

Annexure - II

Technical Schedule

SCHEDULE FOR 230/66/20 K.V SUBSTATION , CIVIL WORK

The tender shall list below the principal details upon which his tender is based.

Any other items not listed under the item column shall be entered by the Tenderer

If PEEGT reject any material or finishing as being unsuitable; **No** claim for additional costs will be considered.

If any item is not applicable, the Tenderer should write (NONE).

| Item No. | Description | Unit | Tender Requirement | Submitted Offer |
|--|--|------|--|-----------------|
| PEEGT responsibility shall be restricted only to handle the site of substation, and the contractor shall undertake the complete works for preparing the site to commence with execution works. | | | | |
| | Materials | | All materials could be provided from <u>the available in local markets</u> of the best quality, PEEGT's staff accepts that, and the cost of these materials items & workmanship should be offered by local currency . | |
| | Doors | | Steel- double leaf -best manufacturar - wood-soild wood - best type . Aluminum - best and biggest sections - well known types . | |
| | Windows | | Aluminum & furnished with exterior Venetian blinds of louvered aluminum fitted with screen for the control room and offices(double glazed). | |
| | Glass | | Double glass for control room and offices- not less than 6 mm - colored (Blue - Greeny .. Or similar) | |
| | Internal wall finishing | | The concrete block walls, concrete walls and all columns shall be plastered and generally painted (three plaster coats and four oil paint coats after four base coats). Taking into consideration that walls of toilets, Kitchen, battery room and bath room should be covered with ceramic Tiles for complete height with the ceiling of toilets, Kitchen. | |
| | <i>furnishing of (PEEGT Offices) (Qty. & Type)</i> | | 1 Supervisor desk with swivel chair for the chief engineer with 4 arm chairs. 1 tables with lockable drawers and 2 swivel chairs. 1 Conference table about “ 1.5 × 3m “ with a sheet of glass 6 mm thick over it. With 8 upright chairs 1 Refrigerator not less than 0.5 m3 storage space. | |

| Item No. | Description | Unit | Tender Requirement | Submitted Offer |
|----------|---|------|---|-----------------|
| | <i>furnishing of (PEEGT Offices) (Qty & Type)</i> | | <p>2 Personal computer complete set (Table ,Ups ,Laser Printer, Monitor with flat screen 17 inch compatible with IBM) locale assembly with the last technical specification in the local market.</p> <p>All necessary book cases trays waste bins</p> <p>Suitable kitchen equipment for preparation of hot drinks sinks.</p> <p>- Digital document photocopying machine..., for documents having A3 size .</p> <p>- And two portable computer best quality complete set .</p> <p>- A telephone set for each room - best quality .</p> | |
| | Roof finishing for all buildings with slope about (1%) | | <p>- The concrete roof shall be finished as follow:</p> <p>- Foam concrete screed layer average 100 mm thickness with slopes and quitters.</p> <p>- Covered with cement plaster coat of 20 mm thickness.</p> <p>- Elastomeric bitumen (4 mm thickness) with non-woved glass fiber mat reinforcement. self-protection by colored granules under faced with sand</p> <p>- Protection cloth (water proofing).</p> <p>- Insulation material (5 cm).</p> <p>- Grushed gravel (5 cm) .</p> <p>- (River sources)</p> | |
| | Exterior Wall finishing for all buildings | | Granete tiles. | |
| | Control building | | Separate one . taking into consideration separate diesel generator room (see attached initial drawing) . | |
| | Length | m | App. 35 For separate control building | |
| | Width | m | App. 18 For separate control building | |

Remark :

Any equipement over roof shall be fixed over concrete foundation (like water tank ...) which should be heigher than water treatment materials not less than 5 cm and membrane sheets should cover it totally

| Item No. | Description | Unit | Tender Requirement | Submitted Offer |
|----------|--|------|---|-----------------|
| | Floors | | <p>Floor of the control room shall be covered with marble tiles.</p> <p>Floor of the electrical rooms, kitchen, and gate house shall be covered with Granete tiles.</p> <p>Floors of the corridors stairs (ifany), offices,bath room and toilets shall be covered with marble.</p> <p>The other floors shall be hardenerfloor coated with epoxy with suitable colour . (Water proofing shall be provided where needed.)</p> <p>Battery room should be covered with acid resistant tiles (walls, and floor) in addition to basin, sewage outlet.</p> | |
| | Ceiling | | The concrete ceiling shall be generally plastered and painted (three coats plaster and four coats of oil paint after four base coats). | |
| | WALLS | | Walls of control room covered by Granete tiles | |
| | Control Room ceiling | | Suspended | |
| | Corridors ceiling | | | |
| | Offices ceiling | | | |
| | Path room and kitchen | | <p>Shall be covered with ceramic tiles and Kitchen should be furnished at least by :</p> <ul style="list-style-type: none"> - Wall to wall granete or marble basin . - Down and up best quality coupebourds -Mixer and tab Grohe type or similar . | |
| | Fire detection(for control building) | | | |
| | System | | Smoke & fire detectors | |
| | Zone | | 8 zone min | |
| | 20 k v Hall ventallation | | (preferable package roof units) | |
| | 20 k.v building | | Area and height | |
| | Area of PEEGT offices Building (temporary Building) . | m2 | 75 | |
| | All underground Pipes (electrical purposes) | | UPVC | |
| | All Cooled and hot water Pipes | | Galvanized | |
| | Air Conditioning | | Type and source | |
| | Control room and protection -AC-DC | | (48000 BTU-2400 BTU)for unit capacity | |
| | For Others | | (24000 BTU -8000 BTU)for unit capacity | |
| | Control room | | Shall be conditioned | |
| | PLC -AC- DC | | | |
| | All Offices | | | |
| | Temporary Building | | | |

| Item No. | Description | Unit | Tender Requirement | Submitted Offer |
|----------|--|---------|--|-----------------|
| | Roads | | | |
| | Width of access and transformer roads | m | App. 6 | |
| | Width of sub road | m | App. 5 | |
| | Pavement width around Buildings and for main roads and materials | | Building -App- 1.5 m Main roads App -1- m | |
| | Capacity of the car park | car | App. 10 cars | |
| | With suitable shade protection | | | |
| | Concrete work | | | |
| | Min strength For structural | kg/cm2 | 210 | |
| | For watertight | kg/cm2 | 280 | |
| | National Design code | | | |
| | National Workmanship code & Material standards | | In addition to the Norms mentioned in the specifications the Syrian Arabic Code issued by Engineering Institution, with its annexes and Technical & General Specifications for Syrian Ministry Of Building And Construction , will be considered the main reference for All Civil Works (loads, design, material specifications and work's execution, etc...). | |
| | Site investigation | | Final soil technical report should be provide by contractor and final design will be accordingly , no extra cost will be valid to any case. | |
| | Number of boring | Qty | 8 at least | |
| | Depth of boring | m | 15 | |
| | Sanitary Equipment | | | |
| | Description of all type of sanitary equipment | | | |
| | Manufacturer | | Best quality of the available in local market grohe or similar . | |
| | Area of leveling and height of Back filling . | m2 m | | |
| | Level of : (considering ground level is 0.00) - Gravel - - Roads - - Pavements - - Buildings - | | 15 cm 25 cm 35 cm as design requirements . | |
| | Beasment height if any | | | |
| | Beasment wall protection | | | |
| | Cyclopean concrete | | | |
| | concrete | | Ready mix | |

| Item No. | Description | Unit | Tender Requirement | Submitted Offer |
|----------|---------------------------------------|------|---|-----------------|
| | Security system | | | |
| | 1-Watching system (Cameras) | | Out door use with protection case | |
| | Type | | Colored App. 1 lux | |
| | Range | | Best | |
| | 2-Two ways intercom | | Between main gate, gatehouse (temporary Building) and control room. | |
| | FireFighting System | | | |
| | Type & description | | | |
| | Water treatment | | | |
| | connecting with main sewage net | | S/S should be connected with main sewage net | |
| | Fire rating walls | | Buildings beside Transformers , and between transformers | |
| | Axis road | | from existing road till S/S gates | |
| | Transformers roads and rails . | | R. concrete with all technical requirements | |
| | Oil collecting pits | | preffered separated | |
| | Cable trenches | | R.C - covers - protection - - Cable trays. | |
| | Wall stiffeners | | | |
| | Leighting | | Materials and lux values . | |
| | Tifour Foundations . | | | |
| | Jacks Foundations . | | | |
| | Earthing system. | | | |
| | Leightning system. | | | |
| | Border R.C fence . | | Height(3m at least) covered with white local stone with suitable decorration . | |
| | Outer metalic gates . | | KG/M2 Fitted with personal entrance and having the ability of manual and electrical movement . | |
| | Accessoreis for outer gates . | | (- Interphone - Electrical Key and locker...) | |
| | Water tank | | Capacity (50m3 at least) Ground or high one withall needed accessories . | |

Annexure - III

1 PEEGT Specification - Volume 4 - Civil Works

2 Tender Drawings

- (i) Initial layout 230/66/20kV - Khan AlJouz
- (ii) Initial drawing Control Protection Auxiliaries Building
- (iii) Location of Khan Al Jouz substation
- (iv) Natural Levels drawing
- (v) Levelling & site drawing
- (vi) Riverside works drawing
- (vii) Initial drawing for R C retaining wall in the lower parts
- (viii) Initial drawing for R C retaining wall in the higher parts

**SYRIAN ARAB REPUBLIC
MINISTRY OF ELECTRICITY
PUBLIC ESTABLISHMENT OF ELECTRICITY
FOR GENERATION AND TRANSMISSION
(PEEGT)
STUDIES DIRECTORATE**

TENDER No. 303/2011

**(230/66/20) KV OUTDOOR
CONVENTIONAL TYPE**

**KHAN AL JOUZ SUBSTATION
IN LATTAKIA**

VOLUME 4


CIVIL WORKS

DAMASCUS 2011

VOLUME 4

CIVIL WORKS

| | |
|-----|--------------------------------------|
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| C.2 | Scope of civil works |
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| C.4 | Design requirements |
| C.5 | Materials and workmanship |
| C.6 | Annexes |



C.0 Location of the site :

C.0.1 KHAN ALJOUZ S/S at the West North of **SYRIA** about 50 km to the East of **LATAKYA** city .

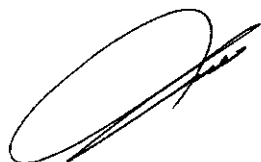
| No. | Description | Particulars |
|-----|---|-----------------|
| | Average air temperature yearly C° | 17 |
| | Average air temperature Max yearly C° | 24 |
| | Average air temperature Min yearly C° | 10 |
| | Average of absolute max temperature yearly C° | 43 |
| | Average of absolute min temperature yearly C° | -3 |
| | Average relative humidity % | 65 |
| | Airborne contamination | semi dusty wind |
| | Wind velocity (3 second gust) M/sec | 50 |
| | Ice loading, radial thickness mm | 10 |

C.0.2 Rainfall and Earthquake:

A– **Rainfall** Max yearly precipitation:

For substation site : About 900 mm.

B-**Observation** taken at S/S for seismic load – factor for seismic as Syrian Arabic code requirements .




C1 – General Information And Requirements

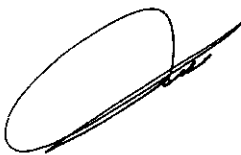


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C1.3.2 Buildings for contractor.

C1.3.3 Temporary facilities, equipment, work.... etc.

C.1.4- Setting out.

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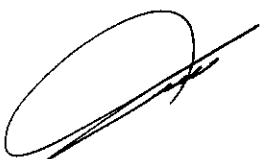
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C.1.5.3- Electricity.

C.1.5.4 - Telephone lines.

C.1.5-5- Documents , drawings and others to be submitted (with offer , after the contract awarded and during the work).



C.1- GENERAL INFORMATION AND REQUIREMENTS

C1.1- Civil work:

The civil work needed to be implemented under this contract is intended to cover the design, supply, delivery, supervision, testing construction, commissioning and guaranteeing of all civil works for (230 / 66 / 20) kv **OUTDOOR CONVENTIONAL substation**, including all various foundation buildings and facilities,etc . as a turnkey job FOR :

KHAN ALJOUZ S/S IN LATAKYA

C1.2- Site

C1.2.1- Location of the site :

In this specification "site" means the area contained within the security fence of the 230/66/20 substation, as mentioned in C.0 .

C1.2.2- Foundation conditions :

Foundation depth and type:

- KHAN ALJOUZ S/S .

- As an initial indication for s/s area soil layers, tenderer can prepare calculation by the following :

- The soil consists of :

- First layer - ≈ 0.35 m top soil (agricultural) .
- Second layer - 0.35- 6 m (and more) calcareous clay gray to brown mixed with gravel by 30-60% and considered a good layer for Foundations .
- The near by river will be flooded in winter and spring and the low part of the site could floded, So technical procedures should be taken to avoid that .

- The square and the rectangular footing can be relized , and it's advised to have special solutions for structures near the river .

Maximum bearing pressure ≈ 2 kg/cm² .

- Contractor shall protect the site from flooding especially for the low parts by :

- Backfilling for the low parts (as the recommendations for backfilling) to have a suitable level for the all site by rising the low parts , and to be accessable with the outer road .
- Construction of reinforced concrete walls by all the side of the river to stand the soil and backfilling and to Isolate S/S from the river and it's water .

Geophisic

Soil Thikness

Resistance

0-2 m

1000 Ω .m

> 2 m

100 Ω .m

-During contract stage PEEGT will provide extra information for soil report if any .

-Contractor shall make complete soil investigation report and make his final design accordingly , no extra cost will be valid .

C1.2.3- Climatic conditions, wind and earthquake:

- a- For Climatic conditions see C.0 .
- b- Observation taken at all substation site for seismic load should be taken as syrian arabic code requirements .

C1.2.4- Source of materials and disposal area, unless otherwise specified, all necessary materials for the construction **shall be furnished by the contractor.**

Materials could be provided form the avelable in local market of best types and qualities abroad manufactured or locally if equals **and the cost of these materials items & workmanship should be offered by local currency.**

Materials shall come exclusively and directly from sources and factories chosen by the contractor and approved by PEEGT , otherwise PEEGT may call at any time for samples of materials proposed for testing, so that all materials not corresponding in quality and not approved by PEEGT will be rejected, therefor the contractor must immediately remove from the site all rejected materials at his cost.

C1.3- Requirements of temporary work

C1.3.1- PEEGT Offices :

The contractor shall be responsible to, erect with all facilities, equip, maintain, guard, clean, heat & cool and light the temporary building for the use of the PEEGT or client staff together with access road and parking areas at substation.

The contractor shall submit detailed proposals of his intended arrangements for the approval of PEEGT .

The Office shall be erected having a total ground floor approximately 75 m2 and should be divided as follows:

- Chief resident engineer room.
- Conference room.
- Senior engineer 1 rooms.
- Two Male/female lavatories with eastern W.C, and two hand wash basins.
- Kitchen

Each room shall be heated and conditioned.

The contractor shall fully furnish these offices with the minimum requirements:

- 1 supervisor desk with swivel chair for the chief engineer with 4 arm chairs.
- 1 tables with lockable drawers and 2 swivel chairs.
- 1 conference table about " 1.5 m x 3 " with a sheet of glass 6 mm thick over it.
- 8 upright chairs.
- 1 refrigerator not less than 0.5 m3 storage space.
- 2 personal computer complete set (Table ,Ups , Laser Printer, Monitor with screen 17 inch compatible with IPM) **locale assemly and two portable computer complete set (studying directorate, civil section + project supervision)**
- All necessary book cases trays waste bins,
- Suitable kitchen equipment for preparation of hot drinks sinks.
- 1 digital document photocopying machine..., for documents having A3 size and fax machine .
- Telephone equipment in each room .

C1.3.2- Temporary buildings for contractor at substation:

The contractor shall provide, erect, construct and keep clean all temporary building, laboratories, sanitary conveniences, equipment, stores workshops, parking areas etc.

C1.3.3- Temporary facilities, equipment, works, and other facilities for the completion and maintenance of the work at the substation....., etc.

The contractor shall provide the necessary facilities, equipment, and instruments....etc., this include but not limited to the following major item:

- a- Site roads.
- b- Laboratory and testing equipment at the site.
- c- Temporary first aid room.
- d- Fire detection, alarm and fire fighting system.
- e- Temporary water supply and distribution.
- f- Temporary sewage collection and treatment system.
- g- Site lighting

Note : All temporary building with all facilities equipment, etc. will be the property of PEEGT at the end of the contract No. additional charges shall be made.

C1.4- Setting out: The contractor shall establish the markers to mark the final axis of each work and shall be responsible for the preservation of the markers if any of them are destroyed during the work, the contractor shall replace them at his own expense.

If necessary he shall establish secondary marker and perform all necessary setting out. PEEGT staff will be able to check their secondary markers and stakes but the approval does not release the contractor from his responsibility.

C1.5- Objects to be supplied or lend by PEEGT (or project owner) .

C1.5.1- Raw water:

Raw water will be supplied by PEEGT (or project owner) at the site of substation.

The contractor shall submit his requirements for raw water in his proposal.

The contractor shall perform a test of the analysis of raw water and shall treat it if necessary before his using and shall submit the result to PEEGT for approval.

C1. 5. 2- Temporary site:

Temporary site for work is lend by PEEGT (or project owner) for the duration of the contract (if possible) .

The contractor shall submit the total area and layout needed in his proposal.

This area which is to be cleaned up by the contractor and shall be handed over to PEEGT (or project owner) at the end of the contact.

C1. 5. 3- line 20 kV and transformer 20/0.4 kV, will be supplied by PEEGT (or project owner) at substation site. The contractor shall submit his necessary capacity of electricity in his proposal. The contractor shall pay the cost of electrical energy used during the work.



C1. 5. 4- Telephone line and communications *PEEGT* (or project owner) shall assist two telephone lines for substation to be connected to the public telephone system for use by the contractor and *PEEGT* staff **at contractor expense**.

C1. 5. 5- Documents and others to be submitted (with offer, after the contract awarded and during the work).

a- The tenderer shall submit the following documents and others with his offer :

- 1- **A bar-chart:** out line civil program based on the overall program for substation showing how the works are to be completed in the time available, the tender schedule of civil works proposals shall be completed listing the various size materials and furnished on which the tender has been based.
- 2- **Preliminary** planing and arrangement of temporary works specified in "Requirement of temporary works" for substation.
- 3- **Preliminary** site plan by scale 1: 2000 for substation.
- 4- **Preliminary** architectural drawings for the building to be built at the site of substation.
- b- The contractor shall submit for *PEEGT* approval within specified period (one month) after putting the contract in force (CPM) a detailed civil constructional program for the works developed from the contents of the above schedule.**

In addition to the individual program, he is to prepare a key program on a single sheet showing the phasing of the works as a whole.

- 1- **The program** shall be discussed and adjusted with *PEEGT* staff. Once the program has been agreed, it shall not be departed from the contract, without the written approval of the *PEEGT* .
- 2- **Additional** site investigations program and result of evaluation.
- 3- **Drawing** list including date of submission.
- 4- **Working** drawings (including temporary works).
- 5- **Detail** drawings.
- 6- **Calculation** sheets.
- 7- **Instruction** notes and specifications.
- 8- **Construction** manuals.
- 9- **Spare** parts catalogue.
- 10- **Plan** of facilities, equipment, plumbing, air-conditioning, ventilation...etc.
- 11- **Copies** of codes and standards to be referred to in designing and planning (except specified codes and standards).
- c- During** the work each month *PEEGT* and contractor will meet to review the contractor's plans, at which time the contractor will modify his plans as might be deemed necessary and if during the work it is established that the work is not programming in accordance with the schedule established by the contractor and that the delay is not due to a case of force majeure.

The contractor shall, within ten days from the receipt of the informally written summons given to him, take all necessary measures to make up for the established delay and to propose a new schedule. If no improvement is found after this period, *PEEGT* reserves the right to take any necessary action to correct the delay at the contractor's expense and risk.

d- Others: civil sub – contractor:

- 1- **The** contractor may employ a civil sub – contractor or use a competent specialized section of his own organization to carry out the civil works, however the contractor only has overall responsibility.
- 2- **The** contractor shall provide and maintain upon the site to be available for use by *PEEGT* staff; all surveying interments and testing equipment required for setting out , also measuring the works for controlling and testing the quality of materials and workman-shop.
- 3- **The** contractor shall provide all the assistance *PEEGT* staff may require including laboratory, chairmen and others for the purpose of checking the setting out and making tests.....etc.

e- Bill of quantity for *each item of civil works.*

f- All designs, drawings and calculation's sheet...etc. shall be submitted to *PEEGT* for approval and all safety factors should be included in these calculation standard and requirements.

g- Contractor must submit *PEEGT* all documents (drawings, calculation and bill of quantity ... etc. on CD "**COMPACT DISC**").

h- Weekly progress report detailing the works performed and the main civil tasks to be performed and the updated detailed civil works time schedule and the weekly progress report as per percentage .

Civil works design :

1- **the** civil works design must consider the increased prusser resulted from the arc fault for building design .

2- **Design** shall include the followings and not limited to :

- (230 ,66,20 k.v) Swichyards copletely (equipment foundations , roads , cable channels and ducts , crossings , ...)
- Control room.
- Protection room .
- Battary room and battery charger room with AC-DC distribution panels
- Communication equipment room .
- Offices .
- Toilets , bathroom , kitchen .
- Diesel generator building .
- 20 k.v conventional equipement building and out door equipment foundations .
- Guard House Building with needed facilities .
- Temporary Buildings .
- Fence works .
- Leveling works (including cleaninig and removing any objects or obstacles in site) and backfilling with compation to reach the desired level .
- Retaining R.C walls beside the river and where needed .

3- **The** contractor shall undertake responsibility of his design and borings required to decide the soil bearing resistivity .

4- **Calculation** and design of the grounding network shall be included in the design stage

C2 – SCOPE OF CIVIL WORKS

C2. Scope of civil works

C2.1 - Scope of works by the contractor :

The civil engineering and building works comprise of: sub-soil investigations, leveling – back filling by improved soil retaining R.C. walls – concrete fence covered by white local stone with suitable decoration around limits of s/s , detailed design and erection of civil work for substation, control building, 20 k.v building - Gouard House - Temporary Building – Diesel room and construction of substation completely,

All requirements for completion to achieve the works as **turnkey job**, and to fulfill the requirement of the complete contract.

