight loss shall be not more than 12% mass. Where the presence of the weathering rock is suspected, petrographic test shall be carried out to determine the proportion of secondary minerals present.

The "ten per cent fines" value of coarse aggregate det rmined in accordance with BS 812: Part 3 - 1975 shall not be less than 8 tonnes, and not less than 5 tonnes on a soaked specimen. Alternatively the aggregate crushing value etermined in accordance with BS 812: Part 110 - 1990 shall not exceed 35%, and shall not exceed 40% on a soaked specimen.

6.4 Aggregate For Base Course

The aggregate for base course shall comply with the general requirements above with the following additional requirements.

The flakiness index of the aggregate determined in accordance with BS 812 shall not exceed 35%. The number of rounded stones in the sample used for the flakiness test shall not exceed 20% of the total number of stones in the sample.

6.5 Aggregate For Surfacing

The aggregate for surfacing shall comply with the gene al requirements above with the following additional requirements.

The flakiness index of the aggregate, determined in accordance with 812 shall not exceed 30%. The number of rounded stones in the sampl used for the flakiness test shall not exceed 20% of the total number of stones in the sample. The elongation index of the aggregate, determined in accordance with BS 812 shall not exceed 35.

The minimum polish stone value shall be 60 as determined in accord nce with BS 812. The Engineer may request the Contractor to carry out t o determine the polished stone value of the aggregate at no extra cost to the Contract.

6.6 Chippings For Prime Coat

Chippings for prime coat shall be 6 mm chippings or cl n sharp sand of 6 mm maximum size with not more than 20% passing a 600 micron sieve.

6.7 Bitumen

Bitumen for the priming coat shall be MCO (MC30) and RS1 (RS70) for the ack coat both complying with AASHTO designation M82, or similar approved cut-back bituminous emulsion as appropriate.

Bitumen for dense bitumen macadam shall be straight run bitume f 60/70 penetration to BS 3690.

6.8 Filler

If filler is approved for use it shall comply with BS 987.

6.9 Water

The Contractor shall make his own arrangements to provide and ensure a sufficient supply of approved water.

In general water for construction purposes shall conform to the following standards:-

(a) Water shall be fresh and free from all sediment and di solved or suspended matter, which may be harmful to the work. Brackish water may be approved for washing sand and aggregate. Water samples for the intended source of supply may be taken by the Engineer for analysis before any work is commenced and at intervals throughout the duration of the contract. If at any time samples prove unsatisfactory the Contractor will be required at his own cost either to change to a new supply or to make arrangements acceptable to the Engineer to remove the offending matter. The Contractor shall state the source or sources from which he proposes to obtain water and submit evid nce to show that an adequate supply is assured.

(b) Water for drinking, sanitation and other non-constructional purposes shall be approved by the Engineer.

7.0 STORAGE TANK

7.1 General

7.1.1 Scope of Work

Supply and erect cylindrical Glass-Fused-to-Steel bolted water storage tank, including foundation, tank cover, tank structure and appurtenances as shown on the Engineer's s and described herein.

All labour, materials, plant, equipment and tools, as uired for the construction of the storage tank shall be included.

7.1.2 Definitions[1]

Capacity: The net volume that may be removed from a tank filled just to the top capacity level and emptied to the bottom capacity level. The bottom acity level shall be the water level in the tank shell when the tank is emptied through the sp ied discharge pipe.

Constructor: The party that furnishes the work and materials for placement or installation.

Manufacturer: The party that manufactures, fabricates, or produces *materials* or products.

Purchaser: The person, company, or organisation that purchases any materials or work to be performed.

Reservoir: A flat-bottom cylindrical tank having a shell height equal to or smaller than its diameter.

Standpipe: A flat-bottomed cylindrical tank having a shell height greater than its diameter.

Tank: A standpipe or reservoir used for water storage.

7.1.3 Responsibilities of Parties[1]

Manufacturer's responsibility: The Manufacturer shall furnish a tank structure free of defective materials, including coatings.

Bidder's responsibility: The Bidder shall offer new tank structures as supplied from a Manufacturer specialising in the design, fabrication and erection of factory applied Glass-Fused-to-Steel, bolted sectional tank systems. The Manufacturer shall own and operate its own production plant, fabricate and glass coat the tank pl tes at one location so as to provide full quality control responsibility over product.

Purchaser's responsibility: The Purchaser shall allow access to the *structures* at the request of the Manufacturer or the Bidder for the purpose of inspection, if required.

7.1.4 Submittal Drawings, Calculations and Specifications

Construction shall be governed by the Owner's plans and specifications showing general dimensions and construction details, after approval by the Engineer of submittal drawings prepared by the Manufacturer. There shall be no deviation from these drawings d specifications, except upon written order or approval om the Engineer. As a minimum, the submittal drawings shall show:

a. Dimensions, description of materials and other pertine information.

b. Joint and foundation attachment details.

c. Tank assembly (general arrangement drawing) with positions of appurtenances.

d. Details of appurtenances.

e. Roof details (if applicable).

f. Floor details (if applicable).

The Bidder is required to furnish, for the review and approval by the Engineer, 4 No sets of construction drawings for all work not shown in complete detail on the bidding drawings. A complete set of structural calculations shall be provi d for the tank structure. All such submissions shall be authorised by an engineer employed by the Manufacturer.

When approved, two sets of such prints and submittal i mation will be returned to the Bidder marked "APPROVED FOR CONSTRUCTION" and these drawings l then govern the scope of work detailed thereon. The approval by the Engineer of the Manufacturer's drawings shall be on approval relating only to their general conformity h the bidding drawings and specifications and shall not guarantee detailed dimensions and quantities, which remains the Bidder's responsibility.