In addition to that, the following should be covered, but not limited to, in the civil works:

- a- **Concrete** structures for equipment, piping...etc. Also the contractor shall deliver the required anchor bolts and embedded parts other than reinforcing bars.
- b- **Galvanized** steel structures for supporting the electrical equipment at switchyard of substation, crane girders hoist beams, pip supports, line hangers, sliding plates, shim shoes guards, anchor points including bolts and welding (as specified in electrical section) and all needed Templates .
- c- **Cable trenches** made of reinforced concrete:
 - Anchor rails for transformers.
 - Cable racks.
- d- **Pipe tunnels and trenches** made of reinforced concrete.
 - Pipe supports; such as beams & columns including base plates and anchor bolts.
 - Cable racks.
- e- **Covers for cable and pipe trenches.**

The trenches shall be covered generally with pre cast reinforced concrete, in the areas where concrete covers cannot be used for any reason, cast iron manholes galvanized grating or checkered plate or suitable pre fabricated covers shall be provided.
- f- **Wall opining**, cut out for piping, cables, air ducts... etc.
- g- **Sealing**, gaskets, frames and anchors for pips, cable and ducts.
- h- **Pipe sleeves** for electrical cables and connecting with pipes shall be water tight type .
- i- **Earthing system** and lightning protection.
- j- **Security system:** color watching cameras minimum two for each gate (Audio & video) and main sites in S/S **minimum four** .

Two 17 inches color monitor first in gate house and second in control room.
Two auto & manual change switch system between cameras not less Than 8 channels each.
Two way intercom between main gate, gatehouse and control room.
- k – **Reinforced concrete roads** near transformers and for holding equipments and for all roads inside S/S .
- L- **Fire alarm system** and Fire fighting system.
- M- **Transformer foundation** with needed oil collecting pits, jack lifting foundation- pulling transformer foundation ...
- N- **All needed roads** in addition to outer road to connect existing road till S/S gates and roads with needed curves .

O- **Complete** rain water drainage system for roofs and outlet pipes should be connected to rain water inspection pits then to main inspection pits .

P- **Complete** rain water drainage system for swich yards connected to the main .

Q- **Pavements** should be erected all around Buildings witch must be inter look type or similar about (1.5)m and (1) m for main road .

R- **Metalic doors and sliding doors for 20 K.V and control Building should be from best international known types with PEEGT approval .**

S- **Planting** of site (trees – grass – flowers ...)

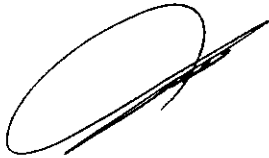
T- **Complete** water net for Buildings and S/S area connected to the main , and complete sewage net for Buildings connected to the main net if any or to have another suitable solution .

U-**Water tank** (high or ground one) about (50) m3 volume with all needed connection – accessories pump ..to all Buildings and areas supplied by water .

v- **Fence** – R.concrete fence around the site covered with white local stone with suitable decoration – 3 m – height .

W- Suitable Material entrances gates will be provided and erected by contractor .

X – Others .



C3- DESCRIPTION OF CIVIL WORKS FOR SUBSTATION

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- 3 Laboratory testing
- 4 Results of the site investigation.
- 5-Excavation and filling for leveling.

C3.2- Substation buildings and Gate House APP- 45 m2.

C3.2.1- General .

- 2 Foundation.
- 3 Substructure slab on grade.
- 4 Substructure column and beams.
- 5 Exterior closure.
- 6 Roof finishing.
- 7 Interior construction.
- 8 Specialists

C3. 3 -Drainage system

C3.4 - Fence, gates and signs inside substation.

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C3.6 - Connecting Substation with main swage net &Plumbing for substation

C3.6. 1- General

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- 3 - Sanitary fixtures.




C3.7- Heating,Ventilating And Air Conditioning

C3.7.1- Scope of work .

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C3.1 - Site investigation for the site of substation

C3.1.1. General

After award of the contract, the contractor is to ascertain for himself the nature of the sub-soil conditions over the site of the works, by means of holes and trial excavation etc. **Samples** shall be taken as necessary and tested to determine the physical and chemical characteristics of the various strata and of the ground water, if encountered.

The following should be considered as a minimum requirement, assuming uniform conditions over the site, but should be extended if any inconsistencies are encountered.

C3.1.2- Field sampling and testing:

- a- **Depth** of bore holes shall be not less than 15 meters unless rock is encountered, in which case the thickness shall be proved to be greater than 1.5 meter on two bore holes. Where weak soil are encountered, bore holes shall be taken down to a load bearing stratum and adequate thickness proved on at least two bore holes.
- b- **Bore hole records** shall describe and indicate level of all soils encountered and indicate the natural water table level. Rock core records should specify total core recovery, solid core recovery and quality of the rock cored.
- c- **Where** applicable, samples of the soil shall be obtained from all strata or at least 2 meters intervals in a single stratum and tested to determine physical and chemical properties, particularly with respect to substances which would react with concrete or other materials to be used in the works.
- d- **Where** applicable, in site soil tests shall be applicable to all soil strata or at least 2 meters intervals in a single stratum. Standards penetration tests in non-cohesive soil and field loading tests in sensitive cohesive soil.
- e- **Ground water samples** shall be obtained from each bore hole and tested in accordance with approved practice. The contract shall analyze sulfur content of the ground water and shall take the necessary of using sulfur-resisting cement.
- f- **Electrical resistivity** of the soil shall be verified on four samples, in accordance with an approved British Standard.

C3.1.3- Laboratory testing

Appropriate laboratory tests shall be carried out on all soil and ground water samples to an extent approved by PEEGT's Engineer.

All tests shall be in accordance with an approved British Standard "latest edition".

C3.1.4- Results

Records of ground borings trial excavations, results of in – situ tests and laboratory tests to determine the physical and chemical properties of the soil and ground-water samples shall be incorporated into a comprehensive sub – soil investigation report.

The contractor shall prepare an interpreted geotechnical report including recommendations for earth-works, foundations, road pavements, and concrete mix design.

Sub – soil investigations shall be carried out by an approved subcontractor.

Work shall be done to meet international standards (B.S) 5930 or DIN standards, ... etc. So the design and construction for all foundations shall be done by the contractor according to the actual results of the site investigation for the substation.

C3.1.5- Excavation and Filling for leveling .

- All substation area should be leveled with acceptable slope (0.5- 1 %) and as possible with the same level of surrounding existing lands or Buildings and contractor should make all excavation works what ever soils type be in site with all required tools , machines ... and also filling of areas to be raised by imported acceptable mixtures approved by PEEGT , layers should not exceed 20 cm after compacting till 95% proctor at least .

slope for outer sides of leveling :

≤ 45° - in excavated area .

≤ 30° - in Filling area.

- Imported Back filling materials should be from acceptable and approved sources by PEEGT.

- Back filling should be constituted from selected materials , with a precentage of fine materials (< 74 U) LESS THAN (10%) and compacted by an adequate copacter to reach a minimum modulus of elastising (500) kg/cm² defined by load plate tests

- the suitable selected materials are presented on the sieves analysis sheet .

- Removing of all objects and obstacles from the site before starting works .

- Site of all S/S could be at one level or could be by two levels (230 section at first level – 66 k.v at second level) taking in consideration connecting the two levels by – roads – R.C stairs – cable channels ... and also connecting the all s/s with the outer road by acceptable slopes and entrances for entering – transformers and all heavy equipments .

C3.2 – Sustation buildings and gate House :

Control building of 230/66/20 k.v S/S:

C3.2.1 - Dimension of Control building App. 35 x 18 m (see attached initial drawing) .

This building will consist of, AC & DC, protection panels room, offices, control room, store workshop, telecommunication equipment, batteries room , toilets for men and other for women (western WC and Eastern WC) with hand basin , shower and kitchen and separate path with shower.

Note: Diesel-engine room should be seperated .

C3.2.2 Foundations,

The following items are included in the civil works, but not limited to substation building:

Footings :

The footings shall be individual and combined ones, made of reinforced, concrete., with min. thickness of 100 mm lean concrete shall be cast under the footings.

Foundations:

The foundations shall be made of reinforced concrete.

Drainage shall be arranged for the basement with perforated under drain pips (if needed).

C3.2.3 Substructure:

Slab on grade:

The Slab on grade for the basement shall be made of reinforced concrete on 200 mm. layer of compacted gravel and -10- cm lean concrete .

A vapor barrier shall be placed under the casting.

C3.2.4 Substructure:**Columns and beams**

The columns and beams shall be made of reinforced concrete.

Structural walls

The exterior walls for the cables basement shall be made of reinforced concrete and protected by membrane protection sheets in the perfect suitable way with block wall (10)cm in the outer side .

Roofs

The roof shall be made of reinforced concrete.

The other concrete surfaces shall be plastered and painted.

Handrails shall be provided .

Stairs and ladders for basement (if needed).

The stairs to the basement shall be made of reinforced concrete.

And shall be covered with concrete topping, also provided with non-slip noising. .

The ladders leading to the roof shall be made of reinforced concrete .

C3.2.5 Exterior closure**Exterior walls:**

Exterior walls shall be made of hollow concrete blocks, with 200 mm. thickness, and furnished with artificial granite tiles (60×60) cm² or (60×30) cm² .

- wall stiffeners should be erected where ever wall is heighher than (4) m.

Exterior doors (best quality and best manufacturers) .

The personnel's entrance door shall be single reinforced glaze hollow metal, made of aluminum leaf.

The other exterior doors shall be double leaf, made of steel.

Windows and louvers

The window panels consist of aluminum frames with single-fixed glazed (6 mm at least) sliding Glazing fitted with screen.

The small windows in toilets...etc. shall be single reinforced glazed, operable Aluminum windows fitted with screen.

The windows in the control room and offices shall be furnished with exterior venatian blinds of louvered aluminum fitted with screen and duble glass for control room and offices.

C3.2.6 Roof finishing

- The concrete roof shall be finished as follow:

- Foam concrete screed layer average 100 mm thick with slopes (about 1%) and quitters.

- Covered with cement plaster coat of 20 mm thickness.

- Elastomeric bitumen with non-moved glass fiber reinforcement self-protection by colored granules under faced with sand approximately (4) mm. thick

- Protection cloth (water proofing) geotextile .

- Insulation material (5 cm)

- Crushed rounded gravel (5 cm) river sources .

C3.1.2.7 Interior construction

Interior walls

Generally , the interior walls shall be made of hollow concrete blocks with 150 mm .

Interior doors (best quality and best manufacturers) .

- The interior doors shall generally be double leaf doors made of steel.
- The interior doors in office and social premises shall be generally made of solid best wood , except toilets, path room and kitchen made of aluminum.
- The fire doors shall be made of steel , according to the fire code with rating of 60 minutes.

Wall finishes :

- The concrete block walls, concrete walls and all columns shall be plastered and generally painted (three coats plaster and four coats paint (oil) after four base coats. Taking into consideration that ceiling and walls of toilets , path room and kitchen shall be covered with ceramic tiles first class .
- Walls of control room covered by granite tiles .

Floor finishes

- Floor of the control room shall be covered by marble .
- Floor of the electrical rooms, locker rooms shall be covered with mosaic white cement tiles, kitchen floor will be first class granite tiles .
- Floors of the corridors, offices, bath and toilets shall be covered with marble.
- The other floors shall be coated with floor hardener with epoxy or similar after smooth finish (steel dowel finish + Helycopter machine) .
(Water proofing shall be provided where needed.)

Ceiling finishes

- The concrete ceiling shall generally be plastered and painted (three coats plaster and four coats of oil paint after four base coats).
- The control room, offices, corridors shall be provided with suspended ceiling.

C3.2.8- Specialists

- The following should be covered in civil works:
- Storage shall be furnished with metal shelves.
- Kitchen fixtures with a sink shall be erected in the kitchenette with up and down cupboards .
- Metal shelves and a sink shall be installed in the cleaning equipment room.
- Toilets and shower shall be furnished with best equipment and accessories (eastern and western type W.C., completed with sanitary installation (Grohe- Hanza- or similar), roof water tank with 2 m³ volume, taking into consideration all fittings and pipes which is required to be connect with existing water network (where required).
- Complete electrical installation system with internal lighting
- Heating, air conditioning and ventilation system.
- Telephone installations.
- Concrete path App. 1.5 m wide around the building covered by Interlock tiles .

Note: Battery room should be covered with acid resistant tiles (walls, and floor) in addition to basin, sewage outlet.

C3.3 - Drainage system

- **Contractor** shall provide a drainage system for collecting surface water in accordance with soil absorption and the rain fall record of site.
- **The** drainage system should be approved earlier by (PEEGT).

C3.4 - Fence, Gates and Signs

C3.4.1- General

The following items are included in the Civil works, but not limited to :

- Perimeter fence for the site .
- signs.
-

C3.4.2- Perimeter Fence.

- **Perimeter** security fence around the site of the subststion shall be made of (150)mm and (200)mm hollow concete blocks supported by reinforced cast – in place or ready mix concrete foundations , columns and top and bottom beams .
- The fence shall be plastered and covered with white local stone with suitable decoration for all sides and outside and inside and fitted with suitable electrical leighting – one over each column or any other acceptable technical solution , The height shall be (3) m at least and it will have suitable metallic main gate at the entrance of the manual and electrical s/s and have grounding connected to the main earthing net .
- expantion goints should be erected each 20-25 m and filled and covered suitably .

C3.4.3 - Gates

- **The** main entrance gates through the security fence .

C3.4.4 - Signs

- **Modern** architectural concrete covered with marble and indicating name of the substation shall be erected according to the desire of PEGGT.
- **All** dangerous areas, machines and equipment shall be provided with the signs approved by PEEGT .

C.3.5- Drainage

C.3.5.1 General

- **The** following items are included in the civil works but are not limited to:
 - Surface water, drainage
 - Sewage drainage

Surface water sewage shall be disposed of through separate system to avoid contamination.

Surface water from the roof shall be piped away from the immediate and disposed of in soak away or main net if nearly .

Sewage shall be piped to the sewage treatment plant and disposed of in soak away (OR SEVDGEPIT AFTER TRFATED) or in main net .

- **All** underground site sewers shall be of PVC or PHE plastic pipes or concrete ones.
- **The** pressure test class of pipes shall be selected according to covering depth.

C. 3.6- Plumbing for substation

C. 3.6.1 General

The following items are included in the civil works but are not limited to:

- Plumbing
- Sanitary fixtures.

The work of this section comprises the following

- Plumbing services for all building consisting of fixtures, waste (sewage) water pining venting hot and cold water pining and roof drainage pining

Drip drains for the air-conditioning installation and equipment drains are included in this scope

The following general requirements of equipment shall be met if not otherwise stated concerning different buildings:

C. 3.6.2 Plumbing

Water supply for all fixtures shall be done by gravity from potable water tower

Hot water supply for lavatory, shower and kitchen sink shall be by a water heater The contractor shall provide clean-out at the base of each soil, waste vent and rain water conductor stack The contractor shall design famish and install pining clean-outs in all horizontal runs of soil and waste pining at intervals not exceeding 15.0m or when 90 degree changes in direction have occurred

In all horizontal runs of rain drainage clean out shall be installed in a manner as specified for sanitary drainage except that the spacing is increased from 15.0m to 25.0 m intervals

All cold and hot water pining shall be galvanized steel with threaded connections or equals

All soil waste rainwater pining below the ground floor slab and within 1.2 m outside of the building shall be PVC plastic pipe or concrete ones. All waste rainwater and vent piping above the ground floor slab is cast iron pipe (painted) that means all buried piping (cast iron or similar) must be waterproofed and tested .

All valves 50 mm and smaller sizes shall be glove valves, bronze body; 65 mm and larger sizes shall be gate valves cast iron body

Check valves shall be swing checks.

All water pining and concealed rain water conductor above ceilings areas, with the exception of exposed connections at the ffxture shall be insulated with 20 mm thick glass fibered sectional pipe covering. All insulation shall be protected by a jacket and shall be secured in place by aluminum bands .

C. 3.6.3 Sanitary fixtures

Water closet siphon jet action elongated bowl, white vitreous china, 40 mm top spud, flush valve with vacuum breaker

Water closet (Eastern type); squat toilet with trap, cast iron or china flush tank

Urinal : washout urinal with vitreous china 20mm top spud 50 mm outlet connection wall hung flush valve

Lavatory: 500 x 450mm with vitreous china, front overflow wall hung, faucet, P cast brass trap, with clean -out plug chrome finish 32 mm inlet x 40 mm outlet.



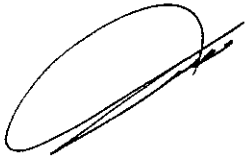
Service sink: with vitreous china, 560 x 450 mm through back faucet and wall hanger, s trap 56 mm outlet with strainer

Water cooler: water cooler shall have the capacity to cool 36 liters of 21 C° to waste 10 C°

Water heater with capacity not less than 80 lt.

Water closets: water closet type for substation shall in general be eastern type.

Hand washbasins shall be provided for each toilet wherever is and in Battery room.



SECTION C3.7
HEATING, VENTILATING AND AIR CONDITIONING
SYSTEMS

C3.7.1 SCOPE OF WORK

This section of the works covers the complete, installation and putting into operation the heating, ventilating and air conditioning systems required for

Substation's control and other buildings and temporary building .

All heating, ventilating and air conditioning systems shall operate all anticipated conditions normally and shall be fully automatic in operation and shall be capable of maintaining internal conditions within the bands of temperature.

C3.7.2 The contractor shall be responsible for providing all materials, erection equipment and tools necessary for a complete installation.

C3.7.3 AIR CONDITIONING

The following areas at 230/66/20 k.v substation shall be air conditioned:

- Control relay Room –AC-DC
- PLC Room
- Offices (including temporary Offices of *PEEGT* staff) Guard house .
- metering room

Air conditioning shall be provided in the form of split wall or ceiling air condition systems, according to the installation place, containing number of units each one consists of 48000 BTU capacity unit for control and protection –AC-DC rooms applied for cooling and heating with wireless remote control, and 24000 BTU capacity unit for others; taking into consideration that air conditioning system should be from the same manufacturer and origin of country.

All equipment must be capable of continuous operation at rated capacity during periods of high atmospheric dust concentrations as would be found during periods of severe sandstorms for all ambient temperatures.

C3.7.4 MECHANICAL VENTILLATION

Supply and extract ventilation systems shall be provided to serve the following areas:

- 20k .v building – and :
 - 1- Battery Room
 - 2- Store and workshop
 - 3- W.C (Extract only) – Bath – Kitchen.
 - 4- Diesel Building– and basements if any .
- **Extract** ventilation shall be provided by means of wall mounted fans discharge to atmosphere individual extract fan shall be provided for (toile – Bath – Kitchen) .
- **Extract** fans shall be of the propeller flameproof type, they shall be wall mounted, complete with automatic shutters, and shall operate on 220 V single-phase 50-cycle current.
- Extract** fan shall be interlocked with the air-handling units as system operates on 100% fresh air.

Toilet extract ventilation shall be provided by surface mounted centrifugal extractor fan supply air shall not be ducted directly to toilet but shall be delivered into an adjacent area and drawn in through transfer grille in toilet door ventilation systems and ducting for battery room shall be corrosion resistant.

The following air change rates /hour shall be provided in mechanically ventilated areas:

- Battery Room 15
- Store and workshop 15
- Toilets 12 (extract only)

C3.7.5 INTERNAL SOUND LEVELS

The maximum acceptable sound levels in the various areas of each building are:

- Control and relay room 50 db
- PLC Room 50 db
- Offices 50 db
- Store and workshop 60 db
- Toilets 60 db
- Battery room 60 db
- Buildings. 60 db

All plants and equipment shall be suitable selected and installed to insure that the maximum sound levels stated are not exceeded and where necessary attenuation devices shall be incorporated.

C3.7.6 VENTILATING UNITS

The ventilating units shall be factory assembled draw-through units consisting of a centrifugal fan, primary inertial sand filter with bleed air fan secondary permanent cleanable filters and bird screen, all mounted in a unit housing suitable for roof mounting or being locate within an equipment room, as applicable.

The clean air fan and drive shall be provided

Three (3) stages of filtering are required in the ventilating units. The first stag shall be the inertial spin or blade type; the second stage shall be permanent, cleanable, the third stage shall be disposable bag type.

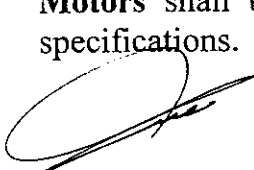
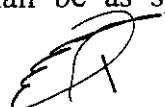
Inlet bird screens shall be 12.7 x 12.7 mm galvanized wire furnished with painted steel frames all exposed parts of the assembly shall be finished as specified elsewhere in the specifications inertial filter exhaust fans shall be direct drive, centrifugal type, complete with motor, access door, drain connection, predrilled inlet and outlet flange, exhaust duct and discharge screen.

Fans shall be of the industrial type, arrangement 4, and extra heavy-duty construction and shall be constructed throughout of carbon steel.

Fans blades shall be welded to the flange and back plate and shall be accurately balanced both statically and dynamically and shall free from objectionable vibration and noise.

Fan casings shall be 4.37 mm carbon steel, motor supports and side plates- shall be 4.37 carbon steel.

Motors shall be TEFC and shall be as specified in the electrical division of these specifications.

C3.7.6.1 Ventilating unit controls

Controls shall be furnished as a part of the unit, located in a rain and dust proof cabinet with remote status panel indicating fan operation filter service and function switch labeled "on-off" previous shall be made to interlock unit operation with area exhaust fans.

C3.7.6.2 TOILET EXTRACT UNITS

Toilet extract shall be forward curved centrifugal type direct driven.

Fan outlets shall be fitted with counter weight shutters to prevent back draught and re-circulation through the standby fan.

Direct driven fan / motor units shall be supported on the fan deck by means of anti-vibration supports.

Toilet extract units for indoor mounting shall be wall mounted, and shall be fitted with a white ABS plastic or enamel finish sheet metal casing. Toilet extract units serving a single internal toilet shall incorporate an automatic timing device connected to the lighting circuit and arranged such that the unit for twenty minutes after the roof lighting has been switched off.

C3.7.7 GRILLS DIFFUSERS AND LOUVER

Grills and diffusers shall be of aluminum construction and shall be fixed by means of sub frames with spring clips or screw fixings. Spring fixings shall not be used for ceiling mounted grilles and diffusers.

The corners of front flanges of grilles, diffusers and sub frames shall be mitered and jointed to produce a clean unbroken appearance and all visible aluminum sections shall be free from extrusion marks. Front flanges shall be at least 30 mm wide and shall incorporate a lip of at least 4.5 mm and a plastic fixing gasket. Grills and diffusers blades shall be fixed at even centers with intermediate mullions giving supports for blades of more than 550 mm long. Grill and diffusers finishes shall be a dished natural aluminum color except where otherwise indicated.

All grills and diffusers shall be fitted with an opposed blade damper for regulation purposes.

Grills and diffusers shall be fitted with acoustically lined inlet plenums where necessary in order to comply with the acoustic limits of this specification.

Double deflection supply grills shall be fitted with two sets of adjustable blades to give vertical and horizontal deflection of the airflow. The blades shall be aerofoil section extruded aluminum set in nylon bearings at not more than 20 mm centers with horizontal blades at the front and vertical blades at the back.

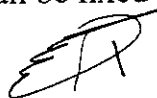

Ceiling diffusers shall be at the square pattern and shall be adjustable to enable the airflow patterns to be varied.

Outdoor air louvers shall be of all extruded aluminum construction. Sand trap type, fitted with opposed blade dampers in the connected ducting where necessary for airflow regulation.

Movable blade louvers shall not be used.

Louvers shall be weatherproof and shall incorporate an aluminum wire mesh screen on the inside surface. Sand trap louvers shall have an efficiency of 80 % on AC coarse (20.20 microns) and 50% on the AC fine (1-70 microns) test dust.

The dimensions of louvers for mounting in the building structure shall suit the concrete block or brick modules and shall be fixed to hardwood frame.



C3.8 Connecting with main water and swage net General

C3.9- Roads and walkway Substation.

Length and location of the access roads:

Width of the access roads and main roads shall be App. 8.0m.

Width of the sub roads shall be App(4-6)m - 4 m- for secondary.
- 6 m -for main.

The permanent roads and other traffic areas shall be constructed as follows:

- Sub base 300mm thickness of natural stone free from dust.
- Base 250-mm. thicknesses of broken stone.
- 15cm thickness reinforced concrete layer for roads with expansion joints each 6 m .
- Transformer road -25 cm reinforced concrete with (30+25) sub bases.

Generally the main roads shall be provided with paved sidewalks, width 1.0 m.

All the permanent roads and other traffic areas at the site shall be provided with curbstones and suitable slopes to drain surface water.

Close to the control building of S/S shall be provided a car park App. for 10 cars

Car parks shall have suitable shed for protection of hot weather.

Road signs and marking shall be provided at roads and car parks.

C3.10 - Security system

Watching system : color watching cameras min two for each gate (audio & video) and main sites in S/S min. four (best manufacturers and quality) .

Two 17 inches color monitor first in gate house second in control room .

Two auto & manual change switch system between cameras not less Than 8 channels each .

Two way intercom between main gate , temporary(gate house) and control room .

C3.11 – Complete Water Tank .app (50) m3 .

- Water tank shall be installed and erected with the following requirements and not limited to :

- Connected with the main net .
- Connected with all needed Buildings and areas .
- Capacity -50-m3 at least .
- Provided with needed pumps and accessories .
- Isolated perfectly (ceramic inside walls) .

Ground or high one , reinforced concrete structure

- General-

- Walls of Buildings near transformers should be fire rating walls .

- Longitudinal and cross rails (with needed foundations) should be done as initial lay out drawing .

- Connection between outside main road till new s/s gates should be done by contractor completely with all needed sub grades and curbs.

- Transformer foundation and oil pits should be erected by reinforced concrete water tight type .

- All reinforced concrete works below soil level should be painted two coats by approved bituminous painting material .

C4-Design Requirements

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C4.DESIGN REQUIREMENTS

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C4.DESIGN REQUEREMENTS

C4.1 Purpose of the design standard

The purpose of this design standard is to apprise the contractor of the criteria and parameters upon which the design shall be executed.

C4.2 Contractor's responsibility for design

The Contractor shall be responsible for the design of the works and shall ensure that the completed work in every way performs the required functions.

Those items or civil engineering and building work closely associated with mechanical plant shall be designed to the specific requirements of the mechanical plant and the requirements of the specifications.

The Contractor shall be entirely responsible for the stability and sufficiency of the works.

C4.3 Applicable design standards

The Contractor shall perform the design in accordance with relevant international standards and codes or with the Syrian codes and laws and local regulations subject to the approval of the *PEEGT*

These standards and codes are referred to in the latest edition published.

C4.4 Designs and drawings

All civil engineering in addition to all leveling drawings and sections for leveling and all retaining reinforced concrete walls if needed and building work (including temporary works)for every structure and item of plant required for the complete substation shall be designed and drawn in detail by the Contractor , subject to the provisions of he Specification.

for All designs, drawings and calculations sheets etc. shall be submitted to the *PEEGT* approval.

C4.5 Design loadings and manual of designs

C4.5.1 Dead load

The dead load of a building shall include the weight of walls, permanent partitions, framing, floors, roofs, and all other permanent construction entering into and becoming a part of a building.

C4.5.2 Live load

Live load is the load superimposed by the use and occupancy of the building not including the wind load, earthquake load or dead load.

The minimum live loads in kilogram per square meter listed below shall be taken to the design of floor and roof.

Cable floors

| | |
|------------------|-----------------------|
| Electrical rooms | 750 Kg/m ² |
| Other rooms | 750 Kg/m ² |

Operating floor

| | |
|------------------|-----------------------|
| Electrical rooms | 750 Kg/m ² |
| Other rooms | 750 Kg/m ² |

| | |
|------------------------------|-----------------------|
| Roof | 250 Kg/m ² |
| Stair, platform, walkway | 500 Kg/m ² |
| Other plant buildings | |
| Machine or equipment room | 750 Kg/m ² |
| Office and general floor | 500 Kg/m ² |
| Roof | 250 Kg/m ² |

Taking into consideration real weight of equipments and electrical apparatuses in design.

C4.5.3 Wind load

Wind load shall be determined according to B.S (last editions) or similar and the meteorological data mentioned in chapter C.1.2.3

C4.5.4 Seismic load

Seismic load shall be in accordance with Syrian Arabic code or U.B.C or equivalent and the factor mentioned in chapter C1.2.3.

C4.5.5 Short circuit load:

Tensile force in conductor due to short circuit.

C4.5.6 Ice load:

Thickness of Ice = 10 mm with V=20 m/sec.

C4.5.7 Thermal load

Thermal load shall be based on a temperature differential of 20 C⁰ rise and 10 C⁰ fall.

C4.5.8 Snow load

Snow load, full or unbalanced shall be considered of value, which is according to Syrian Arabic code U.B.C. or similar.

C4.5.9 Loading combinations

Loading combinations shall be considered according to U.B.C or similar and *PEEGT* suggested

C4.5.10 Manual of designs

All buildings or structures consisting of steel structure shall be designed in accordance with Syrian Arab Code or AISC "MANUAL OF STEEL CONSTRUCTION", "MATERIALS AND WORKMANSHIP" of this volume (C5) and the U.B.C or similar
All buildings or foundations consisting of concrete shall be designed in accordance with Syrian Arab Code or ACI 318, "MATERIALS AND WORKMANSHIP" of this volume (C5) and the U.B.C. or similar. Brick and block work shall be designed in accordance with, "MATERIALS AND WORKMANSHIP" of this volume (C5) and the U.B.C or similar

C4.6 Foundation design

Equipment of building foundations shall be a substantial reinforced concrete raft, unless otherwise approved by the *PEEGT*

These foundations shall be capable of carrying all applied loads such that maximum total settlement does not exceed 50 mm and differential settlement is kept within the limits considered in the design. Equipment foundations shall be design such that amplitudes of dynamic loads such as vibration are within limits specified by equipment manufacturer. These foundations adjacent to other structures or foundations shall have a safe margin from them.

C4.7 Building or structure design

All building and structure shall be designed reasonably for all imposed loads, and shall be settled on the most suitable type of foundation.

C4.8 Design Requirements

Columns and beams shall be designed for vertical loads, lateral loads and moments due to connection eccentricities. Slabs on grade and elevated floors shall be designed to support actual equipment loading including the impact and vibration.

Slabs on grade shall not be used in the design to carry lateral forces at the column bases. **Bearing walls** may be used in economical design.

All necessary construction and expansion joints shall be provided.

C4.8.1 Reinforced concrete design

All concrete work shall be designed in accordance with the U.B.C, ACI and "MATERIALS AND WORKMANSHIP" (C5) or similar concrete work (Syrian Arabic Code) .

The minimum compressive strength of concrete to be used in the works shall be as follows:

- 1) 280 Kg/cm² (400 psi)-Watertight concrete.
- 2) 210 Kg/cm² (3000psi)-General use
- 3) 140 Kg/cm² (2000psi)-Lean concrete

Generally, maximum allowable deflections due to imposed loads shall be as follows

1/240 span for roof members

1/320 span for concrete floors, beams for concrete floors

All necessary construction and expansion joints shall be provided.

These joints shall be located so as not to disturb the structural integrity of building.

Control joints shall be provided in slabs on grade to limit uncontrolled cracking.

C4.9. Steel work design (SPECIFIED IN ELECTRICAL SECTION)

Steel work design shall be according to AISC and U.B.C. or similar.

Full consideration shall be given to the effects of changes in temperature , so expansion joints should be provided where necessary.


C4.10 Roads

Access roads, site roads and paved areas shall be designed to dispose surface water.

Pavement thickness design shall be in accordance with the AASHO design method or similar for the design of all permanent roads and paving on the site.

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The design criteria given bellow makes no assumption for any construction traffic, which may use roads prior to completion of the contract. Any roads or paved areas damaged by the construction traffic shall be repaved in accordance with this specification.

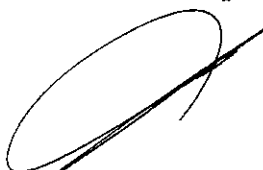
The strength of sub grade shall be measured by means of the California Bearing Ratio test.

The minimum thickness of concrete shall be 150 mm.

For design of parking areas, the minimum concrete thickness shall be the same as for road design.

C4.11 Fire Risk

Fire risk should be taken into consideration, and structures should be in a stable manner when exposed to fire, so the suitable fire resistance should be applied.



C5. Materials And Workmanship

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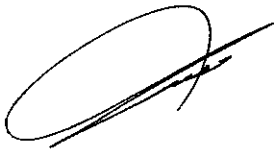
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C5. MATERIALS AND WORKMANSHIP

C5.1 General

All materials could be provided from the available in local markets of the best quality, PEEGT's staff accepts that, and the cost of these materials items & workmanship should be offered by local currency.

For the execution of civil work, the contractor shall conform to the construction plans and calculation sheets approved by the PEEGT and shall conform to the technical specifications and the codes and standards indicated in this specification for each parts of the works.

All of the operations processes and sequences of construction and erection and all of the materials and equipment used in the works shall be approved by PEEGT

All of the construction materials and finishes to be used shall be of the best quality.

Samples of the materials, finishes and products shall be submitted for the PEEGT's approval.

Note: In addition to the Norms mentioned in these specifications the Syrian Arabic Code issued by Engineering Institution, with its annexes and Technical & General

Specifications for Syrian Ministry Of Building And Construction, will be considered of the main references for All Civil Works (loads, design, material specifications and work's execution, etc...) so the heaviest loading should be considered .

The Arabic edition of Code, annexes and Technical & General Specifications for Syrian Ministry Of Building And Construction are available in ENGINEERS INSTITUTION in DAMASCUS city.

C5.2 Earth works

These works include the excavations and backfilling, which shall be executed for S/S area leveling and for the construction of the works, control of underground and surface water, and loading, transportation, unloading and spreading of the excavated materials at appropriate places.

C5.2.1 Clearing, cleaning and scraping

This is the operation which removes the surface layer of the natural ground containing organic matter, topsoil, stubble, roots, peat and any other unsuitable material in order to make the ground suitable for construction works. This work shall be preformed on all of the surfaces where excavations are to be executed or earthworks composed of compacted material are to be constructed and removing all off obstacles of any type exist in s/s area before starting works mentioned above.

If, for fulfillment of the above-mentioned objectives, it is necessary to make the scraping deeper than fifty centimeters (50 cm), the additional depth shall be regarded as leveling and shall be in accordance with what is stipulated in the corresponding specification.

All of materials resulting from the clearing and cleaning shall be removed from the lot or eliminated under the contractor's responsibility. These operations include the loading, transportation, unloading and spreading in horizontal layers of depth less than fifty centimeters (50 cm), of the materials resulting from the scraping in the disposal zones indicated in the plans or by the PEEGT, in such a manner that the said materials do not interfere with the natural drainage and do not mar appearance of the zone.

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C5.2.2. Rough grading

Within the limits of work shown on the drawings or as directed by the *PEEGT* the contractor shall carry out all necessary rough grading to establish the finished graders or constructions requirements of the site. Grades shall be uniform levels or slopes between points and existing finished grades. **The** contractor shall furnish any additional fill required to complete rough grading work.

Rough graded cut and fill area, which are to be top soiled and seeded, shall be graded 150 mm below the finished grades indicated on the drawings.

Where paving or slabs occur, all rough grading shall be carried to the sub-grade of the base course, removing all large stones and debris and grading and compacting uniformly to the correct lines and levels for the placing of the paving or slab. All areas of unsuitable sub-grade material and areas where rock is encountered shall be excavated to a minimum depth of 300 mm below sub-grade or to such depth as the *PEEGT* may designate. **The** portion so excavated shall be refilled with suitable selected material as approved by the *PEEGT* as specified, in layers not exceeding 100 mm and shall be compacted by the thoroughly compacted to 95 percent of maximum density at optimum moisture.

C5.2.3 finish grading

This is the operation whereby the material between the scraped ground and the leveling elevations indicated in the plans or by the *PEEGT* 's are excavated and removed.

The ground shall be fully scraped before the commencement of the leveling works.

The activity indicated above includes control of the underground and surface water, the loading, transportation, unloading and spreading of the materials obtained from the leveling, in the disposal zones indicated in the plans or by the *PEEGT* or in the stockpiling zones, if the materials are to be used in the construction works.

The materials, which are not used, shall be spread in horizontal layers or depth less than fifty centimeters (50cm). **The** materials which are to be used shall be placed in longitudinal stockpiled in places close to the sites of the works where good runoff and drainage conditions can be obtained. In both cases, the materials shall be deposited where they will not obstruct the construction works, will not obstruct the natural or planned drains, and will not cause damage to third parties.

C5.2.4 Excavations

The excavation operations include the removal of materials in accordance with the levels, forms and dimensions indicated in the plane, depositing of the materials in appropriate places, the works necessary for ensuring stability of the slopes, such as shorings, lowering of the level of the underground water, control rainwater of floods.

All combustible and other waste materials shall be removed from the construction area and disposed at the expense of the contractor.

The banks shall have the protections necessary to prevent and control landslides.

The excavations shall conform to the alignments, slopes and levels indicated in the plans.

The contractor can use explosives for excavations in rock, when the corresponding approval is obtained from *PEEGT* and regarding authorities.

Experienced personnel must handle the explosive and excavation shall not alter the condition of materials located near the excavation.

Any unsuitable material, which is located at the bottom of the excavation, shall be excavated and replaces with compacted selected material or with lean concrete, depending on what the *PEEGT* decides.

C5.2.4.1 Excavations for structures

In general, the sides of the excavations shall have vertical faces when forms are not required for the pouring of the cement .**If** use of forms is required, the excavation can be extended 40 cm beyond the form work to provide room for the anchoring and bracing.

When some time elapses between the completion of the excavation and the construction of the structure, the excavation shall be interrupted at a level of 50 cm above the bottom of the slab or base layer, to protect the foundation ground. **The** remaining 50 cm shall only be removed when the corresponding construction works are soon to be commenced.

C5.2.4.2 Excavation for channels

These excavations include the excavations for pipe channels, cable channels, drainage channels, etc.

The bottom and the slopes shall be profiled so that smooth surfaces are obtained.

No point of the excavated cross-section shall deviate by more than 5 cm from the planned cross -section. Systematic deviations will not be accepted even when they are less than 5 cm.

C5.2.4.3 Excavation of trenches for pipes

These trenches shall have vertical walls and their minimum width shall be as indicated below , according to the diameter of the pipe.

| Pipe diameter (inches) | Trench width (cm) |
|---------------------------|----------------------|
| 2-4 | 50 |
| 6-8 | 65 |
| 10 | 75 |
| 12 | 85 |
| 24 | 140 |
| 27 | 150 |

In places where the piped are laid directly on the bottom of the excavation ,this shall be shaped by hand to the natural from of the bottom of the pipe throughout its length , so that the bottom quarter of the circular cross-section is firmly supported .

C5.2.5 Control of underground water and surface water during the construction works.

The contractor shall execute the temporary works necessary for draining and protecting at all times against floods the work zones and the material stockpile zones, in such a manner that the rainwater will not hinder the progress of the construction .**For** his channels, drains, pumping wells, pipelines, etc. necessary for fulfillment of the specified requirements.

The contractor shall excavate all drainage ditches, which are required to intercept runoff, in order to protect the banks of excavations or to lead the water from the intercepting drains and channels.

The work, which the contractor performs on the watercourses existing at the site *shall* not affect the downstream users. *PEEGT*,

C5.2.6 Landslides and over excavations

If the excavations are deepened or widened beyond what is indicated in the plans the over excavated volume shall be filled with lean concrete, in accordance with the instructions of the *PEEGT* when due to the effect of the pumping operation s or the action of rainwater, the soil at the bottom of the excavation has deteriorated excessively, to the extent of becoming unsuitable, the excavation shall be deepened until underteriorated soil is encountered and the levels shall be corrected by means of fillings in the same manner as specified for over excavations .

The contractor shall execute all of his excavations in such a manner as to minimize the possibilities of landslides. Consequently he shall, in cases where the ground is unstable because of its essential nature, use approved appropriate preventive methods, such as sloping of banks, covering of banks with layers of mortar, use of shearing and sheet pilings or other methods.

If use of sheet piling is required to support the wall of the excavation, the sheet piling shall be constructed before the excavation is executed.

The materials used for the fillings shall of free from garbage, waste matter, roots, organic matter and any other elements which might reduce the quality or affect the stability of the filling.

C5.2.7 Removal of excavated materials

All excavated materials, which are suitable and necessary for construction of fillings, shall be stockpiled in such a manner that they can be used for this purpose. **The** materials shall be places in longitudinal stockpiles in places close to the sites of the works, where good runoff and drainage conditions are available.

The materials, which are not used, shall be spread in horizontal layers of depth not greater than 50 cm in the disposal zones indicated in the plans or the zones authorized by *PEEGT*.

In all cases the materials shall be deposited in such a manner that they do not obstruct the construction works or obstruct the natural or planned drains or cause damages to third parties, or detract from the appearance of the zone.

C5.2.8 Fillings

This item includes the works necessary for obtaining, by use of selected Materials, the elevations specified in the plans, when the scraped ground is below the planned elevations.

C5.2.8.1 Filling for structures

The filling around the structures shall be put in place as soon as possible after the construction works but when there is not danger of the structures being damaged by premature filling.

The filling to be compacted must be laid in uniform layers of thickness less than 20 cm.

The filtering layers behind abutments, walls and other works shall be laid and compacted simultaneously with the selected fillings, care being taken not to mix the materials.

Special care shall be taken in the handling of equipment and materials around structures, to avoid damage to the structures.

C5.2.8.2 Backfilling of piping trenches

The trenches excavated for the laying of pipes shall be back filled with well-compacted selected material up to the level of the original surface of the ground, when the laying of the pipes has been approved by the *PEEGT* in cases where the pipeline is excessively close to the surface, an additional layer shall be provided to ensure that the thickness of the covering over all points of the pipeline is greater than the minimum specified in the plans.

The base for the fillings shall be completely free from vegetation, organic matter, waste and other unsuitable materials.

The base compacting of the fillings can be completely free from vegetation, organic matter, waste and other unsuitable materials.

Manual or mechanical materials used can do the compacting of the fillings, fillings can be classified as follows:

a. Filling consisting of permeable selected materials

The materials used for these fillings shall be free from gypsum and clay .It is necessary to use natural beach materials consisting of hard, tough, durable particles of which the permeability and quality conditions are approved by the *PEEGT*. These fillings shall be compacted to 70 % of the maximum density of the modified proctor test and shall basically be used for raising the level of the ground when the elevations are too low.

b. Fillings consisting of impermeable ordinary material.

The materials for these fillings shall be obtained from excavations executed in borrow zones. These fillings shall be compacted to 95 % of the maximum density of the normal proctor test and shall basically be used for filling the excavations around the structures and for piping trenches.

The back filling shall be executed in two stages: in the first stage the pipes shall be carefully surrounded with the best materials available, the materials being tamped down in order to eliminate voids but without causing movements of or damage to the pipes. This work shall be done with selected material to a level of 30 cm above the pipeline .In the second stage the filling shall be brought up to the level indicated in the plans, the compacting being performed on uniform layers of thickness less then 25 cm each.

C5.3 Concrete works

C5.3.1 General

The concrete work consists of the construction of plain concrete reinforced concrete, foundation, columns, slabs, walls, screens, etc., in accordance with what is indicated in the plans .It includes the provision of equipment, tools and various construction elements, supply of materials, construction and installation of forms preparation and pouring of concrete mixtures finishing and curing of the concrete, any repairs which are necessary, and, in general, all operations required for executing the concreting work in accordance with the construction plans, the calculation sheets ,the specifications and the instructions of the *PEEGT* .

The concrete structure consists of all the support elements for metal

Structure, floor structure slabs, interior and façade frames, the heads of groups of piles, etc.

The following aspects shall be taken into account as construction specifications:

The plans of the concrete structures are complementary to the plans of the metal structures with regard to anchoring and vertical bracing system.

When there are conflicts between the plans or specifications stipulated herein and the above mentioned codes, the plans or specifications should have priority.

C5.3.2 Cement

The cement used throughout the works shall be obtained from manufactures approved in and shall comply immediately before use, with whichever of the writing by *PEEGT* following standards is relevant:

Ordinary Portland cement ASTM C150

High-Early-Strength Portland cement

Sulfate-Resisting Portland cement) ASTM C150 –V

Where, in the opinion of the *PEEGT*, the nature of the aggregate so requires

It, the total alkali content of the cement shall not exceed 0.6 % calculated as the equivalent Na₂O.

Cement used in the works shall be ordinary Portland cement except where sulfate resisting cement is necessary (for all parts connected with s/s soil) .

The use of high early strength or other cement will be permitted only where the consultant is satisfied that the circumstance allow.

Unless otherwise directed by the *PEEGT* manufacturer's test sheets shall be supplied with each consignment of cement certifying compliance with the revenant standard.

The contractor shall provide from each consignment of cement delivered to the site such samples as the Engineer may require for testing .**Any** cement which is, in the opinion of the consultant, lumpy or partially set shall be rejected and the contractor shall promptly remove such cement from the site.

Cement, which has been stored on the site for more than forty days, and cement, which in the opinion of the *PEEGT* is of doubtful quality, shall not be used in the works until it has been resettled, and for plastering only.

C5.3.2.1 Storage of cement

Immediately upon arrival at the site, the cement shall be stored in silos designed for the purpose or in dry weather right and properly ventilated structure with floors raised 500 mm above ground level and with adequate provision to prevent absorption of moisture .**All** storage facilities shall be subject to approval by the *PEEGT* and shall be such as to permit easy access for inspection and identification. Each consignment of cement shall be kept separately and the contractor shall use the consignments in the order in which they are received.

C5.3.3 Aggregates

C5.3.3.1 General

The aggregates to be used in the concrete shall general, conform to the "Specification for concrete aggregates"(ASTM C-33), or equivalent.

C5.3.3.2 Fine aggregated

Washed sand with maximum particle size of 0.5 cm. (3/16) inch shall be used as fine aggregate .**The** sand shall be washed and be free from each, particles of large size, slate, alkalis, organic matter, topsoil, mica and other harmful substances and shall satisfy the following requirements.