The Manufacturer's standard published warranty shall b included with the submittal information.

The Bidder is to include the Manufacturer's standard Inspection and Maintenance Manual upon receipt of approved drawings.

7.2 Design Criteria

Tank Size

The tank shall have a nominal diameter of 11.10m (36 ft), with a nominal shell height of 7.03m (23 ft).

Tank Capacity

Tank capacity shall be 680.10 m^3 (149,600 UK Gallons) with 7.03m (23 ft) water depth.

Design Standards

The tank materials, design, fabrication and erection of the tank shall conform to the 'AWWA STANDARD FOR FACTORY-COATED BOLTED STEEL TANKS FOR WATER STORAGE' – ANSI/AWWA D103-97.

The Glass-Fused-to-Steel coating system shall fully conform to Section 10.4 of ANSI/AWWA D103, latest revision.

The tank and all materials in contact with the stored water shall be certified and listed by the National Sanitation Foundation (NSF) to meet ANSI/NSF Additives Standard 61.

Design Loads

Specific Gravity = 1.0.

Design (guaranteed) Freeboard = 0.60 m (2 ft).

Wind speed = 67.06 m/s (150 mph) – AWWA D103 Standard is 100mph (44.7m/s).

Allowable Soil Bearing Capacity = 143.64 KPa (3000 psf) – To be furnished in Engineer's Soils Report.

Earthquake Seismic Zone 3 - In accordance with AWWA D103, latest revision (Zones 0, 1, 2A, 2B, 3 or 4).

7.3 Materials

Structure Bolts

Bolts used in tank lap joints shall be ½" – 13 UNC-2A rolled thread, conforming to ASTM A325[2] and A490[3].

Bolt Strengths:

ASTM A325 Compliant Bolts:

(a) Minimum Tensile Strength – 120,000 psi (827 MPa)

(b) Minimum Proof Load – 85,000 psi (586 MPa)

(c) Minimum Allowable Shear Stress with threads excluded from the shear plane – 30,000 psi (207 MPa)

ASTM A490 Compliant Bolts:

(a) Minimum Tensile Strength – 150,000 psi (1034 MPa)

(b) Minimum Proof Load – 120,000 psi (827 MPa)

(c) Minimum Allowable Shear Stress with threads excluded from the shear plane – 37,500 psi (259 MPa)

Bolt finish to be hot dipped galvanised coating.

Bolt Head Encapsulation:

(a) All structure bolts shall have ultraviolet resistant polypropylene encapsulation of the bolt head.

(b) Bolt head encapsulation shall be certified to meet ANSI/NSF standard 61[4] for indirect additives.

All lap joint bolts shall be properly selected such th threaded portions of the bolts will not be exposed to the shear plane between tank sheets.

All bolts for the tank shell and optional Glass-Fused-to-Steel roof shall be installed such that the head portion is located inside the tank, and the nut and washer are on the exterior.

Bolt lengths shall be selected to achieve a neat and u orm appearance. Excessive threads extending beyond the nut after torquing will not be permitted.

The torque values (as set down in the Manufacturer's C truction Guide) shall not be exceeded during tank construction.

All lap joint bolts shall be designed to prevent rotating during tightening.

Plates and Sheets

Plates and sheets used in the construction of tank shell, optional steel floor and optional steel roof shall comply with the minimum requirements of Section 2.4 of AWWA D103-97.

All steel plates and sheets shall be sourced from reputable international steel mills, and produced by a hot rolling process.

Raw materials delivered to the Manufacturer's plant shall be tested/inspected to ensure compliance with the Manufacturer's requirements for st ngth and chemical composition.

Typical Test Certificates and Certificates of Conformity shall be available for the Engineer's inspection if required. Such Certificates all be requested at the time of issue of the Purchase Order.

Mild strength steel shall conform to ASTM A1011 SS Grade 33[5].

High strength steel shall conform to ASTM A1011 Grade Class 1 or ASTM A1011 Grade 60 class 1.

When multiple vertical bolt line sheets and plates are used, the effective net section area shall not be taken as greater than 85% of the gross area, as required by AWWA D103-97, Section 3.5.2.

The annealing effect created from the glass coated fir ng process shall be considered in determining steel ultimate and yield strengths.

Structural Shapes

Material shall conform to the minimum requirements of ASTM A36[6].

Horizontal Wind Stiffeners

Where a roof is specified within the scope of supply, he top stiffener shall provide a flat, horizontal, continuous surface at tank rim level.

Where an open topped tank is specified within the scope of supply a variation of top stiffeners may be utilised (internal and external) to suit the specific application.

Wind stiffeners shall be steel, hot dipped galvanised, rolled steel angle or web truss types.

Sealant

The sealant shall be used to seal lap joints, bolt connections and sheet edges.

The sealant shall cure to a rubber-like consistency and have excellent adhesion to the glass coating, have low shrinkage and be suitable for interior and exterior exposure.

The sealant shall be a one component, moisture cured, polyurethane compound.

EPDM or Neoprene gaskets and tape type sealer shall not be used other than for shell access manway door.

The sealant shall be suitable for contact with potable water and be compliant to NSF Standard 61 for indirect additives.

7.4 Glass Coating

Surface Preparation

Sheets shall be steel grit-blasted to a silver grey finish on both sides to remov mill scale and surface oxidation.

Grit blasting shall be performed to the equivalent of SSPC SP10[7], as required by AWWA D103-97, Section 10.4.1.