1. **The** particles shall not be of flattened or elongated from they shall be approximately spherical or cubic.
2. **The** organic material content shall be such that when the color test (ASTM-C-40) is performed, a lighter color than normal is obtained: otherwise the aggregate will not be acceptable.
3. **The** dust (particles smaller than 74 microns: number 200 screen-ASTM-C117) content shall not exceed 3% by weight.
4. **The** content of smooth particles, slate, etc., added to the clay and silt content, shall not exceed 6% by weight.
5. **If** the sand is obtained from natural deposits of sand, its particle size shall be within the following maximum and minimum limits:

| Screen No. | Side length of the Opening in mm | Percentage by weight retained | |
|------------------|----------------------------------|-------------------------------|---------|
| | | Minimum | Maximum |
| 4 | 4.760 | 0 | 5 |
| 8 | 2.380 | 5 | 50 |
| 16 | 1.190 | 15 | 50 |
| 30 | 0.590 | 40 | 75 |
| 50 | 0.297 | 70 | 90 |
| 100 | 0.149 | 90 | 98 |
| Finesses modulus | | 2.20 | 3.38 |

If the sand is obtained by crushing stone, the resulting particle size shall be within the maximum and minimum limits indicated in the following table,

| Screen No. | Side length of the Opening in mm | Percentage by weight retained | |
|------------------|----------------------------------|-------------------------------|---------|
| | | Minimum | Maximum |
| 4 | 4.760 | 0 | 5 |
| 8 | 2.380 | 10 | 25 |
| 16 | 1.190 | 20 | 50 |
| 30 | 0.590 | 50 | 70 |
| 50 | 0.297 | 70 | 90 |
| 100 | 0.149 | 90 | 95 |
| Finesses modulus | | 2.40 | 3.35 |

The coarse aggregate which is used for the preparation of concrete shall be consist of durable, clean fragments of hard rock of size varying between 0.5 and 3.5 cm (3/16 inch and 1-3/8 inch) and be well graded within these limits. **The** coarse aggregate shall be washed and free from unacceptable quantities of dust, earth, slate, alkalis, organic matter, topsoil, chalk, and other harmful substances and shall satisfy the following requirements:

1. **The** maximum size of the coarse aggregate shall not exceed one fifth of the minimum distance between faces of the structure and /or three quarters of the distance between reinforcing bars.

2. **The** coarse aggregate shall have maximum wear of 40 % according to the abrasion test performed with the "Los Angeles "machine.

3. **The** particles shall not be of flattened or elongated form; they should be approximately spherical or cubic.
4. **The** absolute density shall not be less than 2.4 tons per m³.
5. **The** dust content (particles of size less than 74 microns, No.200 screen, ASTM C-117) shall not exceed 1% by weight.
6. **The** aggregate shall not contain organic matter, salts or any other foreign substance in concentrations harmful to the concrete.

C5.3.4 Water

The water used in the preparation of the concrete shall be clean, fresh and drinkable. It shall be free from harmful quantities of acids alkalis, mud and organic matter which might reduce the concrete's strength and durability. Special care shall be taken to ensure that the water supplied is not contaminated with oils or greases.

C5.3.5 Admixtures

The contractor can use admixtures for the concrete when they are strictly necessary for improvement of the conditions or properties of the mixture, with prior written authorization from the consultant with regard to the type, class and system of application of the admixture. **The** admixtures shall not reduce the basic properties specified strength of the concrete in which they are used, or cause deterioration of the embedded elements.

All admixtures which are used to speed up or slow down the setting or make the concrete waterproof, for the convenience of the work or the contractor's convenience, will be the contractor's responsibility. **All** of the admixtures shall be used in accordance with their manufacturer's instructions and shall conform with ASTM standard or equivalent. **When** air-incorporating admixtures are used in the mixture, these shall conform to ASTM standard or equivalent.

When air-incorporating cements are used, it is necessary to conform to ASTM standard or equivalent, the materials for the production of this cement shall conform to ASTM standard or equivalent.

C5.3.6. Grouting

This section covers materials and procedures for grouting equipment and structural base plate.

Where the use of the following materials is specified herein, such materials shall be in accordance with these requirements:

Cement: ASTM C150, Type 1 or equivalent

Sand: ASTM C 33 fine aggregate, or equivalent clean well graded natural sand

Gravel: ASTM C33 coarse aggregate, or equivalent with 100 per cent passing a 10 mm (3/8 inch) sieve and 90 per cent retained on a No.4 sieve

Water: Clean and free from deleterious substances

All equipment and structural base plates shall be firmly and solidly grouted in place by methods that will insure complete, uniform, and permanent filling of all space beneath the base without disturbing or displacing the alignment or level of the base in its correct position.

Should the installation of any equipment be done under the supervision and direction of a manufacturer's erection superintendent, or other accredited supervisor provided by the manufacturer of the otherwise, these specifications should govern.

C5.3.7 Design of mixtures

The design of mixtures shall be done by weight and shall be based on the water – cement ratio necessary for satisfying the 28-days strength requirements, which are stipulated in the plans or in these specifications. **The** above mentioned ratio shall not exceed 0.55 by weight. **The** following aspects shall be taken into account when the mixture proportion for concretes are determined.

Type of concrete:

It is necessary to determine the concrete type to be used in the structures, and structural elements.

Strength:

In the plans it is necessary to indicate, together with the concrete's class, its 28- days compressive strength. In cases in which earlier strength is required, this shall be obtained in seven days.

Slump

The slump of the concretes shall be determined by the "Slump test method for Portland cement concretes" (ASTM C-143), or equivalent and shall be within the tolerance indicated in the following table:

| <u>Structural elements</u> | <u>Maximum</u> | <u>Minimum</u> |
|--------------------------------------|-----------------------|-----------------------|
| Reinforced shoes | 75 | 25 |
| Plain concrete shoes and foundations | 75 | 25 |
| Reinforced slabs, beams and walls | 100 | 25 |
| Columns | 100 | 25 |

Coarse aggregates:

The maximum size of the coarse aggregate shall not exceed:

- One** fifth of the minimum distance between the faces of the forms;
- One** third of the thickness of the slab, in the case of slabs;
- Tree** quarters of the shortest distance between reinforcing bars or between bars and forms.

The coarse aggregate shall not be of size greater than 40 mm when it is to be used in the preparation of concrete with strength value $f_c=210 \text{ Kg/cm}^2$ or more.

Proportion of mixtures:

The contractor shall deliver to a laboratory previously accepted by the *PEEGT* representative samples of the cement and aggregates which he intends to use, for study and determination of the appropriate proportion of the materials in the different mixtures for the specified strength values. In all cases, before commencing the works the contractor shall perform check tests of the proposed proportions using the labor and equipment, which will be, used in the construction works.

The PEEGT may order the contractor to perform any tests and confirmations which he considers necessary for ensuring that the specified strength values are obtained during the execution of the works.

Mixtures containing cement quantities which may cause harmful setting shrinkage will not be acceptable. **The Contractor** shall have the approval by **PEEGT** for the different mixture designs established by him.

Final proportioning:

The components shall be proportioned after establishment of the water –cement ratio in accordance with ASTM standard C-94 and ACI standard 613-54 or equivalent. **The weighing** of the materials shall conform to the following tolerances:

| | |
|------------|--------|
| Cement | -+1% |
| Aggregates | + - 2% |
| Water | + - 1% |

Mixing Time

1.5 minutes
2 minutes
2.5 minutes

Mixing Load

0.75 m³ to 1.5
1.5 m³ to 3 m³
3m³ to 4 m³

The mixing time shall be measured for the moment when all of materials, except for the total quantity of water, are in the mixer. **The PEEGT** may increase the mixing time if he considers this necessary.

The concrete shall be mixed in the quantities needed for immediate use. Concrete which has begun to set or of which was mixed more than 30 minutes before the intended time of use, cannot be used. **Before** the drum is loaded with the materials for the next mixing operation, it shall be confirmed that the entire previous mixing load has been discharged, and that the inside of the drum is clean and free from accumulations of hardened concrete and mortar.

The contractor shall provide sufficient mixing and pouring equipment to prevent interruptions of the work, which could cause cold joints in the concrete structure.

Prior To the installation of plant and equipment for handling, transporting, storing and measuring components of the concrete, and for mixing, transporting and installing the concrete, the contractor shall submit to the **PEEGT** for approval the plans and drawings showing the general layout proposed for the plant and description of the equipment which will be used, giving the details of its functioning and the efficiency of its operation.

C5.3.8 Classes of concrete

Concrete is classified according to its type of fabrication and its strength. There are four classes of concrete as follows:

C5.3.8.1 Structural concrete

The structural concrete shall have minimum strength of 210 kg/cm² (3.000psi) and shall generally be used in all of the structures. It is possible to use concrete of 245 and 280 kg/cm² (3.500 and 4.000psi) when they are considered desirable for design reasons, and for floors which are going to receive repeated loads or passing loads of machinery. As a general rule, this concrete shall be reinforced although plain concrete may be used.

Concrete used for the watertight structure shall have a minimum strength of 280 kg/cm² (4000psi), (Transformer foundations - Inspection pits ...).

C5.3.8.2 Lean concrete:

The lean concrete shall be mixed in the proportions of 1:3:6 weight and shall be used covering for the bottom of excavations to prevent the reinforcement of the base from coming into contact with the ground, or for similar purposes.

Important remark :

where necessary cyclopean concrete should be used (under foundations and where needed) on the expense of contractor with no extra cost on PEEGT.

C5.3.9 Measuring, batching and mixing

C5.3.9.1 Premixed concrete

The premixed concrete shall conform, with regard to standards, systems, times, transportation, etc... with the specifications and conditions established for this type of mixture in the " Specifications for Premixed Concrete " (ASTM C-94) or equivalent.

C5.3.9.2 Concrete mixed at the site

The components of the concrete shall be mixed together perfectly in a mixer of size and type previously approved by the *PEEGT* .The mixer shall be designed to ensure in appositive manner uniform distribution of all the component materials by the end of each mixing period, so that a uniform mass is formed within the periods of time specified by the manufacturer, and shall have a mechanism for weight control of the aggregates with a tolerance of $\pm 1\%$.It shall also have tank and mechanism for measuring the water , and appropriate filling hoppers. The discharging system shall be designed so that the mixed concrete is discharged without segregation of its components.

When the duly proportioned materials are in the mixing drum, they shall be mixed for a period of time determined as indicated hereunder, depending on the operating conditions;

C5.3.10 Preparing for concreting

The concrete shall be placed immediately or, at the latest, 30 minutes after its preparation. It cannot be transferred more than once and cannot be poured in a free fall from a height greater than 1.50 m.

Placing of concretes cannot be commenced until the *PEEGT* has approved in writing the formwork, the layout of the reinforcing bars, the placing and layout of the parts which are to be embedded and the state of the surfaces against which the concrete is to be placed.

Immediately before the concrete is placed, all of the foundation or excavation surfaces shall be free from pools or water, mud and waste the earth or old concrete surfaces against which the new concrete is to be placed shall be thoroughly wetted.

C5.3.11 Handling and storage of materials

The aggregates shall be handled and stored in such a manner as to minimize their segregation and fracturing and so that they are not contaminated with foreign matter or grouped together with aggregates of other sizes, **Any** material which appears to be segregated and/ or contaminated may be rejected and the *PEEGT*.

May order its removal from the site of the works. **For** the purpose of confirming fulfillment of the above requirements, all of the aggregate samples to be used for quality control tests (cleanness, particle size, color, density, etc) will be taken from the mixture proportioning place

In the case of the fine aggregates, drainage must be permitted in order to maintain uniform moisture content.

The cement shall be stored in dry places such as sheds or silos, for protection against moisture and contamination. These storage places shall be easily accessible for inspection by the PEEGT. Moreover, the Contractor shall keep a record of the dates of arrival of the cement at the site of the works. If the cement has been stored for more than two months, it cannot be used unless it can be proven by means of tests that it is in satisfactory condition. Cement, which has been hardened, semi-set or impaired in any other way, will be rejected.

In cases in which the PEEGT considers such to be desirable, he may order cleaning of the aggregates: this cleaning may be performed by washing or by any other mechanical method which will ensure that the material's characteristics are suitable for use in the cement mixtures.

C5.3.12 Conveying and placing

The method and equipment used for conveying the concrete shall be such that the concrete, which is delivered at the site, has the required composition and consistency without segregation.

In the case of use of belt conveyors, these shall be horizontal. If possible, the conveyors should have as light slope in order to avoid loss of material and segregation at the feed point, in the belt's length and at the outlet. In the case of long belts, the discharge shall be into hoppers, without segregation.

If pumping equipment or air conveyors are to be used, these shall previously be approved by the PEEGT for use of air conveyors and pumping equipment the maximum slump shall be 40 mm.

All of the conveying equipment of each type shall be cleaned at the end of each operation.

The concrete shall be poured only in the presence of the PEEGT.

When the concrete is installed at construction joints of special form, the surfaces of the joints shall be treated carefully with wire brushes soaked in fresh water immediately before they are covered with concrete.

The concrete shall always be poured in its final position and shall not be allowed to flow since this might permit of cause segregation. It is not permissible to cause excessive segregation of the coarse aggregate by letting it fall from an excessive height or very far from the vertical, or by letting the concrete strike the forms or the reinforcing bars. In places where such separation might occur, suitable channels or deflectors shall be installed to confine and control the concrete's fall.

Except where joints intervene, all of the concrete placed in forms shall be laid in continuous layers, which are approximately horizontal and are of thickness generally not exceeding to 50 centimeters. The construction joints shall be approximately horizontal unless the plans indicate otherwise or the PEEGT orders otherwise, and shall be given the prescribed form by means of molds where necessary.

Adequate bonding with the next pouring shall be obtained by removing the "surface grout" by an appropriate "chipping" operation.

C5.3.13 Compaction

Except for slabs less than 250 mm thick, all concrete placed in site shall be compacted with power driven internal type vibrators supplemented by hand spading and tamping.

Unless otherwise agreed by the *PEEGT* slabs 250 mm thick shall be compacted by approved vibrating screeds. **The** vibrators shall at all times be adequate in numbers, amplitude and power to compact the concrete properly and quickly throughout the whole of the volume being compacted, to the satisfaction of the *PEEGT*. *Spare* vibrators shall be readily on hand in case of breakdown.

Internal type vibrations shall be inserted into the incompact concrete vertically and at regular intervals. **Where** the incompact concrete is in a layer above freshly compacted, the vibrator shall be allowed to penetrate vertically for about 100 mm into the previous layer. **In** no circumstances shall the vibrators be allowed to COM into contact with the reinforcement or formwork nor shall they be withdrawn quickly from the mass of concrete but shall be drawn back slowly so as to leave no voids. **Internal** type vibrators shall not be place on the concrete in a Random or haphazard manner nor shall concrete be moved from one part of the work to another by means of the vibrators.

During the concreting of all reinforced concrete, including prestressed concert, a competent steel fixer shall be in attendance on each concreting gang, and he shall ensure that the reinforcement and embedded fittings are kept in position as work proceeds.

C5.3.14 Concreting in cold weather

On no account may concrete be place in contact with frozen ground or formwork or in contact with ice or snow on the ground, formwork or reinforcement. Concrete shall not be made with frozen materials.

Concreting may proceed in cold weather provided the necessary precautions are taken to ensure that the temperature of the concrete at the time of placing is not less than 5 °C (41 °F) and that the temperature of the concrete is maintained above freezing point until such time as it has, in the opinion of the Consultant, developed sufficient strength to resist the effects of exposure in freezing temperatures. Such precautions may include surrounding the structure with a cover and heating the enclosed air; insulating the formwork and finished concrete surfaces; warming the aggregates and heating the mixing water provided that the temperature of neither the aggregate nor the mixing water shall exceed 60 °C (140 °F). **Where** the air surrounding the concrete is heated it shall be kept moist, and draughts of hot or dry air shall not be directed as concrete surfaces.

Where hot mixing water is used the water and aggregate shall be mixed sufficiently long to acquire a uniform temperature before cement is added.

Prior to commencing concreting in cold weather the contractor shall obtain the *PEEGT* 'S; approval, in writing, for the precautions he proposes to take to protect the concrete from the effects of freezing temperatures and methods he proposes to use to assess when such protection may be removed.

Unless special provisions are made to give the concrete a satisfactory temperature at the time of placing and to maintain the concrete temperature above freezing point until it has gained sufficient strength to resist freezing temperatures, and these have been approved by the *PEEGT*, in writing, no concrete may be placed when the atmosphere shade temperature falls below 3 °C (38 °F) nor may it be resumed until the temperature reaches 1 °C (34 °F) on arising thermometer.

C5.3.15 Concreting in hot weather

Concreting in hot weather shall be generally carried out in accordance with ACI standard 305-72 "Recommended Practice for Hot Weather Concreting" or equivalent.

If concrete is placed when the weather is such that the temperature of the concrete would exceed 32 °C (90 °F) as determined by the *PEEGT*, the Contractor shall employ effective means, such as precooling of aggregates and mixing water and placing at night, as necessary to maintain the temperature of the concrete, as is placed below 32. ° C (90. °F). **The** Contractor shall be entitled no additional compensation on account of the foregoing requirements.

C5.3.1.6 Curing of concrete

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, cold, rain or running water. **The** protection shall be applied as soon as practicable after completion of placing by one or more of the following methods, as approved by the *PEEGT*.

A layer of soaking, canvas, Hessian, straw mats, shall cover the concrete, Or similar material, or a layer of sand, constantly wet.

Alternatively, after thoroughly wetting, the concrete shall be covered with a layer of approved waterproof paper or plastic membrane kept in concrete.

Except in the case of surfaces to which concrete has subsequently to be bonded, the concrete may be cured by the application of an approved liquid curing membrane containing reflective pigments.

Application shall be made by low-pressure spray in accordance with the manufacturer's instructions. **On** vertical surfaces, the curing membrane shall be applied immediately after removing the formwork.

No concrete shall be allowed to become alternatively wet and dry.

The temperature of curing water shall be the concrete +20 °C.

General concrete shall be wet-cured for at least 7 days with a further 9 days of dry protection.

PEEGT will not authorize pouring of the concrete until the contractor presents his curing system for approval.

curing process is part of the concrete fabrication process and consequently the Contractor must ensure that it takes place properly.

PEEGT may reject badly cured concrete, the Contractor shall be obliged to repair or replace the concrete without any compensation.

C5.3.1.7 Finishes for concrete

The Contractor shall state precisely on his plans which of the types of finishes described hereunder he intends to use in the various locations. **Any** defective concrete finish will be rejected. **The** *PEEGT* may at his discretion order the defects to cut out and make good. **Plastering** of defective concrete, as a making good will be permitted, except that in the case of minor ...

The *PEEGT* may approve a surface treatment by rubbing down with cement and sand mortar of the same richness as in the concrete. **This** treatment shall be made immediately after removing the formwork.

C5.3.17.1 Formed finishes for concrete

a) Type F.1

This finish is for surfaces against which back fill or further concrete will be placed. **Formwork** shall consist of sawn boards, sheet metal or any other suitable material, which will prevent the loss of grout when the concrete is vibrated.

b) Type F.2

This finish is for surfaces, which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a type F.2 finish shall be faced with wrought and thickness boards with square edges arranged in a uniform pattern.

Alternatively, plywood or metal panels may be used if they free from defects likely to detract from the general appearance of the finished surface.

Joints between the boards and panels shall be horizontal and vertical unless otherwise directed.

This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods approved by the *PEEGT*.

c) Type F.3

This finish is for surfaces prominently exposed to view where good appearance and alignment are of special importance. To achieve this finish; the formwork shall be faced with plywood or equivalent material in large sheets.

The sheets shall be arranged in an approved uniform pattern. .

All joint between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets.

C5.3.17.2 Unformed finishes to concrete

a) Type U.1

This is accreted finish for surfaces of roads or of foundations, beds, slabs and structured members to be covered by backfills, subsequent stages of construction, bonded concrete, topping or cement mortar beds to receive paving and on exposed surfaces or paving where superior finish is not required.

It is also the first stage for finishes Type U.2 and U.3. **The** finishing operations shall consist of leveling and screening the concrete to produce a uniform plane or ridged surface, surplus concrete being struck off by straight edge immediately after compaction.

b) Type U.2

This is a floated finish for of beds and slabs to receive mastic paving or block or tile paving where a hard smooth steel – troweled surface is not required.

Floating shall be done only after the concrete has hardened sufficiently and may be done by hand or machine. Care shall be taken that the concrete is not worked more than is necessary to produce a uniform surface free from screed marks.

c) Type U.3

This is a hard smooth steel – toweled finish for surfaces of concrete paving, tops of walls, exposed surfaces of engine and plant foundations and in the vicinity of holding down bolt chases, copings and other members exposed to weathering, surface beds and slabs to receive thin flexible sheet and tile paving bedded in adhesive and seating for bearing plates and the like where the metal is in direct contact with the concrete. **Toweling** shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked to the surface. **The** surface shall be toweled under firm pressure and left free from trowel marks.

C5.4 Form work

C5.4.1 General

The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. **The** formwork shall be designed for the loads, lateral pressure and allowable stresses outlined in chapter 1, Design of “ Recommended Practice for Concrete Formwork “(ACI 347) or equivalent and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.

The formwork shall be so constructed that it results in a final structure, which conforms, to the shape, lines and dimensions of the members as required by the drawings and these specifications.

To maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork prior to hardening of the concrete.

To maintain the specified tolerances appositve means of adjustment such as

Wedge, jacks or other means shall be provided for the vertical shores, horizontal struts and diagonal bracing and all settlement shall be taken up during concrete placing operations. **The** forms shall be securely braced against lateral deflections.

The Contractor shall submit for the approval of the *PEEGT* details of the methods and materials proposed for shuttering each section of the work.

In addition, if he required, he shall submit his calculations for approval.

On formwork to external faces, which will be permanently exposed, all horizontal and vertical formwork joints shall be so arranged that joint lines will forms a uniform pattern on the face of the concrete. **Where** the Contractor proposes to make up the formwork from standard sized manufactured formwork panels, the size of such panels shall be approved by the *PEEGT* before they are used in the construction of the works. **The** finished appearance of the entire elevation of the structure and adjoining structures shall be considered when planning the pattern of joint lines caused by formwork and by construction joints to ensure continuity of horizontal and vertical lines.

Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and like, splits or other defects, and all formwork shall be clean and free from standing water, dirt, shavings, chipping or other material. **Joints** shall be sufficiently watertight to prevent the escape of mortar or the formation of fins or other blemishes on the concrete.

Formwork shall be provided for the top surfaces of sloping work where the slope exceeds fifteen degrees from the horizontal and shall be anchored to enable the concrete to be properly compacted and to prevent flotation, care being taken to prevent air being trapped.

Openings for inspection of the inside of the formwork and for the removal of water used for washing down shall be provided and so formed as to be easily closed before placing concrete. **Before** placing concrete, all bolts, pipes for conduits or any other fixtures which are to be embedded shall be fixed in their correct positions, and cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without the approval of the *PEEGT*.

All exterior angles on the finished concrete of 90 or less shall be given 20 mm by 20 mm chamfers unless otherwise ordered by the *PEEGT*.