The surface anchor pattern shall be in the range of 0. 0 mil) to 0.10mm (4.0 mils), with a target value of 0.06mm (2.4 mils).

Cleaning

Immediately after fabrication and grit blasting and prior to application of the coating materials, all sheets shall be thoroughly cleaned by an alkali wash.

Following the alkali wash all sheets shall be rinsed in hot water containing a nitrite based rust inhibitor.

The rust inhibition process shall be followed by heat drying to ensure the sheets are clean and dry ready to be coated.

Coating

All sheets shall receive a coat of catalytic nickel ox de based pre-coat to both sides, as required by AWWA D103-97, Section 10.4.2.1. The pre-coat application weight is controlled and measured and sheets that do not meet the required specification, in accordance with the Manufacturer's specified parameters, shall be rejected at this point.

All pre-coated panels shall be heat dried to ensure that a moisture free surface has been achieved before the final coating is applied.

A coat of cobalt rich glass slip shall be continuously applied to both sides of the sheet followed by heat drying.

The coated panels shall be visually inspected and sheets with spray or glass defects shall be rejected at this point.

The thickness of the coating system shall be measured using an electronic instrument; the instrument shall have a valid calibration record. Int rior and exterior dry film coating thicknesses shall be between 0.15mm (6.0 mils) and 0.48mm (19.0 mils) as required by AWWA D103-97, Section 10.4.2.2. Sheets that are not within the Manufacturer's specified parameters shall be rejected at this point.

After inspection sheets shall be fired through the furnace at approximately 850°C (1562°F) in accordance with the Manufacturer's approved procedures and as required by AWWA D103-97, Section 10.4.2.3.

Tank internal sheet colour shall be as specified by the Manufacturer. Tank external sheet colour shall be Blue (Munsell 5PB 2/4, RAL 5013, BS 4900 20-C-40) or Green (Munsell 2.5GY 2/2, RAL 6006, BS 4900 12-B-29).

Sample tests shall be carried out by the Manufacturer ensure that enamel materials meet the physical properties and chemical resistance characteristics as published in the Manufacturer's specification.

Inspection

Inspection procedures shall be carried out within the Manufacturer's plant under ISO 9001:2000 Quality Systems[8].

Colour Measurement:

(a) A colorimeter shall be used to measure the external sheet surfaces. Electronic colour control shall be used to ensure that allowable colour uniformity is achieved within the Manufacturer's specified parameters. Sheets of a colour outside of these limits shall be rejected.

(b) The instrument used shall have a valid calibration record and shall be regularly checked against the Manufacturer's approved calibration standard.

(c) Colour measurement frequency shall be every 15 minutes and every colour and sheet thickness change.

Glass Thickness Measurement:

(a) Finished sheets shall be inspected for coating thickne using an approved electronic instrument suitable for a measurement range of 0 - 0.50mm (0 - 20.0 mils).

(b) The instrument shall have a valid calibration record and shall be regularly checked against the Manufacturer's approved calibration standard.

(c) The thickness of the glass coating shall be maintained in the range specified in AWWA D103-97 section 10.4.2.2. Sheets that have a thickness out e of these limits shall be rejected at this point.

Coating Inspection – External Surface:

(a) The external/non-contact surfaces of all sheets shall be inspected visually under good daylight (or equivalent lighting) for defects in the glass coating.

(b) Any sheet having visible defects larger than 1.0mm (0.04") shall be rejected. Any sheet having more than 3 visible lesser defects per square yard of external surface shall be rejected.

(c) Any visible defects on the external surface of accepted sheets shall be repaired to the Manufacturer's approved procedure.

Coating Inspection – Internal Surface:

(a) Voltage testing shall be performed on the contact surf ces of the finished sheets in accordance with ASTM C 537 – 87 (Re-approved 2004)[9] and BS EN 14430[10]. The voltage test shall be used to identify any discontinuities in the glass contact surfaces.

(b) Inspection shall be carried out using a sampling procedure complying with ISO 2859: Part 1[11].

(c) The Tester shall have an accuracy of ±1% at the test probe and shall have a valid calibration record.

(d) Only finished sheets with zero glass continuity defect on the contact surfaces shall be released for packing. Sheets containing any discontinuities on the contact surfaces shall be rejected.

Chemical Resistance Testing:

Production specimen shall be tested in accordance to the following:

- PEI Test T-21[12].
- Clause 9 of BS EN 14483-1:2004[13] – Citric Acid at Room Temperature.
- Clause 10 of BS EN 14483-2:2004[14] – Boiling Citric Acid
- Clause 13 of BS EN 14483-2:2004 – Boiling Distilled or Demineralised Water.

- Clause 9 of BS EN 14483-4:2004[15] – Hot Sodium Hydroxide.

Chemical resistance tests shall be conducted on a monthly or annual basis in accordance to the Manufacturer's specifications.

Physical Property Tests:

(a) Adherence tests on production specimen shall be in acc nce to BS EN 10209 Annex D[16].

(b) Impact tests on production specimen shall be in accord nce to ISO 4532[17].

(c) Scratch hardness tests on production specimen shall be in accor o EN 101[18].

(d) Physical property tests shall be conducted on a monthly basis in accordance to the Manufacturer's specifications.

An owner's representative may be present during these inspection procedures at their own cost.

Packing

All finished sheets shall be handled within the manufa turing plant using magnetic or suction pads.

All approved sheets shall be protected from damage prior to packing for shipment.

Heavy paper sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion.

Individual stacks of panels shall be wrapped in a spec fied heavy duty plastic and steel banded to special pallets built to the roll radius of the tank panels where necessary. This procedure eliminates contact movement of finished panels during shipment.

Transportation of finished products shall be by dedicated haulier.

7.5 Erection

General

Field erection of the Glass-Fused-to-Steel bolted water storage tank shall be in accordance with the procedures outlined in the Manufacturer's Construction Guide and performed by an Authorised Distributor of the Manufact rer, regularly engaged in erection of these tanks or a suitably qualified specialist sub-contract builder under the control and supervision of the Authorised Distributor.

Levelling of the starter ring (or first full ring) shall be required and the maximum differential elevation within the ring shall not exceed 2.8mm (0.11"), nor shall it exceed 1.0mm (0.04") within any 914mm length (3ft).

Specialised erection jacks or building equipment as specified by the Manufacturer shall be used to erect the tanks.

No backfill or mechanical loads shall be placed on the tank side wall without prior written approval of the Manufacturer. Any backfill shall be placed according to the instructions of the Manufacturer.

Particular care shall be taken in handling and bolting of the tank panels, structural items and ancillaries to avoid abrasion of the coating system.

Bolting and Sealants

All bolts are to be located and tightened in accordance with the procedures outlined in the Manufacturer's Construction Guide.

All sealants are to be applied in accordance with the rocedures outlined in the Manufacturer's Construction Guide.

Coating Inspection and Repair

All surface areas may be visually inspected by the Engineer during constr ction and prior to liquid tests.

An electrical Holiday test shall be performed on all c act surfaces of the shell plates during or following construction using a 9-volt leak detection device. Any electrical leak points found on the contact surface shall be repaired n accordance with the Manufacturer's Inspection and Maintenance Manual.

After completion of the tank build and liquid tests, the Engineer shall sign the Manufacturer's standard Certificate of Satisfaction issued by the Authorised Distributor.

7.6 Foundation Design

Foundation Design Requirements

The tank foundation is a core aspect of the tank design. The foundation design is the sole responsibility of the Manufacturer; the Manufacturer is responsible for the base design. A suitably qualified geotechnical engineer must establish the foundation design and the foundation specification.

The tank foundations shall be based on the soil bearing capacity as detailed in section 2.4.4 of this specification. All earthquake factors are to be considered. The information required for the design is to be supplied free of charge by the Engineer prior to the bid date. All information is to be certified by a licensed Engineer.

The Manufacturer will provide data on the live and dead loading of the bolted wat r tank.

7.7 ROOF

Small Diameter Roofs

Tanks with diameters of 4.269m (14ft) to 9.393m (31ft) shall include roofs with either radially sectioned Glass-Fused-to-Steel or Stainless Steel (grade 316) plates utilising the same fixings and sealant as the tank shell.

The roof shall be free span and self-supporting.

The roof shall be equipped with a 610mm (24") roof ope nspection purposes.

The roof shall be air limiting and equipped with suita venting for air displacement when the tank is filled and emptied so as not to allow an internal pressure or vacuum.

All venting shall be screened to prevent bird / animal entrance.

Large Diameter Roofs

Tanks with diameters greater than 9.393m (31ft) and up to 18.897m (62ft) shall include either a radially sectioned Glass-Fused-to-Steel roof utilising the same fixings and sealant as the tank shell or an aluminium dome structure of interlocking construction. Tanks with diameters greater than 18.897m (62ft) shall only include an aluminium dome structure of interlocking construction.

The roof shall be free span and self-supporting.

The live loads of the roofs shall be fully considered in the tank design.

The roof shall be fully vented and shall include a sui bly sized vent in the centre so as not to allow an internal pressure or vacuum.

All venting shall be screened to prevent bird / animal entrance.

7.8 Accessories

Inclusion and Location of Accessories

All accessories are to be included and located as detailed on the Engineers drawings.

Pipe Connections

Pipe connections penetrating through the tank panels a to be pre-cut in the Manufacturer's facility.

Where the location of pipe connections is unconfirmed due to site restrictions or added after the opportunity to factory cut has passed, they shall be field located accordance with the Manufacturer's Construction Guide.

All pipe connections through the tank shell shall utilise the same fixings and sealant as the tank shell.

Overflow piping shall be 150 mm (6 inches) in diameter and shall include an external overflow down pipe of 7.03m (25 ft) in length.

Outside Tank Ladder

An outside tank ladder shall be furnished and installed as detailed in the Engineer's drawings.

Ladders shall be manufactured in accordance to Occupational Health and Safety Administration (OSHA 29 CF3 Part 1910)[19] requirements.

Ladders shall have a hinged and lockable anti-climbing device if required to conform to local safety requirements.

Shell Manholes

One manhole shall be provided in the first ring of the tank shell as detailed in the Engineer's drawings.

The manhole shall be minimum 610mm (24") in diameter up to a maximum of 800mm (31.5") in diameter and shall be suitably reinforced.

The manhole shall be hinged or fitted with a davit so as to allow opening without the need for additional lifting equipment.

Identification Plate

The tank shall be furnished with an identification plate that is fixed to the tank shell during construction. The identification plate shall list all relevant information for the Manufacturer to trace the tank in the future (serial number, model reference, date of manufacture and project number).

Cathodic Protection

The tank shall be supplied with a passive cathodic protection system.

7.9 Field Testing

Hydrostatic Testing

On completion of erection, Holiday testing (as detaile in section 5.3.2) and curing of the tank sealant the tank shall be tested for liquid tightness by filling with water to the overflow elevation and being observed over a 24 hour period.