No ties or bolts or other device shall be built into the concrete, for the purpose of supporting formwork without the prior approval of the *PEEGT*. The whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50 mm from the surface in the case of reinforced CONCRETE AND 150mm in the case of un- reinforced concrete. Holes left after removal of such supports shall be neatly filled with well rammed dry – pack mortar.

Formwork in contact with the concrete shall be treated with a suitable non – staining mould oil to prevent adherence of the concrete except where the surface is subsequently to be rendered. **Care** shall be taken to prevent the oil from coming in contact with reinforcement or with concrete at construction joints. Surface retarding agents shall be used only where ordered by the *PEEGT*

C5.4.2 Removal of formwork

Formwork shall be so designed as to permit easy removal without resorting to hammering or levering against the surface of the concrete.

The periods of time elapsing between the placing of the concrete and the staking of the formwork shall be as approved by the *PEEGT* after consideration of the loads likely to be imposed on the concrete and shall in any case be not less than the periods shown in the table below. **Where** the formwork is constructed in a manner that allows the removal of the majority of the formwork and the retention during and after such removal of a sufficient number of adequate supporting props in an undisturbed condition the contractor may with the agreement of the *PEEGT* remove the formwork at the earlier times listed below provided that the props are left in position.

| Position | Time for striking using ordinary Portland cement | |
|---------------------------------|--|----------------------------------|
| | Normal weather Above 15 C (60 F) | Cold weather Above 2 C (60 F) |
| | Days | Days |
| Beam sides, walls and columns | 1 | 3 |
| Slabs (props left under) | 3 | 5 |
| Props to slabs | 7 | 14 |
| Beam soffits (props left under) | 7 | 10 |
| Props to beams | 14 | 21 |

Notwithstanding the foregoing the contractor shall be held responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

C5.5 Reinforcement steel work

C5.5.1 General

The work to which this specification refers consists of supply, by the contractor, of steel reinforcement bars, and also the operation of cutting, bending, anchoring and installing the bars, including spacers, saddles and other metal accessories required for installation of the reinforcements in the concrete structures.

The reinforcement steel specifications, which are not included in the following articles, shall be in accordance with the standards of the American Concrete Institute ACI standards 315 and 318 – 71 or equivalent.

The following articles specify the general properties of the steels which can be used in the different structures, special preference being accorded to use of deformed steel bars for the main structures, slabs, foundations, walls, prefabricated elements, etc.

C5.5.1.1 Plain steel bars

The material which is used must be plain bar steel with yield point of 34.200 psi, conforming with ASTM standards A15, A - 431 and A - 432 (ICONTEC No. 161) or equivalent (stirrups and similar).

C5.5.1.2 Deformed steel bars

The deformed steel reinforcement bars shall be of intermediate or hard grade (Gr. 60 and / or Cr. 40) manufactured in accordance with ASTM Standard A 615 – 68 or equivalent with respective yield points of 60.00 and 40.000 psi.

C5.5.1.3 high – strength steel

The high strength corrugated reinforcement bars shall satisfy the requirement contained in ASTM standards A – 431 and a 432 or equivalent.

C5.5.2 Cutting and bending

The cutting and forming of the bars shall be done in accordance with what is indicated in the plans and details and in conformity with ACI standards or equivalent. All of the bars shall be cut to the exact length and bent cold, in conformity with the required forms and dimensions.

It is not permissible to bend the rods projecting from the concrete after the concrete has been poured.

The bending for stirrups and moorings shall be done around a mandrel not smaller than 4 times the diameter of the bar. For the bending of the bars this mandrel's diameter shall be at least 5 times the diameter of the bar, which is to be bent.

The length of the overlaps shall be equivalent to 50 diameters in the case of main bars and 25 diameters in the case of secondary bars.

If the diameters of the bars to be overlapped are different, the larger diameter shall be used for the purpose of determining the length of the overlap.

C5.5.3. Installation and fixing

The installation of the reinforcement bars includes all of the operations necessary for forming hook and installing the cut and bent steel reinforcement bars used for the reinforced concrete.

The reinforcement bars shall be prepared adequately prior to their use in the structures. The separation distances at which the reinforcement bars shall be installed, as indicated in the plans, shall be taken as being from center to center, unless specifically indicate otherwise. The exact position, overlap, size and from of the bars shall be as indicated in the plans. Before the bars and their metal supports are installed, these surfaces shall be cleared of rust, dust, grease and other substances, and shall be kept clean until they are embedded in the concrete.

The bars shall be installed and fixed precisely in place. Their position and their spacing from the forms shall be maintained by mean of supports, blocks, moorings, hangers or other approved supports, so that no movements can occur during the pouring of the concrete and until the final setting thereof.

The blocks shall be prefabricated using mortar. It is not permissible to use pebbles, lumps of stone or brick, pieces of metal or blocks of wood. The necessary care shall be taken to utilize in the best way the length of the reinforcing bars.

All of the connections of deformed bars with maximum yield point of 4.200 kg/cm² shall have an overlap not less than 25 times the nominal diameter of the bar.

C5.5.4 Covering of reinforcements

This article establishes the minimum distances for separation and protection of reinforcements in concrete, i.e. the distance between the outside face of the concrete and the outside edge of the reinforcement bar, taking the distance normal to the reinforcement.

| <u>Type of Structure</u> | <u>Separation</u> |
|---|-------------------|
| Shoes | 70 mm |
| Structures located on the ground without forms | 70 mm |
| Structures located on the ground with forms | 50 mm 50 mm |
| Outdoor structures cast in forms | |
| Slabs and walls not exposed to the weather and not located on the ground | 20 mm |
| Beams and columns not exposed to the weather and not located on the ground | 40 mm |
| Prefabricated elements exposed to the weather | 25 mm |
| Prefabricated elements not exposed to the weather | 20 mm |

C5.5.5 Storage and cleaning

The reinforcement bars shall be stored under cover and shall be placed on supports of which the spacing and height prevent the bars from contacting the ground. The bundles of bars shall be covered with sheets to protect the steel against dust and elements, which cause oxidation. The bars shall be bundled in groups of the same size and quality, with markings indicating the quantity, weight, length and diameter.

C5.6 Steel structures

C5.6.1 General

The contractor shall in accordance with this section, carry out construction and erection of all of the elements of the steel structures in conformity with the plans the *PEEGT* approval being required.

All of the structures, which are constructed of structural steel, shall be in accordance with the requirements of the AISC standard titled "specifications for the design, Fabrication and Erection of structural steel of Building " in its seventh edition or equivalent.

The methods of working, handling and quality control of materials shall be in accordance with the corresponding standards, including the following:

| | |
|------|---|
| ASTM | American Society for Testing and Material or equivalent |
| ASA | American Standards Association or equivalent |
| AISC | American Institute of Steel construction or equivalent |
| AWS | American Welding Society or equivalent |
| NEC | National Electric Code or equivalent |
| NESC | National electric Safety Code or equivalent |
| SAC | Syrian Arabic Code |

C5.6.2 Shop drawings

The contractor shall submit to the *PEEGT* for approval detailed plan of each of the required structures. The plans and other elements which the contractor submits for approval shall give complete information for complete fabrication of all of the components of each structure, including the location, type and size of the bolts and welds which will be used. Also, they shall clearly indicate which of these connections will be made in the factory and which will be made at the erection site

The nomenclature and symbols of the welds and bolts shall be in accordance with those of the AWS or equivalent.

Other symbols can be used if the plans have a clear explanation of them and the same nomenclature is used for all the works.

The plans shall also indicate the mechanical properties of the materials used both for the members and for their connections, and shall give details permitting correct fabrication and erection of each structure.

The contractor cannot commence the fabrication of the structures until he has received the *PEEGT* approval of the calculation sheets and of the corresponding design and fabrication plans. Such approval will be granted in accordance with the criteria and standards contained in these specifications.

C5.6.3 Preparation of steel

A complete new coat of prime paint shall be applied to all surfaces of structural steel materials, all accessible surfaces of field welds and ungalvanized field connection bolts, and damaged galvanized surfaces shall be cleaned.

C5.6.4 Materials

All of the steel elements to be used, including the structural steel, cast steel, forged steel, bolts and welding materials, shall be in accordance with ASTM specifications or equivalent.

The contractor shall submit to the *PEEGT* appropriate evidence that all of the materials to be used in the fabrication and construction of the structures will be in accordance with the plans and with what is stipulated in this specification.

Appropriate evidence that the structural steel used is of acceptable quality will be constituted by certified reports of tests performed in the steel plant, by the fabrication of the structures or by an approved independent.

The tests performed on the steel shall be in accordance with ASTM specification A6, or equivalent.

The maximum allowable deviation for alignment defects, warping or twisting shall be 2 mm per meter of length of the shape.

C5.6.5 Storage

C5.6.6 Fabrication

The fabrication of the structures shall be performed on the basis of the drawings approved by the *PEEGT* and in accordance with what is stipulated in these specifications.

All of the materials shall be clean and straight, the straightening shall be done in such manner that no deterioration of any kind occurs.

The holes provided for insertion of bolts shall be of diameter 1.5 mm larger than the nominal diameter of the bolt as indicated in the construction plan. If the thickness of the material is not more than 3 mm greater than the nominal diameter of the bolt, the holes can be made by punching. Otherwise, the holes shall be drilled with a bit.

The holes shall have cylindrical walls. No irregular widening of the holes will be permitted.

Bolt-holes, which are located close to bends, shall be made after the bending, in order to avoid distortion.

Any burrs, which remain after the punching or drilling, shall be removed with an appropriate tool after the galvanizing or painting of the part.

The bending should preferably be done cold.

Oxygen cutting shall be performed only in the case of sheets of thickness greater than 13 mm. Shears or saws should preferably be used for the cutting.

Edges, which have roughness, burrs, cutting lines or any other irregularity, which might cause difficulty in the fabrication and / or erection of the structures, shall be eliminated by grinding.

All of the parts of an assembly shall be assembled by means of temporary bolted connections made with ordinary bolts, for inspection purposes.

The differences resulting from alignment defects of the fabricated structures which will be subjected to compression stresses shall not exceed 1/1.000 of the between lateral support point. The complete bars shall not have twists, bends or open joints.

A deviation of 0.8 mm (1/32") will be allowable in the length of bars of which the support ends are finished by mechanical means such as planning machines, saws or girding wheels.

In the case of structures which are connected to other structures without finished support ends, a maximum difference of 1.6 mm (1/16") is allowed on their length for parts of up to 9 meters length, and of 3.2 mm (1/8") for parts of length greater than 9 meters, between the measurements of the plan and the measurements of the fabricated part.

Reaming is not permitted for correction of boll-hole placement errors.

The minimum distances between bolt centers and between hole centers and edges of the elements which make the connections shall conform with all of the specifications of the "Manual of steel construction" of the American Institute of Steel Construction (AISC) in its most recent edition, or equivalent.

C5.6.7 Erection

Before commencing the erection of the metal structures it is necessary to check all of the reference axes and the levels of the supports, to confirm that they are in accordance of the anchoring elements, embedded in the concrete.

The structures, which are to be erected, shall be assembled in the appropriate order.

They shall be placed plumb in the required positions in accordance with the plans and shall be temporary supported by means of brackets and diagonal elements until the structure can support it self without danger.

The columns and other elements which are to be based on concrete supports shall be placed at their correct level by means of steel sheets and temporary plates and the grouting concrete shall be put in only when correct positioning of the other members related to them has been confirmed. Erection of these structures can be commenced only when the concrete supports have required the strength necessary for bearing all of the loads imposed by the structure and the erection process.

The erection work shall be executed in such manner that the members of the structure do not sustain damage in the galvanizing, or permanent deformations, and are not subjected to stresses greater than those considered in the design.

During the erection works, the connections shall be secured sufficiently to withstand all loads such as he structure's own weight live loads, wind loads and erection loads.

The unions of the frameworks shall only be permanently tightened or welded when it has been confirmed that the frameworks are perfectly positioned in the system to form a complete network.

The vertical bolts shall be installed with the head upward. The other bolts shall be installed so that the head is situated on the upper or outer side of the member concerned.

The bolts shall be tightened with adjusting spanners or torque wrenches which are of the same size as the nut or the bolt head. Use of improper wrenches is not permissible.

The holes of the different elements of each connection coincide so that cutting or reaming thereof is not necessary to permit the bolts to be inserted. Moreover, displacements of the members, which might cause permanent deformations of the holes of the connections, are not permitted.

The contractor shall leave the structures free from any foreign matter, which adhered to their members before and / or during the erection works.

During the erection works the contractor shall adopt all measures, which are necessary to prevent injuries to persons and damage to the neighboring works.

In the erection of the steel structures, in the individual positioning of the parts a maximum difference equivalent to 1/500 is allowed between the measurements indicated in the plan and the measurements taken at the site, both for the verticality and for the other positions.

When the erection of the structures has been completely finished to the satisfaction of the *PEEGT* general cleaning of all of the shapes shall be performed (by means of steel brushes).

C5.6.8 Galvanizing and painting

The structures for which the orders such shall be galvanized by the hot – dip process. **This** process shall result in the depositing of a protective zinc coating which adheres tenaciously to the parent metal over its entire surface.

After the completion of the fabrication works, except for the threading of the nuts, all of the steel parts are cleared of before they are hot – dip galvanized.

The works of preparation for galvanizing and / or the actual galvanizing not in any way adversely affect the mechanical properties of the steel. **It** is necessary to avoid buckling or twisting of members, which, because of their length, cannot be wholly immersed in the zinc bath.

The quality of the material used in the process conforms to one of the zinc grades of “Specification BG for Zinc Metal (Slab Zinc), Manual Book of ASTM Standards, Parts 7 and 8 or equivalent.

The galvanizing process shall be performed in accordance with the specifications of “Zinc (Hot Galvanized) coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip “, ASTM designation A123, or equivalent.

In order to avoid impairment of the ductility and strength of the steel, which may be caused by the galvanizing process, it is necessary to follow the recommendation contained in ASTM standard A143, or equivalent.

The threads of the nuts shall be finished after the galvanizing process, so that the nuts can be rotated freely on the galvanized surface of the bolts.

The zinc coating shall be protected so that it does not sustain any damage during the operations of transportation and erection of the structures.

The zinc coating shall be smooth, clean, uniform, continuous and free from defects.

The surplus zinc on bolts, nuts, lock – nuts and washers shall be removed by centrifuging.

Defects such as excessive variations in the thickness of the zinc coat, excessive roughness, lack of adherence of the zinc to the steel and other defects which, in the *PEEGT* opinion, indicate that the galvanizing was not executed satisfactorily, constitute sufficient cause for the parts concerned to be rejected. **Damage** to the galvanizing which results in loss of the zinc coating to the extent that the steel is exposed, during the operations of fabrication, transportation, handling or erection, constitute sufficient cause for the parts concerned to be rejected.

The painting of the structures shall be done in accordance with chapter C5.10.

C5.6.9 Welding

If the welds shall be executed by the electric is process, using electrodes of the type having special covering for welding in all positions. The projecting weld over thickness shall be removed by grinding.

The contractor shall execute all welds in accordance with the dimensions; locations, type of electrode and other details specified in the fabrication and erection plans.

The electrodes shall be stored in their original packing in a dry place, with appropriate protection against the weather.

Electrodes, which have areas where the flux covering is broken, or damage shall be rejected.

If the electrodes seem to have suffered the moisture but do not have any other damage, they can only be used when they have been dried in satisfactory manner.

In the case of full – penetration butt welds, when these shall be executed on both sides, the bottom of the weld which is executed first shall be grooved by chisel or adequate means down to the clean metal before the weld on the other side is commenced. Unless it is evident that the procedure used permits complete fusion to be obtained without need for slotting.

After each welding pass, any slag, which has been deposited, shall be removed completely.

In the joints which have cracks, inclusions of slag, large pores or cavities, etc., or in which the filler metal overlaps that of the welded parts without adequate fusion, the defective portions shall be cut or beveled out and the joint shall be welded again.

C5.6.10 Inspection

The materials and workmanship shall be subject to inspection by the PEEGT who will inform the contractor of any faults discovered in the materials, in the fabrication or in the erection, which constitute deviations from and / or contraventions of these specifications and/ or the plans.

C5.6.10.1 Inspection of Materials

The PEEGT may inspect the steel material which the contractor is going to use in the fabrication of the structures and may require presentation of mill sheets for confirmation of the quality of the material. Shapes, which have appreciable cracks, twists and other defects, will be rejected.

The contractor shall provide all necessary cooperation to enable the PEEGT to perform his inspection of the materials satisfactorily.

C5.6.10.2 Inspection during the fabrication works

The contractor is obliged to cooperate effectively in all necessary respects in order to facilitate the inspection operations, which the PEEGT shall perform during the process of fabrication of the frameworks, and shall provide the personnel and tools required for moving the parts in order to check the alignments and all other construction details.

C5.6.10.3 Inspection during the erection works

The Contractor shall collaborate completely and unrestrictedly with the PEEGT for performance of the subsequent inspections of the works during the erection, and shall provide the personnel, tools and scaffoldings, which are required.

C5.6.10.4 Inspection of welds

The inspection of the welds will be performed in accordance with what is specified in the "Standard for Welding in Construction of Buildings" of the American Welding Society or equivalent.

C5.6.10.5 Rejections

Any irregularity or deviation or defect which is discovered in the materials or elements of the structure shall be corrected, or the necessary replacement shall be provided, in accordance with the *PEEGT* instructions. **Such** corrections or replacements shall be executed by the contractor at his own expense.

C5.6.10.6 Markings

The markings shall be in conformity with ASTM standard A6 or equivalent. In order to ensure adequate identification during the erection works, each of the members of the structures shall be identified by means of a mark stamped in the steel.

The mark shall identify the position of the member or connection in the structure, and the type of steel of the marked element.

The erection plans shall clearly indicate the position of each of the members of the structure by means of the corresponding erection number. **Members**, which bear the same erection number, shall be identical and interchangeable. The marks used to identify the elements in the assembly and detail plans shall be the same as those stamped on the corresponding elements.

C5.6.11 Bolting

The installation of high strength bolts and tools and equipment shall conform to all requirements for A325 bolts of the "specifications for Structural Joints Using ASTM A325 or A490 Bolts" or equivalent including the commentary given therewith, as approved by the research council on riveted and bolted structural joint of the engineering foundation, and endorsed by AISC, except as otherwise modified and supplemented herein.

Heightening shall be done using either the calibrated wrench method or the "turn - of - nut" method. The work shall be done by competent and experienced bolting crews.

If the bolts are tightened by the calibrated wrench method, each impact wrench

shall be calibrated at the start of each day's work and at least once during the day.

Calibration records showing the serial number of each wrench used shall be submitted weekly to the wrench calibration shall be performed using the same diameter and length of nose and air pressure used during the tightening of the bolts. With either tightening method, a washer shall be used under the element turned in tightening.

For either method, bolted connection shall be drifted to proper position and the holes inspected to insure that bolt threads will not be damaged by forcing the bolts in place.

Connections shall be tightly drawn together using not less than 25 percent of the total number of bolts in the completed joint but never less than two bolts. **Bolts** for initial tightening shall be distributed uniformly about the joint either fitting - up bolts or high strength bolts may be used for this purpose.

Smooth leveled washers shall be used when the bearing faces of the bolted parts have a slope of 1: 20 or greater with respect to a plane normal to the bolt axis.

Any ASTM A325 bolt or equivalent, which has been, tightened more than one – half turn beyond “ snug tight “ shall not be loosened and retightened. All such bolts shall be discarded and new bolts used in their place.

The tightened bolts shall be checked at random as directed by and in the presence of the *PEEGT*. **Calibrated** hand torque wrenches and the necessary platforms, equipment, and personnel shall be provided for the random check.

The torque wrench shall be constructed so that it will visually or audibly indicate when the proper torque is reached. For ASTM A325 bolts or equivalent the wrench shall be calibrated to indicate a torque equivalent to bolt tension of 18.000 kg for 22 mm (39.000 lbs for 7/8 inch) bolts .the number of bolts checked shall be acceptable to the *PEEGT* based upon his observance of the quality and completeness of the tightening operations. A **minimum** of 10 percent of the bolts in each connection, but not less than two bolts in each connection, shall be checked.

C5.7 Miscellaneous metal

C5.7.1 General

Before fabrication of any miscellaneous metal is started, shop drawings shall be submitted for approval to the *PEEGT*.

These drawings shall include all details of miscellaneous metal required to complete this section of work.

All material shall be well finished bars, plates, strips, angles, rolled sections, extruded sections, pipes, etc., as indicated and specified, clean and free from mill scale, flake rust pitting.

Cast iron shall be soft, tough gray iron.

Accessories for connection of cast iron shall be so treated after fabrication.

Ferrous and non-ferrous materials shall be well formed to shape and size, with sharp lines and angles. Shearing and punching shall leave clean, true lines and surfaces.

Shop connections shall be welded.

Field connections shall not be riveted, but shall be bolted or welded in exposed work and finished work, except as otherwise indicated or required.

Screws shall not be use, where avoidable.

All mitered corners shall be ground after shop welding.

Joints and intersections shall be accurately made, in true pines, with adequate fastening.

Bolted work shall be screwed up tight and threads nicked to prevent loosening except those miscellaneous metal items to be removable or portable and shall have lock or split washers.

Joints exposed to weather shall be watertight.

Castings shall be free from warp or defects that impair their strength or appearance.

Exposed surfaces shall have smooth finish and well defined, sharp lines and arises.

Joints shall be milled to a close fit.

The contractor shall be guided by final, verified measurements and dimensions required for his work, at the time of approval of his shop drawings, and he shall attach to his works, as required, all socket, anchors, other parts for jointing materials under his shop work.

He shall further perform all shop requirements of cutting, drilling, tapping and fitting to accommodate other work coming in contact or passing through his material.

The Contractor shall ascertain and take particular care that all holes, cut outs, etc, have been provided as no claim for extra payment on this account will be considered or allowed.

Side rails shall consist of 62 cm x 0.9 cm (2-1/2"x 3/8) flat bars.

C5.7. 2 Shop painting

All miscellaneous steel, not incased or contacting concrete, shall receive two shop Coats of protective paint.

C5.7.3 Pipe hand rails

C5.7.4 Steel ladders

Ladders shall be securely fastened at top and bottom into wall and shall have intermediate clips or flats and fastening spaced not more than 183 cm (6') apart.

Clips or flats shall be welded to side rails.

Anchors or fastenings within masonry shall be diameters by 30 cm (1') long.

Vertical centerline of steel rungs shall be more than 20 cm from face of wall.

Ladder required in other locations shall be anchored as required.

C5.7. 5 Fence

The height of the fence shall be as indicated Chapter C3. 4.

Accessories for the fence shall be top grade and consist of the following.

C5.7.5.1 Perimeter Fence.

- **Perimeter** security fence the site of the subststion shall be made of (150)mm and (200)mm hollow concete blocks supported by reinforced cast – in place or ready mix concrete foundations , columns and top and bottom beams .

- The fence shall be plastered and covered with white local stone with suitable decoration and fitted with suitable electrical leighting – one over each column or any suitable acceptable solution , The height shall be (3) m ,and it will have suitable metalic main gate at the entrance of the s/s with personal entrance and have manual and electrical movement and have grounding connected to the main earthing net .

Fencing shall be straight and true, tight and secure, and shall follow contours and lines

Provide removable fencing where necessary.

C5.8 Building work

C5.8.1 Brickwork

Bricks shall be best quality providing. **These** are available in sufficient quantities and quality locally. **They** shall be hard, square, even in size and free from soluble soleplates. Samples of bricks to be used in the work shall be submitted to the "PEEGT " for his prior approval. All bricks delivered to the works shall be in all respects up to the standard of the approval samples. **If** any deliveries vary from the standard of the samples, such bricks shall be rejected and removed from the site.

Bricks shall be well soaked before use in hot weather and the tops of unfinished walls shall be wetted before work is recommended. Bricks shall be well buttered with mortar before work being laid and joints thoroughly flushed up as work proceeds.

The Contractor shall ensure that horizontal courses are laid straight and level, that vertical joints are truly in line, that joints are of even depth, that mortar is of consistent color throughout, and the surface is plane and clean.

Brickwork shall be carried out in a uniform manner, no one portion being raised more than 1.0 m above another at any one time. **The joint thickness** shall be such as to give four courses of brickwork to 300mm.

Faced work shall be kept perfectly clean and no rubbing down will be allowed. Scaffold boards shall be turned back during heavy rain and at night to avoid splashing, and newly laid brickwork shall be protected with suitable cover.

Lime mortar shall consist of cement, lime and sand in the proportions of 1:1:6 unless otherwise ordered by the *PEEGT*. **Lime mortar** shall be used for brickwork above the ground level damp proof course unless otherwise ordered by the *PEEGT*.

Cement mortar shall generally be used for brickwork in chambers etc., and shall consist of cement and sand in the proportion 1:3 by volume.

Cement shall be ordinary Portland cement, ASTM C200, or equivalent. **Lime** shall be non-hydraulic lime or semi-hydraulic lime. **Sand** shall be clean natural sand free from clay or clay film over the grains or shall be crushed natural stone of approved quality.

Water used for mixing mortar shall be from the same source as water used for concrete.

Cement and lime shall be stored at the Site in a perfectly dry structure and all consignments shall be used in order of delivery.

Cement and lime affected by dampness shall not be used in the Works.

Lime and sand shall be mixed on a clean and water - tight platform and water added until a suitable consistency is obtained. **This mixture** may be left to stand for the day's working if desired. Immediately before use, cement and further water shall be added and the whole shall be thoroughly mixed until a uniform color and consistency are obtained. **The final mixture** shall be used within one hour after mixing with cement.

Where approved by the *PEEGT* at plasticisers or proprietary masonry cements may be used as an alternative to lime in the mortar. In this case, the proportions of the mix shall be based upon the manufacturer's instructions but shall be the *PEEGT* approval.

C5.8.2 Lathing and plastering:

This section covers metal lath and plasterwork including supports and accessories.

Workmanship shall conform to the best practice and shall be performed by skilled craftsmen. All work and material for gypsum plaster shall conform to applicable provisions of ANSI A 4.2 and A42.4 or equivalent. All works and materials for Portland cement plaster shall conform to applicable provision of ANSI A42.3 or equivalent. Except otherwise specified, all plasterwork shall be three coats.

Lathing and plastering shall be coordinated with other building, electrical, heating, ventilating, and plumbing works. In general, all openings through the plaster shall be protected along the edges with metal grounds or casings made accurately to size and dimension.

Plaster and other cementations materials shall be kept dry until ready to be used; they shall be stored in an enclosed shelter; kept off the ground, and away from sweating walls and other damp surfaces.

Metal goods shall be protected against rusting. Damaged or deteriorated materials shall be removed from the site of the work.

Finishes shall be applied so that all surfaces are straight, true, smooth, even, plumb, and flush with grounds. **The** use of excessive water shall be avoided.

The finish coat shall be applied to a thoroughly dry base, which has been evenly dampened by brushing or spraying.

All plaster shall be protected from premature or uneven drying until thoroughly set. Plastered space shall be kept closed for maintaining humidity as possible. **As** soon as the plaster has set, free circulating of air shall be provide to avoid sweet-outs. Portland cement plaster shall be moistened for at least 48 hours.

The Contractor shall use drop cloths and other protective measures to protect all surfaces from accidental spraying, spattering, or spilling of plaster. **Any** damage resulting from his operation shall be repaired. All plaster deposited on surfaces which are not to be plastered shall be removed as soon as possible to the satisfaction of the *PEEGT*.

Plaster showing overspending, cracks, blisters, pits, checks, or discoloration will not be acceptable. **Such** plaster shall be removed and replaced with new plaster. **Patching** of defective work will be permitted only when acceptable to the *PEEGT* and such patching shall match work in texture and color.

The Contractor shall point up and patch as necessary around grilles, recessed light fixtures, and other openings, leaving all work in neat and finished condition.

At the completion of the finish plastering work, all duster daubs shall be cleaned from beads, screeds, and metal trim. **All** rubbish shall be removed from the building and floors shall be left broom dean. Excess material, scaffolding, tools, and other equipment shall be removed from the building and the project.

C5.8.3 Floors

C5.8.3.1 Slabs on grade

Slabs on grade shall be made according to the structural drawings on the gravel base, which has been duly compacted and prepared at the precise levels and then lean concrete -10- cm thickness,taking into account the standards of the specification concerning concretes. **Special** care shall be taken to observe the levels and slopes indicated in the detail plans.

Shrinking or construction joints shall be made every 6.00 meters in each direction.

An abrupt finish shall be applied to the surface of the slab on grade to ensure proper adherence for the subsequent finish of the floor.

Generally, reinforced concrete 210 kg/cm² on 28 days shall be used. The form work shall be made using straight and preferably planed timber board.

C5.8.3.3 Floors in terrazzo tiles

Samples shall be submitted for approval (color and pattern).

Terrazzo tiles shall be laid on 38 mm. thickness of 1/3 cement and sand. The joints shall be pointed with cement.

C5.8.3.4 Ceramic or porcelain floors or marble

Ceramic floor tiles of an approved quality, free of cracks and flaws shall be used. **They** shall also have the colors indicated by the plans or by the *PEEGT* .**The** cement mortar to be used for leveling the base floor shall be out of 1:3 mixture. **The** tiles shall be placed on uniform and white colored coat of cement.

Joints shall be executed with white cement and the connection of the ceramic tile flooring with adjoining floors shall be in line, sharp and without projection with copper or aluminum borders.

C5.8.3.5 Flooring out of crushed material or gravel

The minimum thickness of the crushed material shall be 1 inch with uniform grading. **The** surfaces upon to be applied the crushed material shall be leveled, compacted and free of undesirable materials, in the judgment of the *PEEGT*. **The** floor must be installed in tamped down layer 10 cm thick.

C5.8.3.6 Slab flooring:

Kind of flooring shall be out of prefabricated clay tablets, bricks or blocks. **They** shall be installed of 1:3 mortars. **The** installation of these tables is similar to that for the ceramic tile floors.

C5.8.3.7 Floors in concrete

The fine floor levels shall be straightened before inserting the flags on the concrete preparation, placing fixed level point at prudent distances and if there drains, leaving the distances required towards these.

A 1:4 binding mortar shall be poured with semi-washed sand, prudently dried and with a minimum thickness of 3 cm. **The** flags shall be immediately inserted; ensuring that the complete surface area is attached. When it is necessary to cut back the flags into special sizes, these shall be inserted in the least visible sites of the area. **The** flag joints shall be sealed with a cement grout, with a mineral colorant additive, of the same color as the flags supplied.

Before the cement grout hardens, the surface of the flags shall be suitably cleaned using dry rags in order to prevent staining the floor.

The floor shall be suitably protected to guarantee its conservation during worksite construction.

The finished flag surface shall be free of projections and salient in its joints and shall remain uniform and continuous. **The** floor shall be finally polished.

The flags to be used shall be of the finest quality.

The mortar shall be 1:4 mixtures with semi-washed average grain sand.

C5.8.3.8 Floors in mosaic tiles

The parts of the concrete preparation surface to be used for the installation of the tiles shall be cleaned and the surface shall be prepared with 1:4 mortar cement and sand, lightly wetted, giving suitable levels to the drains and leaving the surface well smoothed down and even. **The** tiles shall be inserted in agreement with the instructions given below before this layer of mortar has set.

Before installing the panels, all the panels must be checked to ascertain that they have the same tone and size.

The following procedure shall be taken for installing the panels:

1. **The** surface of the plaster shall be smoothed over leaving it to dry for at least one hour.
2. **A** cement grout of a suitable color shall be applied on the panel, completely filling in the spacing of the parts.

3. The panel shall be attached well aligned and smoothed over with a wooden trowel to ensure perfect adherence.
4. A cement grout shall be applied for pointing, using a brushed, until the grooves are even. The surface shall then be rubbed with stuffing, wool or paper until it is clean.
5. The surface of the floor is washed with stuffing soaked in a weak hydrochloric acid solution: nine (9) parts of water for one (1) of acid; afterwards with just water and finally it is polished.

C5.8. 3. 9 Floors in polished terrazzo

This item refers to the execution of floors in polished terrazzo. The Contractor shall previously prepare various samples of the types of terrazzo, which shall be submitted for the approval of the *PEEGT*.

The work shall be carried out as follows: In the first place, the slapping of the floor shall be completely cleaned and leveled. A basic layer shall be laid out afterwards in 1:3 mortar at least 3 cm thick in which a grid of No.14 wire shall be embedded, electrically welded. This grid may be replaced by a reinforcing which gives the same guarantees. The expansions in bronze shall be placed on this layer. They shall be immediately filled with the terrazzo composition in the colors selected, with a thickness of 1 cm and before the basic layer has completely set, in order to form a homogeneous layer, well tamped down to make a compact surface and an even floor level.

The terrazzo composition shall be made carefully mixing the material selected to produce the color chosen by the *PEEGT*.

White cement, marble powder and other foreign material, which could cause damage to the finish or produce cracking, shall not be mixed.

When the terrazzo mixture has been spread and tamped down, it shall be kept wet for a period of eight days following its application until the cement has set so that sprinkling does not affect the aggregate.

Defects, which could appear before the first and second polishing, shall be plugged with white cement forming the body of the initial mixture. Once the floor has been polished, it shall complete with a washed with a 10% solution of hydrochloric acid and then completed with a washing of fresh water. Finally the floor shall be polished.

C5.8. 3. 10 Floors in concrete

The concrete shall have strength of 210 kg/cm². The concrete shall be cast alternately on filling the squares. It shall be left to rest for at least 48 hours before removing the formwork.

A hot asphalt coating shall be applied in the edges of the already cast slabs, before carrying out the finish on the concrete slabs.

The maximum settlement of the concrete shall be 5 cm. When plate is reinforced, the reinforcing shall be inserted after the formwork has been established and before pouring the concrete, in agreement with the stipulations made in the corresponding structural plans, ensure that the former remains at bottom of the slab.

The formwork shall be very rigid, have straight edges and form squares of 3.00 × 3.00 m as maximum dimensions.

The surface shall be finished with a wooden rowel, with this treatment commencing when the setting or the concrete block has commenced.

C5.8. 3. 11 Floors in hardened concrete

The positions, which the future machines of the process areas have to occupy, shall be marked upon the concrete base, using red paint over the entire area of the space designated for each unit. **When** this operation is completed, the final floor shall be installed on the concrete base, leaving the space painted red free, which shall be made as follows:

Clean the surface of the concrete plating with a brush to remove all earth and soil coming from the construction.

Insert the water the concrete surface and apply a coat of dry mortar, strongly tamping it down and following the horizontal line of the guidelines with precision.

The mortar shall be left to stand until the water excess has disappeared (more or less two hours).

Once the Rock Top has been applied, the surface shall be normally smoothed over when this is in the hardening process, but yet still retaining a plastic state. Finally finish it using metal wool.

When the surface is smoothed over with metal wool, it remains smoother, harder and shinier.

After 24 hours, protect the surface of the concrete floor as carefully as possible so that there is no traffic over it or any possibility of surface scoring. **This** care must be kept for 7 days, after which the floor may be put into service .

The sites indicated for the machinery shall receive this latter treatment, with the spaces for making the bases and the corresponding anchoring remaining free, when the special specifications for the basis required by each machine are known.

The Rock Top shall be used at a rate of 3 kilos per square meter of surface area and the Consultant will supervise the proper application of the product with special care, precisely weighing the quantity of Rock Top necessary for each module.

Other products guaranteeing a satisfactory result may be used as substitute to the aforementioned provided that, the *PEEGT* authorizes it in writing.

Epoxy painting or similar as shall be done WITH approved color as a final finish .

C5.8. 4 Waterproofing

This section of the specifications covers all of the integrated or surface treatments, which shall applied to the surfaces exposed to the action of water.

Integrated waterproofing shall be provided by mixing an appropriate additive with the mortar.

All of the concrete coverings required for the works of the plant shall be constructed and waterproofed with:

- **Foam** concrete screed layer average 100 mm thick with slopes and quitters.
- **Covered** with cement plaster coat of min. 20 mm. thickness.
- **Elastomeric** bitumen with non-moved glass fiber reinforcement self-protection by colored granules under faced with sand 4 mm. thickness. It shall also extend at least 0.30 m up the walls.
- **Protection** cloth (water proofing) geotextial .
- **Insulation** layer material (5cm) .
- Crushed gravel – 5 cm – river sources

All of the accessories and materials required, and the method of applying the different layers of the waterproof covering, shall conform with the specifications of the manufacture of these materials and shall be approved previously by the *PEEGT*.

C5.8. 4. 1 Waterproofing of rooms provided with water outlets:

Integrated waterproofing shall be performed, using 1:3 mixture leaving the final coating at the correct height for application of the tiles.

The waterproofing shall not only be on the floor; it shall also extend at least 0.30 m up the walls.

The walls of the showers shall be completely waterproofed.

C5.8. 4.2 Waterproofing for tanks

When the tanks are constructed of, they shall receive integrated waterproofing.

If the *PEEGT* requires such additional interior waterproofing consisting of a coating with integrated waterproofing agent shall be executed in layers to a thickness of 2.5cm (1"). **This** work shall be executed as follows:

The adherence coating consisting of a coat applied by brush using mortar consisting of one part cement and one part washed sand wetted with a waterproofing solution in 1:10 proportion. **All** of the corers and angles shall previously be rounded using mortar with high content of waterproofing agent, in 1:3 proportion mixed with solution of waterproofing agent in 1:8 proportion to water by weight. **A** second waterproofing coat before it has completely set.

This second coat shall be of at least 1.27 cm (1/2") thickness and shall consist of mortar consisting of one part cement to 1.5 parts of washed sand, mixed with solution of the waterproofing agent until a consistency which permits normal application by trowel is obtained.

The floor of the tanks shall receive the following additional treatment. **After** the aforementioned adherence coat, mortar shall be applied to a thickness of 2.54 cm (1"). This mortar shall consist of one part of cement to 2.5 parts of washed sand mixed with waterproofing solution until water appears on the surface.

In all cases, the manufacturer's specification shall be followed in the mixing and application of the additive.

C5.8. 4. 3 Waterproofing for flower boxes

This waterproofing shall be executed with mortar containing waterproofing agent, which shall be applied to the inside surfaces of the flower box.

The procedure followed shall be the same as that followed for the waterproofing of tanks.

C5.8. 4. 4 Waterproofing of channel & beams

This waterproofing shall be executed with mortar in 1:3 proportion mixed with integrated waterproofing agent, used in accordance with the instructions of manufacturer's and in conformity with the specifications given above for the waterproofing of tanks.

C5.8. 5 Acoustic ceiling

This section covers acoustic ceiling materials, including steel supports and accessories. Workmanship shall conform to the best practice and shall be performed by skilled craftsmen.

Acoustic ceiling work shall be coordinated with other building, electrical, heating, ventilating, and plumbing work. Suspended ceiling support members shall be arranged to properly support fixtures and trims.

The acoustic ceilings shall be constructed with removal acoustic panels with ceiling diffusers and recessed lighting fixtures.

C5.8. 6 Glass and glazing

This section covers all glass and glazing for windows, doors, and other openings having glass.

Except as modified or supplemented herein, all glazing shall be done in accordance with the general conditions and applicable details set forth in the Flat Glass Marking Association Glazing Manual, or equivalent.

The Contractor shall obtain all glass sizes from measurements of the work at the site or from the manufacturer of the sash or frames in which the glass is to be set. In all cases, however, the Contractor shall assume the responsibility for the correctness of the size of the glass.

C5.8.7 Doors

C5.8. 7.1 Rolling doors

Roll-up curtain shall consist of horizontal elements made of steel, connected to each other in such manner that they form a uniform articulated joint throughout their length. The curtain shall be fabricated using sheet with thickness of 1.5 mm. The material used for the curtain-galvanized steel.

The lower part of the door shall element, which forms a single piece across the full width of the door. Under this element there must be a strip of vinyl so that good closure is obtained between the floor and the curtain.

The door shall have a steel lock and safely closing devices.

The vertical movement of the curtain shall be along guides consisting of steel channel. The minimum thickness of the steel sheet used shall be 5 mm.

The main shaft of the support of the door shall be made of carbon steel and shall be of sufficient diameter to be able to bear the weigh of the door, allowing deflection of 2 mm per meter of span. **The** shaft shall have sealed self-lubricating bearings.

The weight of the curtain shall be balanced by means of coil springs located on the main support shaft of the door. **These** springs shall be of sufficient strength to balance the weight of the door in any position. **The** springs shall be equipped with mechanisms whereby the spring tension can be adjusted.

The rolled-up curtain shall be housed in a galvanized steel housing of thickness greater than 10mm, with the corresponding bracing element to prevent deformation. **When** the door is installed, the guard shall be inside the building.

The supports shall be made of the sheet steel and shall be firmly attached to means of bolts to the main structure.

The doors shall be operated by means of a reduction gear and shall be operated manually and electrically .

C5.8. 7. 2 Metal doors

The metal doors shall be constructed of pressed cold rolled steel sheet free from warping or deformation. The frames shall consist of bent sheet of gauge 10.

They shall be fixed on the masonry by means of expansion bolts or, depending on the particular case, shall be welded to the metal structure.

The leave of the doors shall have surfaces consisting of two face sheet steel of gauge 18 and shall be welded onto a reinforcing frame consisting of bent sheet of gauge 14.

All of those external welds shall be ground with electric grinding wheels until a smooth surface is obtained. All of the fittings such as locks, hinges and other elements shall be of quality and type approved by the PEEGT and shall be coated with anti-corrosion coatings in accordance with the specifications for metal structures.

C5.8. 7. 3 Folding doors

These doors shall consist of folding-curtain leaves. The curtain is similar to that of the rolling doors, except that the component elements are located vertically.

The sheet steel used is galvanized.

To maintain the verticality of the door, a system of guide channels shall be provided in the floor and the upper beam.

Each sheet shall be mounted on the wall by means of anchoring embedded in the concrete and welded to the shaft of the door.

C5.8. 7.4 Sliding doors

The sliding doors shall be constructed of sheet steel of gauge 10 reinforced with steel angles located at the lower part of the door. The doors shall be opened by sliding horizontally on a lower channel and an upper guide and shall be operated manually and electrically .

C5.8. 7. 5 wooden doors

The wooden doors shall be two-faced and constructed of triplex plywood.

The frames shall be fastened to six treated blocks of 10 cm side length embedded in-the walls, by means of 10 cm (4") bolts which the heads are covered with pieces of wood.

The leaves shall be suspended from the frames by means of copper hinges with removable pins. For swing doors it is necessary to use a " floor and lintel" devices. The bottom edge of the doors must have clearance from 1 to 2.5 cm above the floor.

C5. 9 Cladding and proofing

C5.9. 1 Metal wall cladding

Metal wall cladding shall be protected metal sheeting suitable for long life and be maintenance free and adequate to withstand the climatic and site pollution conditions.

Samples of the proposed cladding shall be submitted to the PEEGT for approval. No orders shall be placed with manufactures until approval has been given.

C5.9.2 Rain water

The gutters shall be formed in suitable long lengths and the joint details, submitted for the Consultant's approval before manufacture. They shall be manufactured from galvanized steel.

They shall be formed with adequate outlets to fit into the rainwater down pipes.

All outlets are to be provided with galvanized wire balloons. Each gutter is to be fitted with suitable over flow points, all to the PEEGT approval.

C5.9.3 Metal roof cladding

Metal roof cladding shall be same material and profile as the metal wall cladding.

C5.9.4 Concrete roof

Concrete roofs may be either in sit concrete or precast concrete. Lightweight concrete screening graded to falls shall be laid on the completed roof slab.

Concrete roofs shall be water proofed according to the requirement of the specification "WATERPROOFING".

C5.10 Painting

C5.10.1 General

This section cover materials, tools and equipments for filed painting work, and application of paint.

Painting work shall include the preparation of surfaces to be painted, furnishing and application of paint materials, and work of a general nature incidental to painting which is required to properly execute and complete the painting work.

The ability of paint to protect, wear, weather and retain its appearance is dependent on proper surface preparation, and manner and technique of application. Class adherence to the Paint manufacturer's recommendations for surface preparation, spreading rate, and number of coats is required for each type of surface and coating.

Compliance by the Contractor to the minimum wet film requirements for each type of coating will be checked the PEEGT, or his representative with a wet mil thickness gage.

The wet mil thickness shall be as required to obtain the dry mil thickness, specified herein. The Contractor for all surfaces to be painted or coated.

C5.10.2 Surfaces to be painted

Except for those surfaces excluded hereinafter, all surfaces of all facilities constructed or otherwise incorporated in the substation under these specifications shall be painted.

Exposed surfaces shall mean all interior and exterior surfaces which are not encased or covered by the finished building structure of equipment and which are visible and/or accessible for painting.

The surfaces to be painted, which would be difficult or impossible to reach after all erection is complete, shall be finish painted at a stage during construction when it's possible to paint these areas. These surfaces are, specifically, the top of surfaces of all structural steel supporting grating and the surfaces of all girts, beams, columns, and beading against which metal wall panel is to be erected, or where such surfaces will be inaccessible after construction is completed.

Any abrade or damaged areas of shop painted surfaces of equipment or building materials, piping, valves, and hangers shall be cleaned and repaired before applying the specified paint, using the appropriate specified materials. Weld, high strength bolts, and other repaired iron or steel surfaces shall be cleaned and prime painted as soon as practicable after erection.

Exposed surfaces of galvanized electrical conduit boxes, and fittings shall be painted only where these surfaces are adjacent to painted parts of the building structure or equipment. **Galvanized** metal surfaces to be painted shall be painted using paint materials and colors selected for the adjacent building surfaces.

The Contractor shall repair and touch up all damaged or abraded surfaces and then repaint with the paint system specified for the particular surface.

C5.10.3 Surfaces not to be painted

Except as otherwise specified or directed by the *PEEGT*, the surfaces of the following materials shall not be painted.