Any leaks identified during this test shall be corrected in accordance with the Manufacturer's recommended method.

Water for the hydrostatic test shall be provided by the owner at the scheduled time of sealant curing and shall be free of charge. Disposal the water shall be the owner's responsibility.

7.10 Warranty

Materials and Coating

The Manufacturer shall provide a warranty for the tank materials and coating. This warranty shall cover against defects in material or wo kmanship for a period of 5 year and against manufacturing defects in the coating for a period of 5 years.

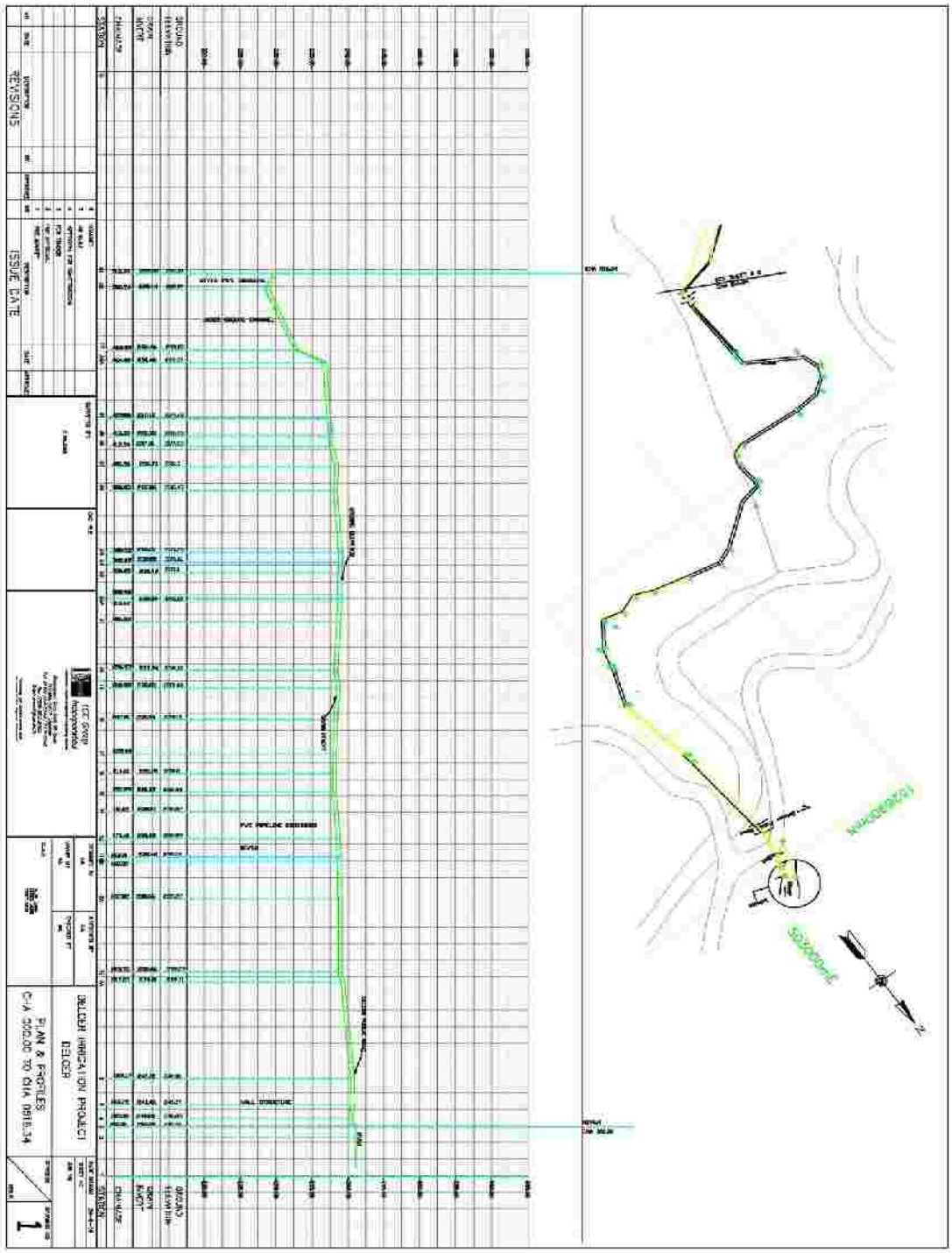
7.11 References

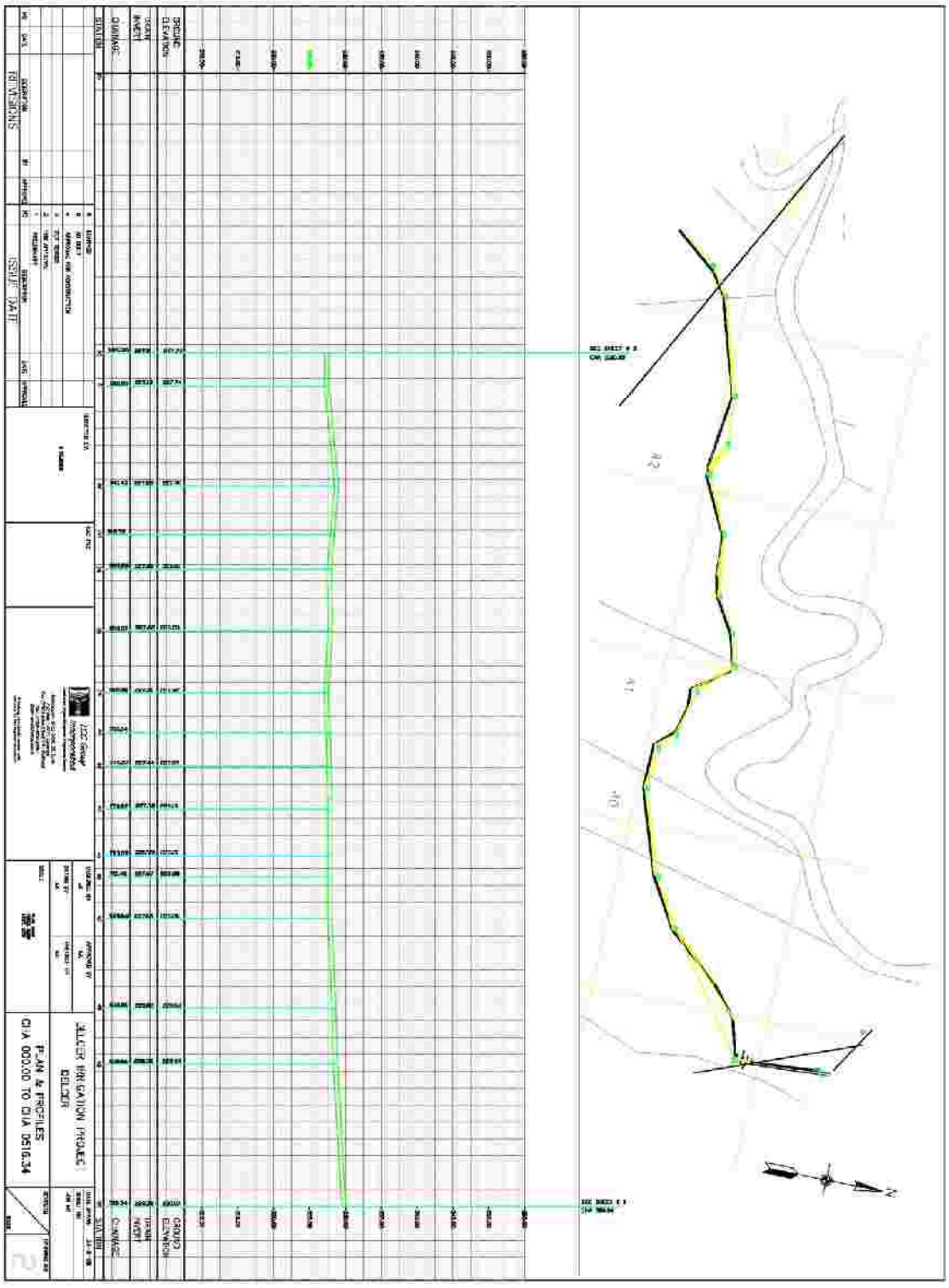
1. AWWA D103-97, AWWA Standard for Factory-Coated Bolted Steel Tanks for Water Storage.
2. ASTM A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
3. ASTM A490, Standard Specification for Structural Bolts Alloy Steel, Heat Treated 150 ksi Minimum Tensile Strength.
4. ANSI/NSF Standard 61, NSF International Certification olicies for Drinking Water System Components Health Effects.
5. ASTM A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
6. ASTM A36, Standard Specification for Carbon Structural Steel.
7. SSPC SP10 Surface Preparation Standard.
8. ISO 9001: 2000, Quality Systems, Specification for Design/Development, Production, Installation and Servicing.
9. ASTM C 537 – 87 (Re-approved 2004), Standard Test Method for Reliability of Glass Coatings on Glassed Steel Reaction Equipment by High Voltage.
10. BS EN 14430:2004, Vitreous and Porcelain Enamels – High Voltage Test.
11. ISO 2859:1999, Sampling Procedures for Inspection by Attribute: Part 1:1999, Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-By-Lot Inspection.
12. PEI Test T-21 – Test for Acid Resistance of Porcelain Enamels.
13. BS EN 14483-1:2004, Vitreous and Porcelain Enamels – Determination of Resistance to Chemical Corrosion – Part 1: Determination of Resistance to Chemical Corro by Acids at Room Temperature.
14. BS EN 14483-2:2004, Vitreous and Porcelain Enamels – Determination of Resistance to Chemical Corrosion – Part 2: Determination of Resistance to Chemical Corrosion by Boiling Acids, Neutral Liquids and/or Their Vapours.