- **Acoustical** ceiling materials, including metal pan type ceilings.
- **Aluminum** and stainless steel.
- **Brass**, bronze, and copper.
- **Brick** and glazed tile.
- **Cable** trays, except support.
- **Chromium** plate metals.
- **Sidewalks**, curbs, and paving.
- **Embedment**.
- **Galvanized** floor plates.
- **Galvanized** hand railing.
- **Galvanized** structural steel.
- **Galvanized** bus ducts.
- **Glazing**.
- **Galvanized** grating.
- **Hardware**.
- **Light** fixtures, except supports.
- **Porcelain** enameled surfaces.
- **Porcelain** bushing.
- **Terrazzo** and terrazzo tile.

C5.10.4 Material

Following are the types of paint materials, which shall be used on various types of surfaces. **These** materials shall be used except where special painting materials are specified.

All paint shall be delivered to the site original containers with labels intact. Except where tinting colors have been added by the supplier, Containers shall be unopened. **Pigments** and tinting colors shall be ground in oil or other liquid compatible with the paint vehicle. **Except** as otherwise specifically required, all paint shall be factory mixed in correct proportions and consistency suitable for direct application in warm weather without addition of thinner.

Paint for intermediate and finish coats shall, whenever possible, be products of the same manufacturer as the primer paint and shall be recommended by the manufacturer for application over the primer coat. **Intermediate** and finish coats shall not wrinkle, lift off, or otherwise damage the shop or field applied primer coat or shop applied finish coats.

Materials not specified but required for successful application of any specified paint or coating shall be of the brand and type recommended by the paint or coatings manufacturer.

Except as otherwise specified or accepted, the complete coating system of a single manufacturer shall be used on each surface.

When specified materials or a manufacturer have been discontinued, only substitutions recommended by that manufacturer will be accepted.

Others

Fire protection

The contractual design and materials of each substation and room shall be such that the spread of fire is related. Means of escape shall be provided to enable staff to get safety.

All doors shall open in the direction of personnel escape routes and all doors shall have panic – handles and magnetic door – holders.

The building shall be compartmented to the approval of the Engineer to restrict the spread of fire. Each fire-protected zone shall have a self-holding abroad button near the entrance.

Walls, floors and other barriers separating compartments shall be such as to give two hours or more fire resistance. Where cable pipes or ducts pass through compartment walls a barrier of non – combustible material shall be provided such that the resistance of the floor, etc.... is not reduced.

- **Doors**, which protect escape routes for safety of personnel – 1 hour.

- **Doors**, which prevent the spread of fire between compartments – 2 hours .the spread of fire or explosion from one transformer to another and to adjacent buildings shall be prevented by blast wall provided between each transformer or as directed by the engineer. Blast walls shall be reinforced concrete or reinforced concrete block work or as directed by the Engineer. Reinforced concrete bock work block bars, two every second course horizontally and one every block vertically. Where walls of building are sufficiently close to be risk and are not protected by a blast wall, such walls shall be designed as blast walls.

An oil drainage pit with broken stone shall be provided to contain and extinguish fire in escaping oil.

Transformer oil pits

An oil collection system shall be provided to contain all oil in the event of the leakage. The system shall be by a common oil drainage pits away from transformers and shunt reactors designed to collect leaking or drained oil from each equipment to affectively remove away oil in case of fire.

Capacity of common oil pits shall also take into consideration the quantity of water discharged by pressure water tank. Oil drainage system must be separated from the from the general system.

An approved electrically operated potable sump suitable for use in all sumps in the substation shall be provided. The pumps shall be suitable for use on both oil and water.

C.6 Annexes

CIVIL WORK

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OUT DOOR CONVENTIONAL S/S 230/66/20 K.V

PEEGT

NOTE:

Civil Works
should take in consideration the Following :
(1)

- ❑ All doors should be fitted with hydraulic pusher and panic handle.
- ❑ All drain pipes and sewage pipes on Buildings be covered totally by façade covering material (white local stone – Granete – tiles ...) .
- ❑ All electrical panels should be at least - 1 m- away from windows to keep the benefit from windows .
- ❑ When fence asked to be covered by white local stone then it should be done for two sides outer and insider ones and top of fence .
- ❑ All External doors and windows should fixed on marble frame when facades covered by granete tiles or on white local stone frame when facades covered by white local stone (All Internal doors fixed on marble frames) .
- ❑ All Buildings should be surrounded totally by pavements at least – 1m- width .
- ❑ At top of each column of fence should has Suitable Lighting Apparatus, With all needed cables and switches (or any other acceptable solution) .
- ❑ All big doors (roller – metallic -...) should fixed at sides on R.C. posts.
- ❑ Buildings should be – 20 cm – at least higher than top of roads .
- ❑ Longitudinal rails should be erected in transformer roads and level of top of rail should be same as top of road .
- ❑ Outer doors in control Building preferable to be double sheets metallic doors with needed R.C holding posts .
- ❑ Leveling and preparing the site of s/s area includes all obstacles of any type removing and demolishing (Asphalt road – old Building or rooms ...) , also removing of top agriculture soil which should be replaced by improved soil or river and rain water routes remains .
- ❑ Final level should be suitable and higher than surrounding areas and roads to avoid entering water into S/S area .
- ❑ Complete reinforced concrete surface drainage channels net should be studied and erected and poured outside S/S area .
- ❑ PEEGT responsibility shall be restricted only to handle the site of substation , and the contractor shall undertake the complete works for preparing the site to commence with execution works .
- ❑ Gratings for transformers pits should be galvanized .
- ❑ All concrete surfaces contacted with soil to be painted at least by two bituminous coating layer .
- ❑ Clear basement height under beams and cable trays not less than (190) cm.
- ❑ Floor of Kitchen and Gate house should be granite tiles .
- ❑ Slabs on Grade should be settled on broken stone- 20- cm at least and then -10-cm lean concrete .

(2)

- The site shall be protected by isolated reinforced concrete retaining walls at the all side of the neighboring river for all the height of the river and until the top surface of the S/S after backfilling till reaching the designed level and then fence over this R.C retaining walls with two cases as attached initial drawings one for the lower parts and the other one for the higher parts .
- The western side of the site should be raised to the acceptable height to avoid flooding and entering water from the nearby river , at the all width of s/s and till reaching the higher side of s/s ,with acceptable connecting with beside main road .
- Taking in consideration that water surface could be near top of soil in winter and spring when designing all substation structures and foundations .
- Taking in consideration to raise all levels of Buildings to avoid interring water in cable channels and basements .
- Thickness of gravel for this s/s at least -15- cm and special isolating good layer should be used in all switchyards to avoid seeds and plants growing in this area .
- Drainage from cable channels should be through pipes with slopes , and openings in channels ground slab should not be allowed .
- All existing things within s/s area should be demolished – crashed – evacuated – leveled ... by the contractor completely .
- S/S area could be in more than one level (230 k.v section – 66 k.v section) .
- All procedures and solutions should be taken by contractor in drainage to prevent water from entering into s/s area from surrounding and to depose water collected inside s/s area .
- Bidders should fill schedules – C– detailed civil prices for s/s .
- Lighting equipments in battery room should be anti acid proof and explosion proof .
- Control Building should contain at least two offices and one of them should have many wall coup boards fitted with locked solid wooden doors .
- Protection room could be (preferable) separate of control room inside control Building .
- Big and good trees should be left without damaging when they are out of equipment locations and switchyard –Buildings , especially at rout of s/s border .
- All small trees inside s/s area within switchyards and Buildings should be removed and evacuated by the contractor .
- When Facing that bearing soil level is lower than foundations level replacement certainly should be by cyclopean concrete .
- When transformer pit is also oil pit (oil pit is not separate) , then volume of transformer pit under stone and galvanized grating that holding the stone layer is equal at least to total volume of transformer oil .



NOTE:

Civil Works
should take in consideration the Following :
 (1)

- All doors should be fitted with hydraulic pusher and panic handle
- All drain pipes and sewage pipes on Buildings be covered totally by façade covering material (white local stone – Granete – tiles ...) or inside Block walls .
- All electrical panels should be at least 1/1 m- away from windows to keep the benefit from windows .
- When fence asked to be covered by white local stone then it should be done for two sides outer and insider ones and top of fence .
- All External doors and windows should fixed on marble frame when facades covered by granete tiles or on white local stone frame when facades covered by white local stone (All Internal doors fixed on marble frames) .
- All internal doors should be fixed on marble frames .
- All Buildings should be surrounded totally by pavements at least 1/1m width .
- At top of each column of fence should has Suitable Lighting Apparatus, With all needed cables and switches or any other suitable acceptable solution .
- All big doors (roller – metallic -...) should fixed at sides on R.C. posts.
- Buildings should be – 20 cm – at least higher than top of roads .
- Longitudinal rails should be erected in transformer roads and level of top of rail should be same as top of road .
- Outer doors in control Building preferable to be double sheets metallic doors with needed R.C holding posts .
- Leveling and preparing the site includes all obstacles of any type removing and demolishing, also removing of top agriculture soil which should be replaced by improved soil or river and rain water routes remains and level of s/s should be raised about (30-50) cm higher than surrounding .
- Final level should be suitable and higher than surrounding areas and roads to avoid entering water into S/S area .
- Complete surface drainage net should be studied and erected and poured outside S/S area .
- PEEGT responsibility shall be restricted only to handle the site of substation , and the contractor shall undertake the complete works for preparing the site to commence with execution works .
- Gratings for transformers pits should be hot dip galvanized .
- All concrete surfaces contacted with soil to be painted at least by two bituminous coating layer .
- Clear basement height under beams and cable trays not less than (190) cm.
- Floor of Kitchen and Gate house should be granite tiles .
- Steel structure tests should be held with the presence of PEEGT civil engineers representative .

CIVIL WORK

OUT DOOR CONVENTIONAL S/S 230/66/20 K.V

PEEGT

(1)




- **Any** item not included in the contractual schedules will be referred to in civil book volume -4-
- **Fire** alarm system and fire fighting system .
- **Transformer** foundation with needed oil collecting pits , jack lifting foundations, pulling transformer foundations ...
- **Complete** rain water drainage system for roofs and out let pipes should be drained by suitable solution .
- **Complete** rain water drainage system for switchyards connected to the main or any other suitable solution .
- **Pavements** should be erected all around Buildings which must be inter lock type or similar about (1.5) m and (1) m for main road .
- **Metallic** doors and sliding doors should be from best international known type with PEEGT Approval .
- **Planting** of site (trees – grass – flowers ...) with needed irrigation pipes and taps .
- **Complete** water net for Buildings and where needed connected to the main if any or to have another suitable solution .
- **Water** tank (high or ground one) about (50) m3 volume with all needed connections – pipes – pump – accessories ... to all buildings and areas supplied by water .
- **All** roads inside s/s should be reinforced concrete type /15/ cm in general and /25/ cm for transformers road with sub base .
- **Diesel** generator Building and 20 k.v Building should be in a separate Building .
- **Contractor** should take all Mesures to reach asuitable technical solution for leveling of new s/s taking in consideration difference level between nearly road and the site including excavation for all soil types and Backfilling by improved soil with PEEGT approval taking in consideration all technical procedures for this type of work ,and the solution should include connecting and leveling between outer road and nearby road and the site and all regarded surroundings .
- **Slabs** on Grade should be settled on broken stone /20/ cm at least and then (10) cm at least lean concrete .
- **Bidders** should fill schedules – C- detailed civil prices for s/s .
- **Complete** solar heating system should be erected for heating water needed in control Building and PEEGT Building .
- **PEEGT** temporary offices building should be erected and built and furnished at the beginning of the project and within first three months to be used by PEEGT staff and no extra cost or charges will be paid for this building which will be belonging with all furniture to PEEGT at end of project
- **Taking** in consideration to raise all levels of Buildings to avoid interrering water in cable channels and basements .
- **All** existing things within s/s area should be demolished – crashed – evacuated – leveled ... by the contractor completely .
- **All** procedures and solutions should be taken by contractor in drainage to prevent water from entering into s/s area from surrounding and to depose water collected inside s/s area
- **Lighting** equipments in battery room should be anti acid proof and explosion proof .

CIVIL WORK

OUT DOOR CONVENTIONAL S/S 230/66/20 K.V

PEEGT

(2)




(3)

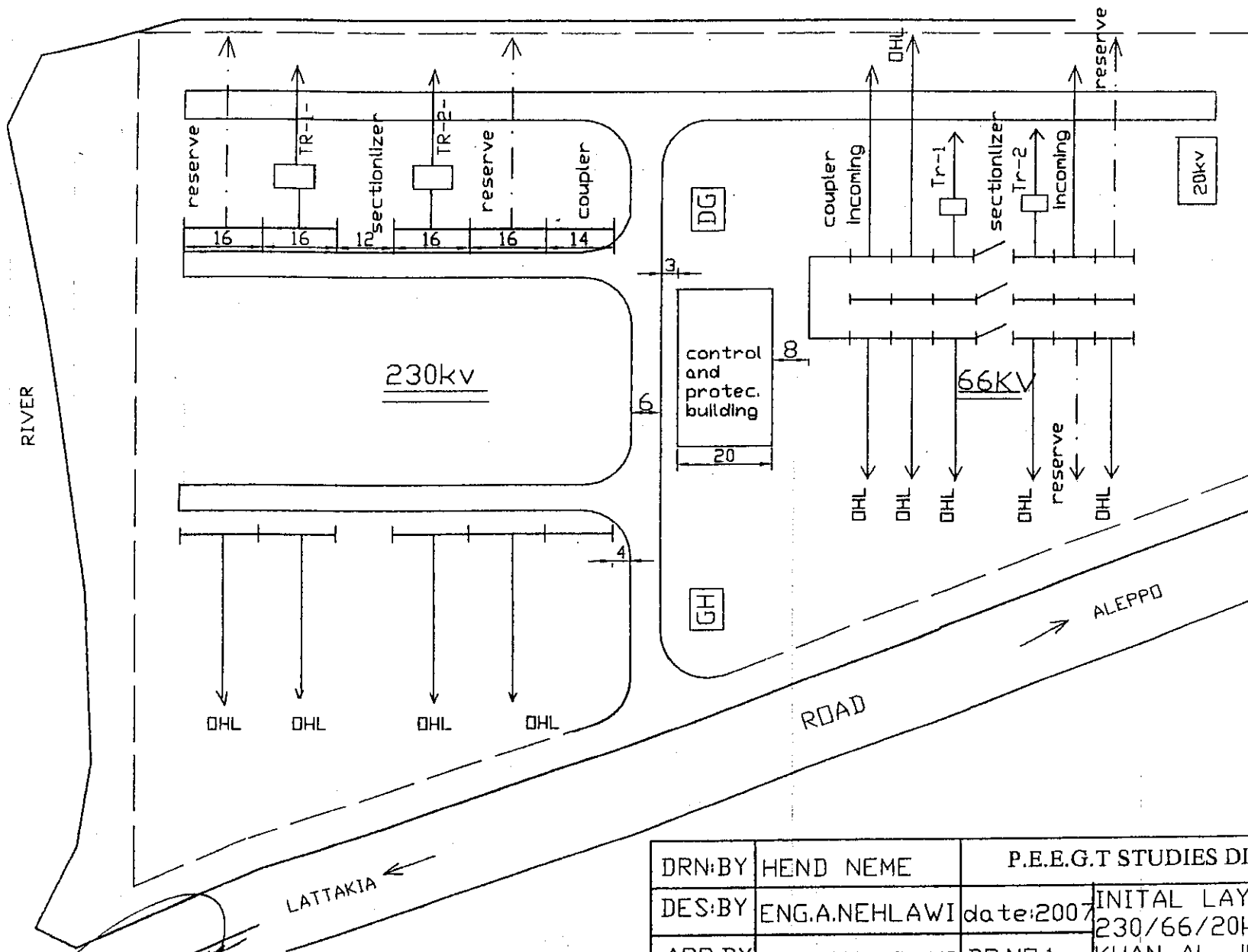
- **Control** Building should contain at least two offices and one of them should have many wall coup boards fitted with locked solid wooden doors .
- **When** Facing that bearing soil level is lower than foundations level replacement certainly should be by cyclopean concrete .
- **When** transformer pit is also oil pit (oil pit is not separate) , then volume of transformer pit under stone and galvanized grating that holding the stone layer is equal at least to total volume of transformer oil .
- **Reinforced** concrete channels and tunnels should be erected by contractor responsibility within s/s area and till border fence for all voltages (230 -66-20) Kv .
- **Air conditioning** of control Building should be through complete central air conditioning unit, while other Buildings will be by split wall or ceiling air conditioning units .
- **Contractor** should evacuate and handed over all remains resulted of all works, that means and not limited to :
(All barrels – empty oil barrels – woods remains – All type of remains – equipments containers – Drums remains) to one of the ware houses that will be named by PEEGT, So substation should be completely clean at works end .
- **Contractor** should realize, study and erect and reinforced concrete area not less than (20 ×30) m2 for heavy weight lifting vehicles for loading and unloading transformers, in addition to extend 230/66 kV tr. Rails for positioning lifting machines (or vehicles) so loading and unloading transformers without needing electricity cutoff .
- **Diesel** tank should be Isolated and away enough from Diesel Generator, and contractor should provide suitable fire fighting equipment (powder extinguisher with enough capacity) over Diesel Generator directly .
- **Switch** Yards (Roads- fence – equipments areas – transformers - ...) should have suitable – good – enough illumination by lighting towers, projectors
- **Dimensions** of main R.C channels should be extended to about (30%) of required sizes to be able to lay extra cables when futures extensions needed .
- **All** measures and solutions –materials to have complete Isolation around (doors – windows rolling shutters – openings ..) in main building should be done by contractor to avoid any dust – sand , or any similar things to inter inside these Buildings .
- **Metal** shutters should be provided for office and used rooms in (Control – PEEGT offices – Guard house) Buildings .

CIVIL WORK

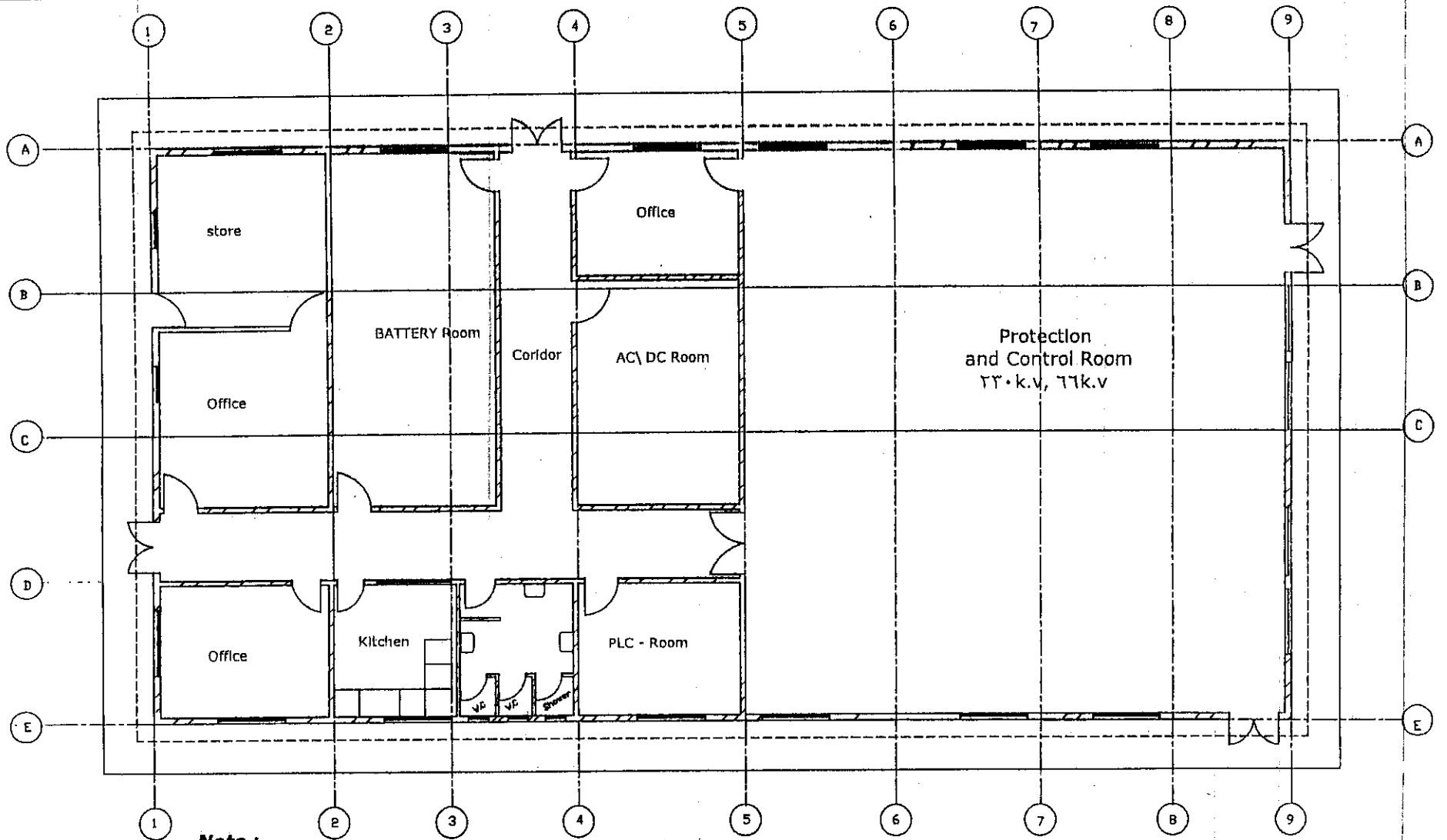
OUT DOOR CONVENTIONAL S/S 230/66/20 K.V

PEEGT

(3)



| | | | |
|--------|---------------|-------------------------------|------------------------|
| DRN:BY | HEND NEME | P.E.E.G.T STUDIES DIRECTORATE | |
| DES:BY | ENG.A.NEHLAWI | date:2007 | INITIAL LAYOUT |
| APP:BY | DR.M.SHAARANI | DR:ND:1 | 230/66/20kv SUBSTATION |
| | | | KHAN AL JOUZ |



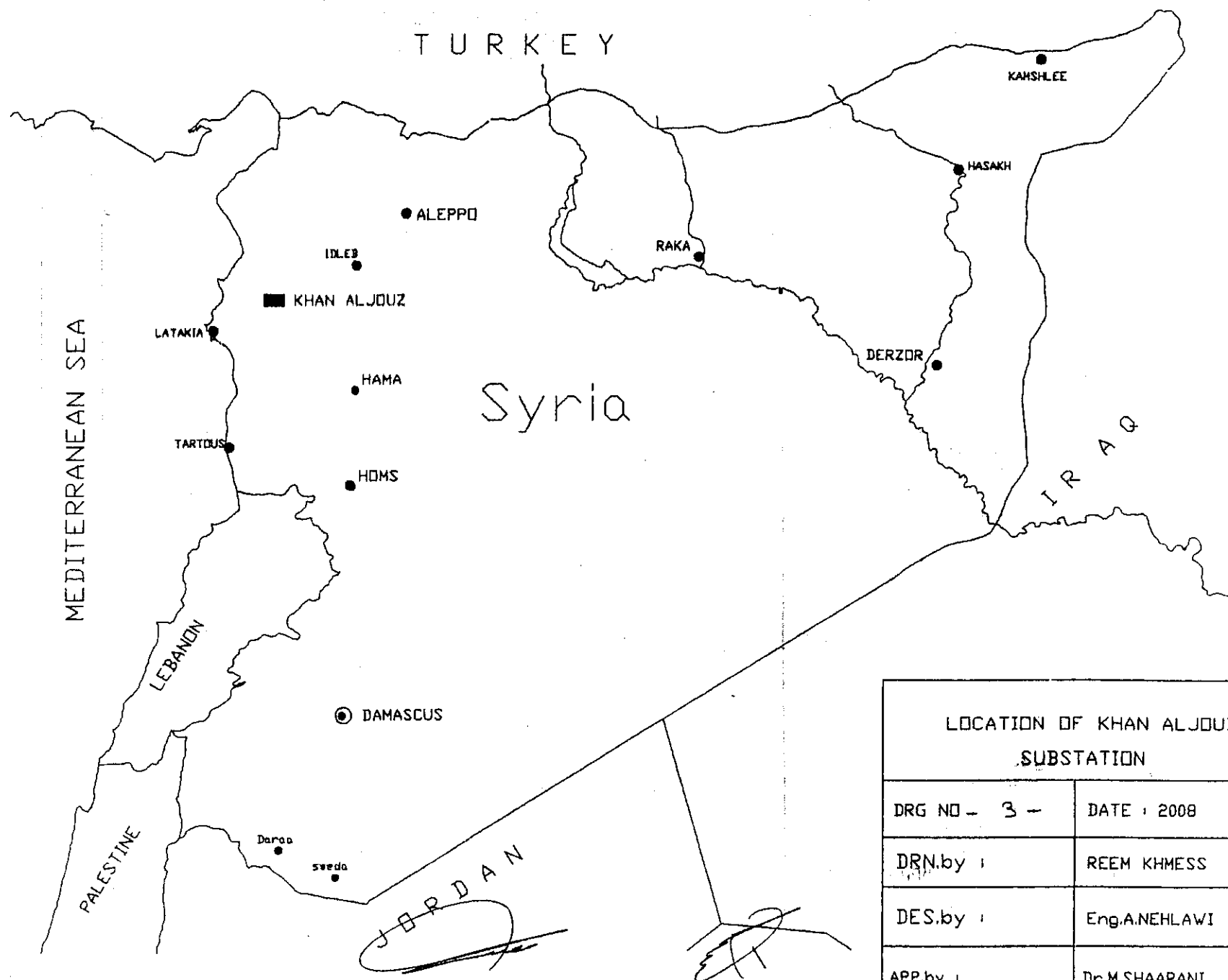
Note :

- Standby Diesel Generator room should be erected Outside of the control building (Separate Building
- All mentioned rooms and facilities should be taken in consideration in any other proposals .
- ٢٠x١٨m (Approximate dimensions).