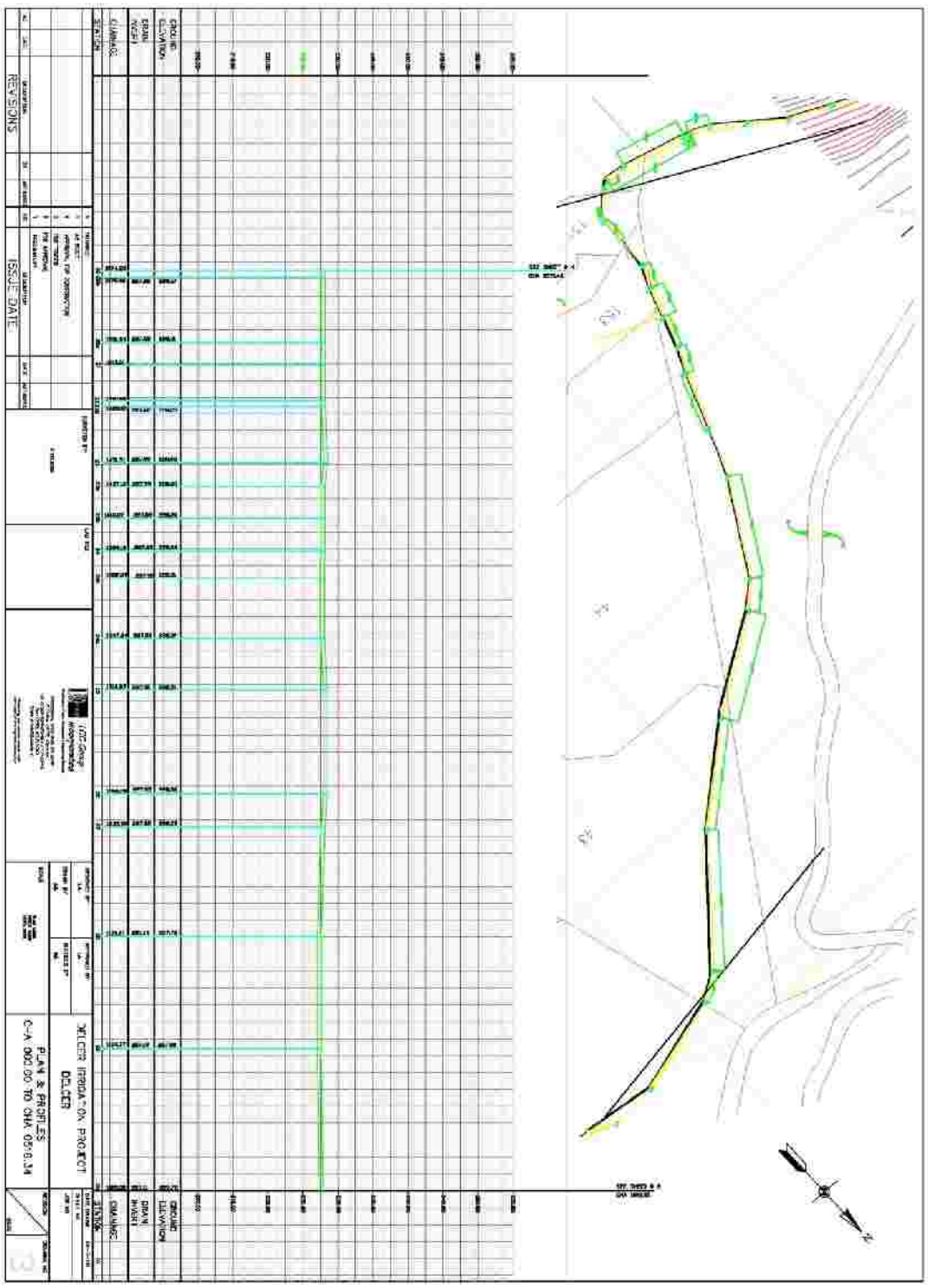
15. BS EN 14483-4:2004, Vitreous and Porcelain Enamels – Determination of Resistance to Chemical Corrosion by Alkaline liquids using a Cylindrical Vessel.
16. BS EN 10209:1996 Annex D, Cold Rolled Low Carbon Steel Flat Products for Vitreous Enamelling – Technical Delivery Conditions.
17. ISO 4532:1991, Determination of the Resistance of Enamelled Articles o Impact: Pistol Test.
18. EN 101:1991, Method for Determination of Scratch Hardness of Surface According to Mohs.
19. OSHA 29 CF3 Part 1910.27, Standard Specification for Fixed Ladders.
20. ANSI/AWWA C652-02, Disinfection of Water – Storage Facilities.

ANNEX IIB

SURVEY DRAWINGS



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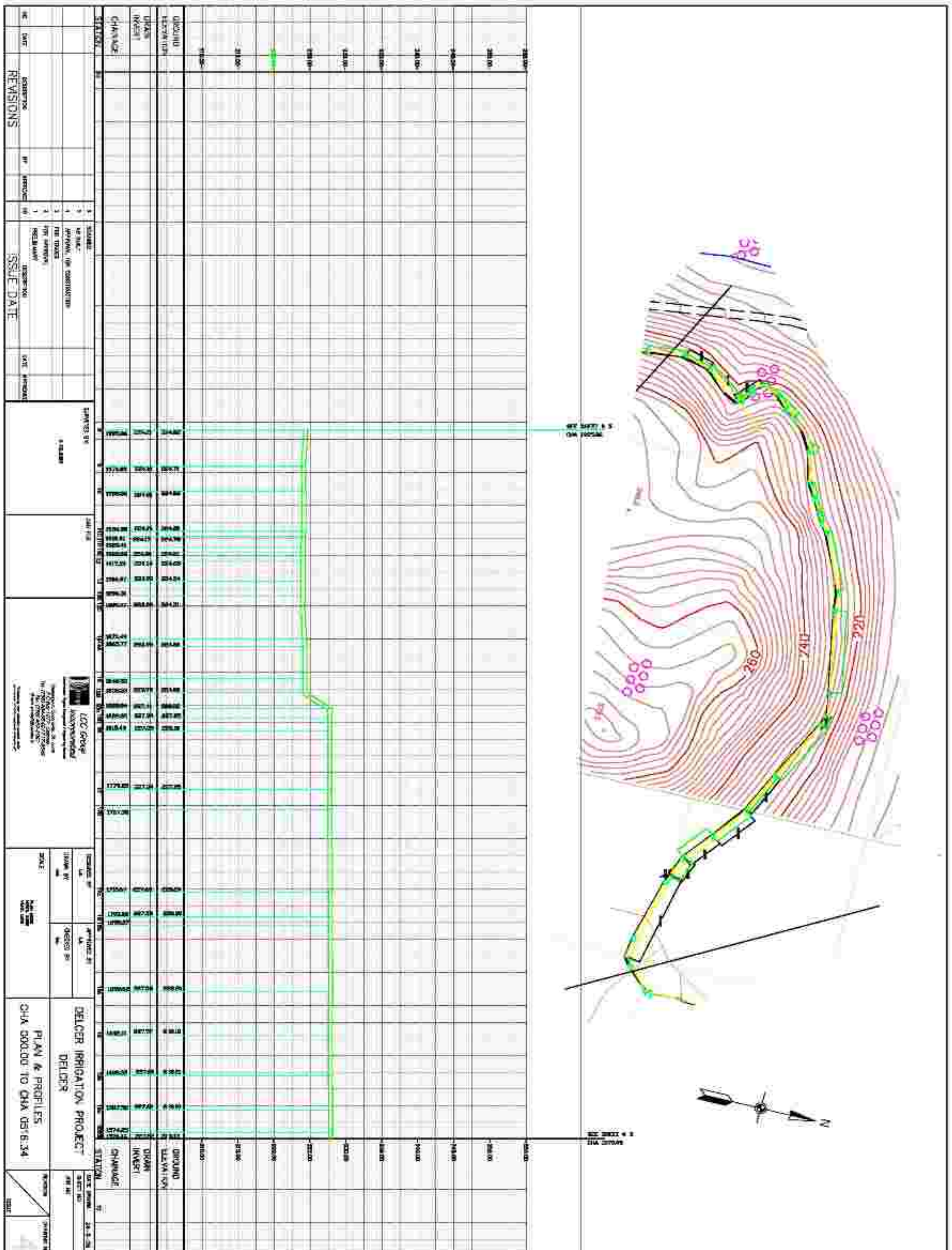
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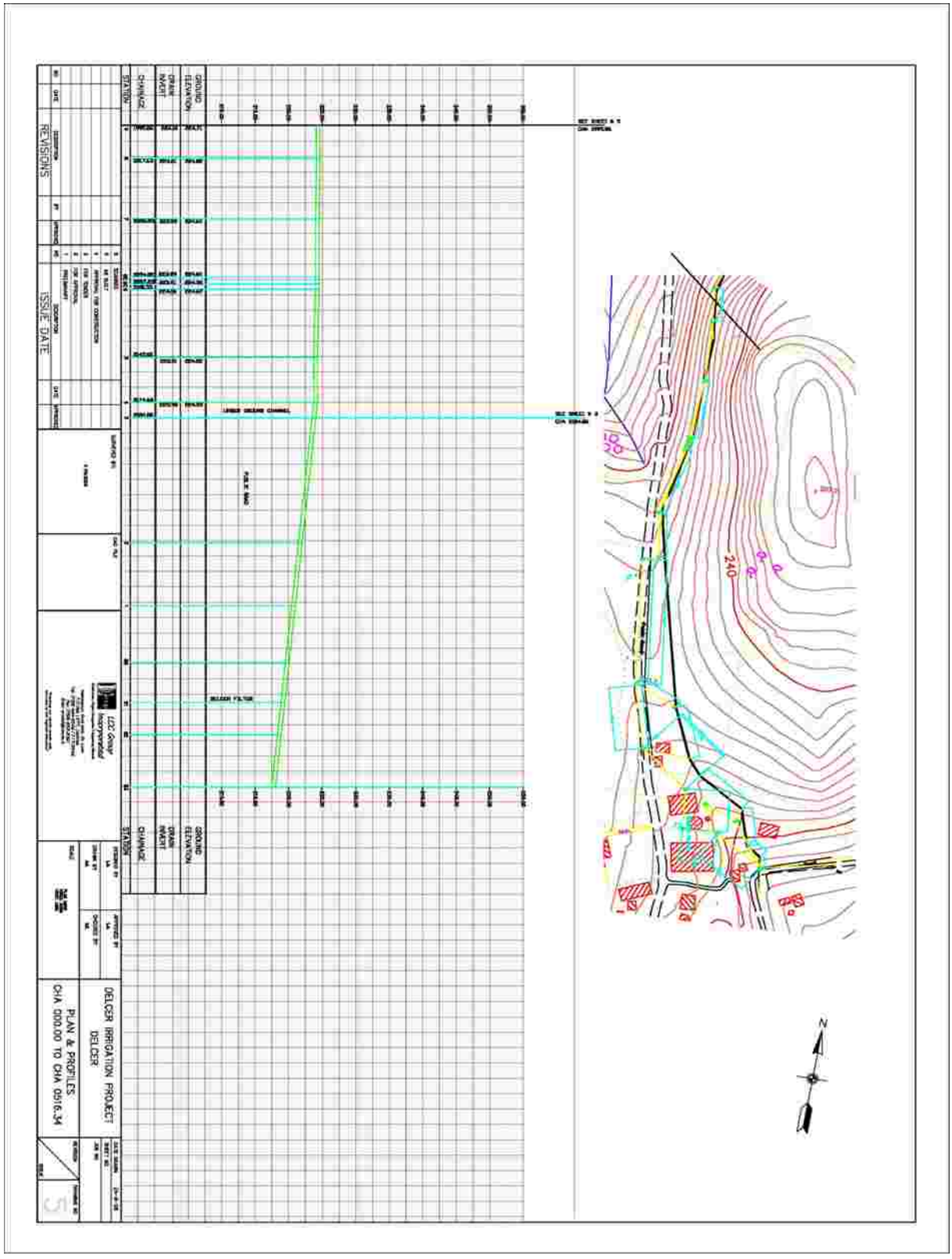
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