SYRIAN ARAB REPUBLIC - PEEGT
KHAN AL JOUZ S/S - Initial Drg.

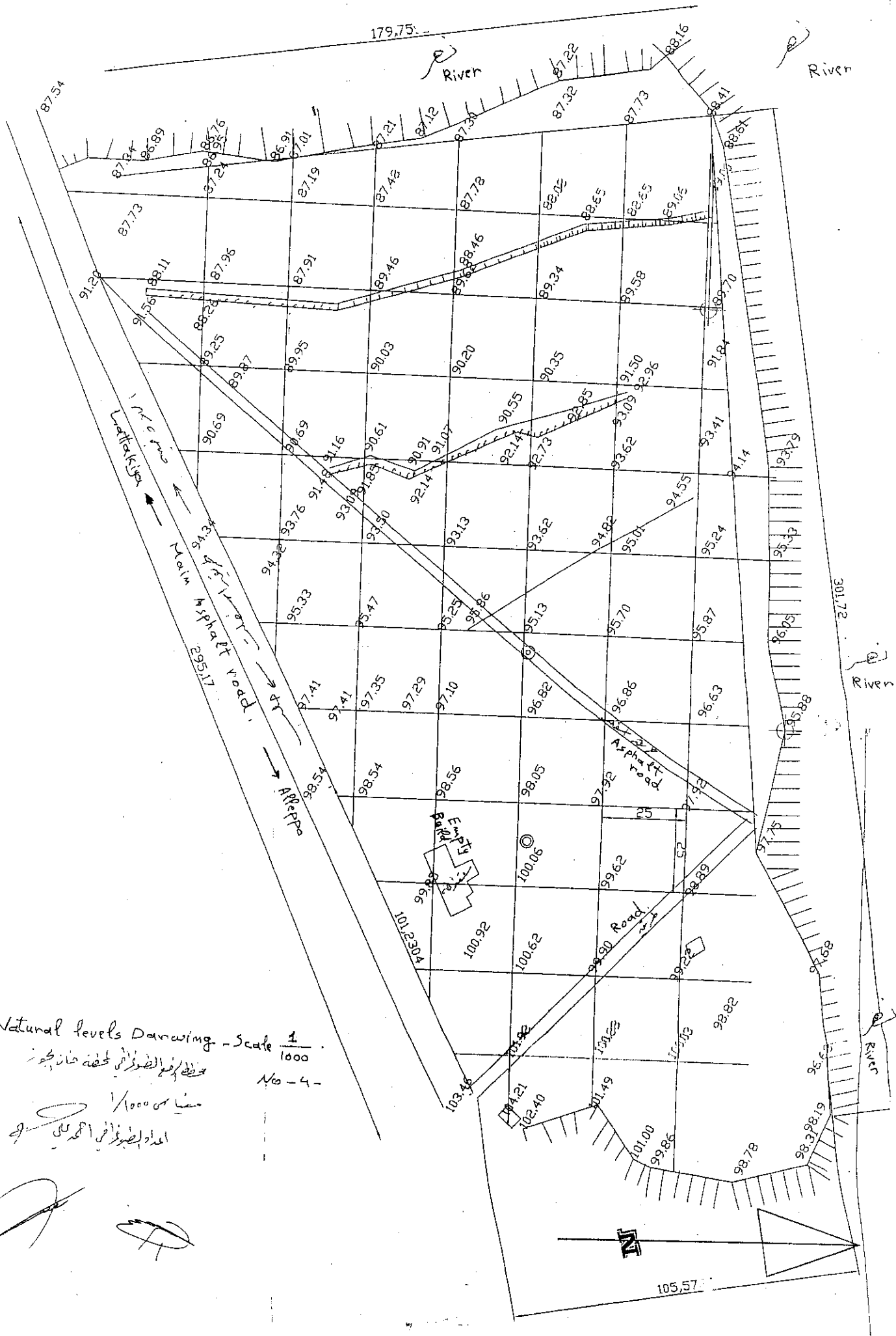
Draw. Hanan Kasem
Design. Eng. Ahmad Bushtak
Approve Eng. Dr.Eng. Moutaz Shaarati Dr. No. - 2 - Date. 11.11.11

Control Protection Auxiliaries Building



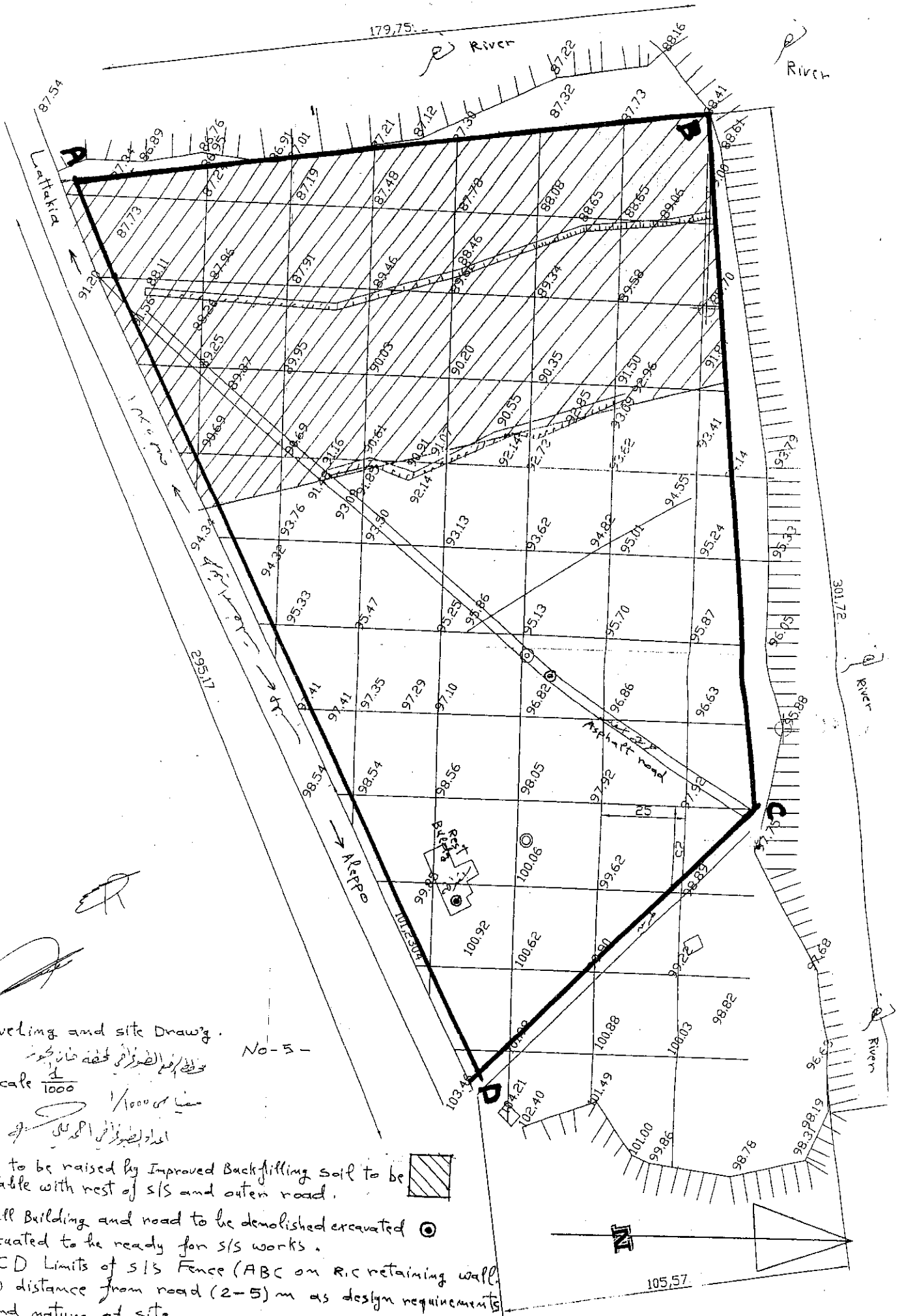
LOCATION OF KHAN ALJOUZ
SUBSTATION

| | |
|--------------|---------------|
| DRG NO - 3 - | DATE : 2008 |
| DRN.by : | REEM KHMES |
| DES.by : | Eng.A.NEHLAWI |
| APP.by : | Dr.M.SHAARANI |



- Natural levels Drawing - Scale $\frac{1}{1000}$

مستفاد من ۱/۱۰۰۰
اعداد اصفهان




Leveling and site Drawg.

No-5-

Scale $\frac{1}{1000}$

1/1000

Area to be raised by Improved Backfilling soil to be suitable with rest of S/S and outer road.

Small Building and road to be demolished excavated  evacuated to be ready for S/S works.

ABCD Limits of S/S Fence (ABC on R/c retaining wall, AD distance from road (2-5) m as design requirements and nature of site.

nks at line ABC
 ill be as Follow:
 R.C Retaining wall from
 he lowest level of the
 ven ground till final
 level of S/S for lower points.
 R.C Fence height - 3-m
 covered with white local stone.
 R.C Fence should cover all
 S/S site.

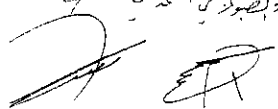
R.C retaining wall on higher
 points will be done as attached
 Initial drawings.

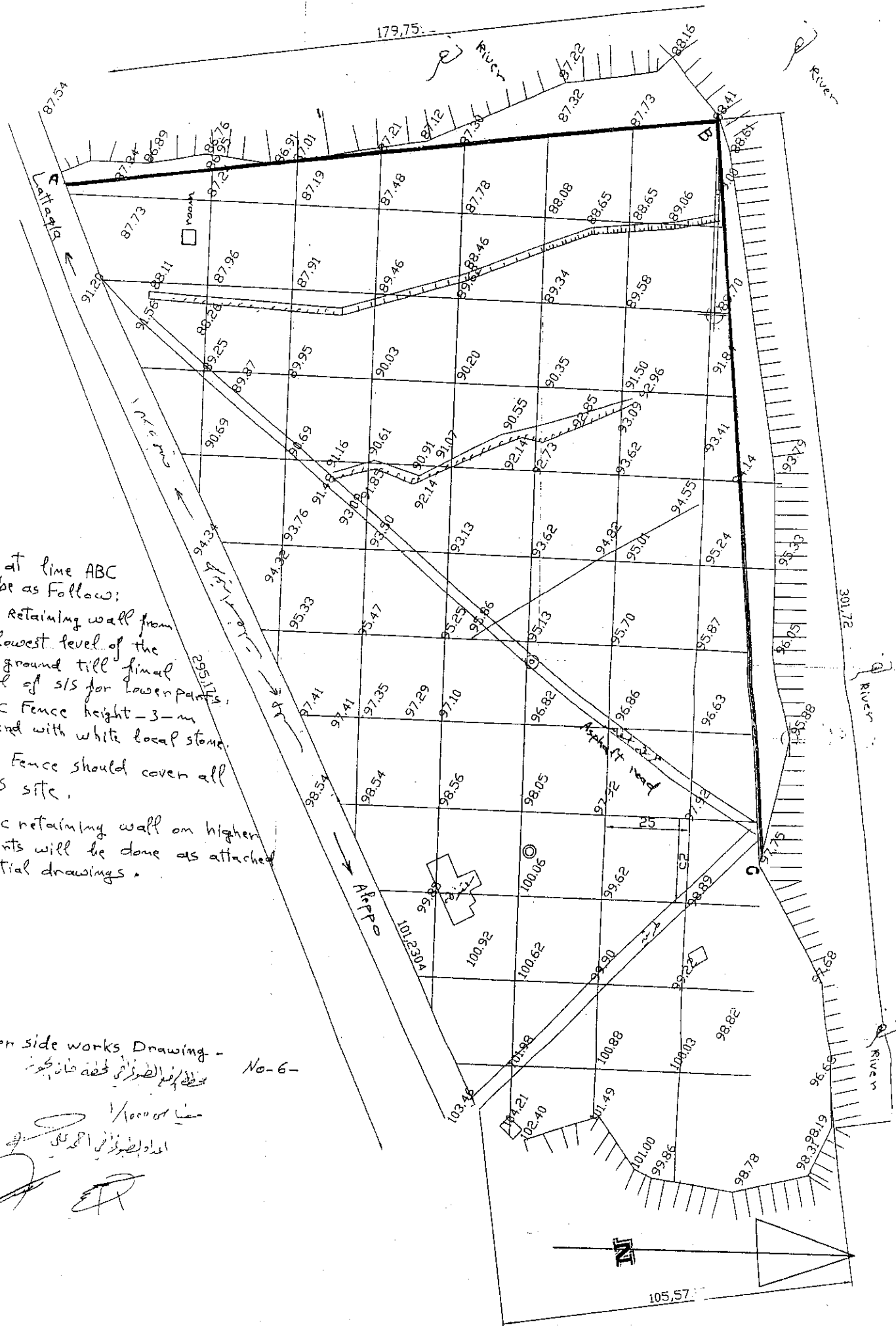
River side works Drawing -
 مخطط الأعمال النهرية

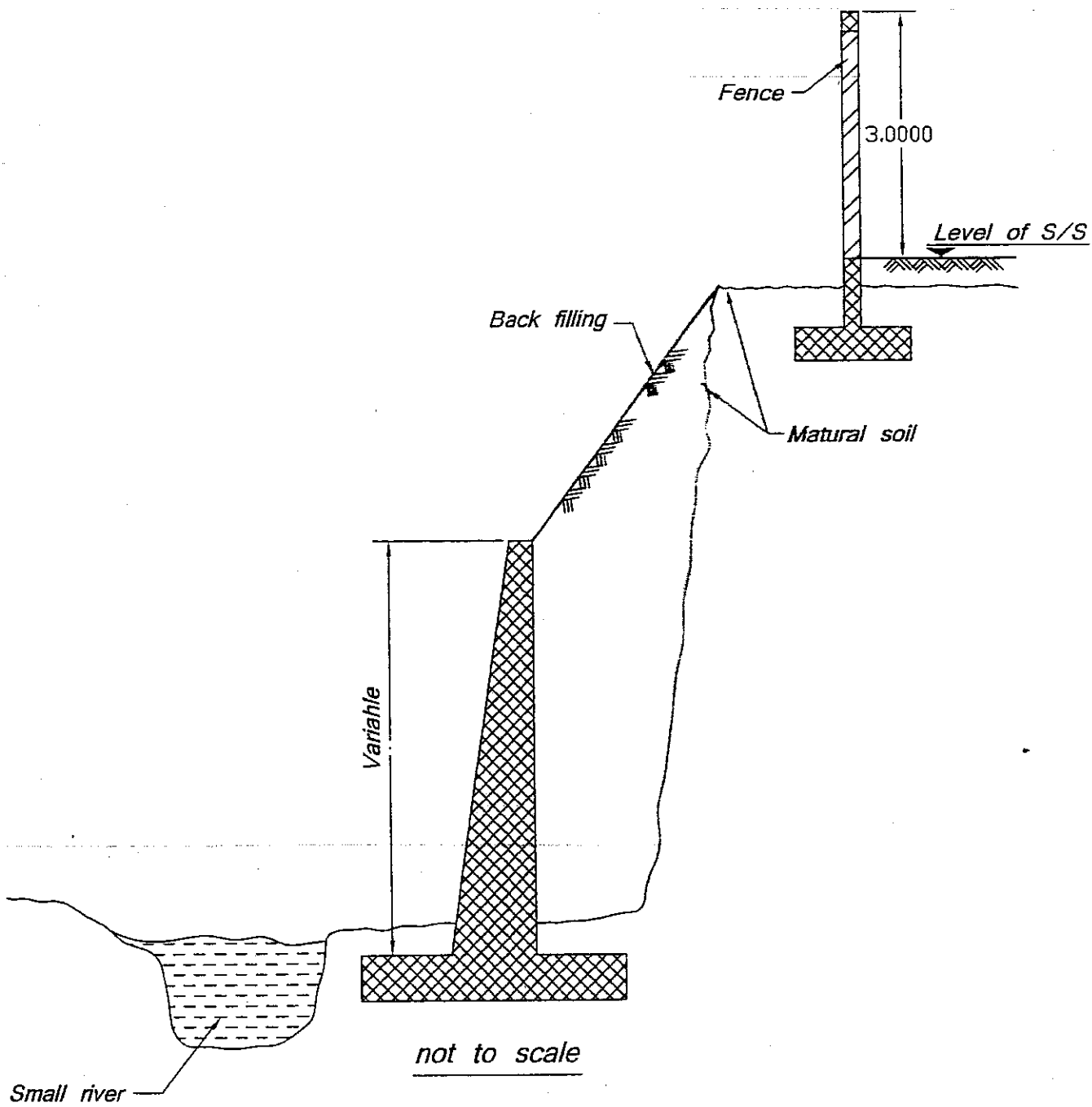
No-6-

1/1000 of scale

اعداد المهندس احمد علي

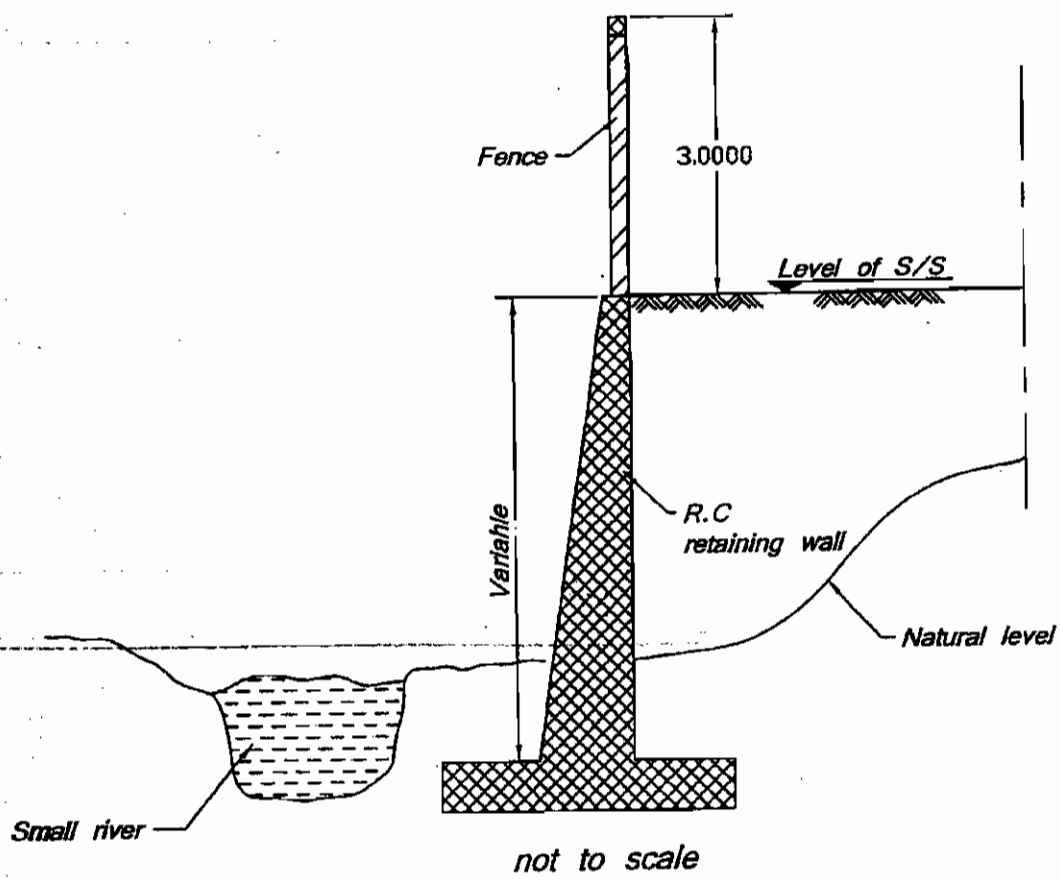






KHAN AL JOUZ S/S

Initial drawing for reinforced concrete
retaining wall in the lower parts .



[Handwritten signature]

KHAN AL JOUZ S/S

Initial drawing for reinforced concrete
retaining wall in the ~~lower~~ parts .
HIGHER