EXCAVATIONS AND BACKFILLING

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1 SCOPE OF WORK

1.1 GENERAL

1.1.1 Works
This section of the Specification covers all excavation, filling and back filling for footings filling under slab for all structures and roads included in this project.

In particular this section covers:

• Excavation for basement, pilecaps, foundations, tanks, pits, sumps, services channels.

• Compacted backfilling to above in a controlled manner.

1.2 NATURE OF THE GROUND

1.2.1 General
The soils investigation for the project site can be viewed at the project managers (EC Compound).

1.2.2 Tendering
During the Tender Period, Tenderers are required to satisfy themselves as to the precise nature of the excavation and filling required, so that their Tender prices will have allowed for everything necessary in connection with this work.

1.2.3 Backfill
Fill materials to be engineering graded. The contractor shall submit the filling sample to the client/project manager for approval. Excavated soils shall not be used for backfilling as should be disposed off site.

The backfilling is to be controlled by placing in layers of a maximum 300mm thickness. The compaction of the fill material is to be determined by the compressibility of the underlying soft organic silts.

1.3 BUILDING PLATFORM

1.3.1 General
The Tenderers attention is drawn to the fact that no additional monies will be paid for minor variations in the amount of cutting or filling required due to the fact that actual site levels compared to the information supplied differs.
1.3.2 Setting out

The Contractor shall set out the building on the platform as shown on the drawings in relation to the boundary.

The contractor at this time should also check the boundary marker locations and submit a report, to the Project Manager, on their accuracy prior to commencing work.

1.4 PLATFORM PREPARATION

1.4.1 General

The Contractor shall ensure platforms are in place for all plant machinery used for excavation works. The contractor will submit a method statement and specification for forming the construction platforms.

2 EXCAVATION

2.1 EXCAVATION TO ALL FOOTING

2.1.1 Extent

The contractor shall refer to the foundation and basement level to produce Excavation plan, which describes the extent and detail of the excavation works.

The Client will require to approve all excavations before any following works begins and may order the Contractor to vary the depths as work proceeds.

All changes to levels of excavations (and foundations) so ordered will be measured by the Client and agreed with the Contractor.

Provided always that any over excavation by the Contractor in good ground (which the Client would otherwise not have ordered to be excavated) shall be made up to level with lean mix concrete or selected approved fill material as directed by the clients project manager at no extra cost.

2.1.2 Maintain and Protect Excavations

- Secure and maintain all excavations and keep them clear of water and fallen materials.

- Provide and maintain shoring, planking, strutting, etc., and pumping, baling, etc. as required, so that at all times the Vietnamese regulations on safety in construction and all other legal obligations are fully met.

The Contractor shall so plan his works that as soon as he has reached a level where the excavation is approved by the Client, he shall be able to effectively protect such excavated surface against damage by any cause whatsoever.

2.1.3 Failing to Maintain and Protect Excavations

Should he fail to provide adequate protection, (resulting in the approved surface being damaged to such an extent that the Client's approval has to be withdrawn) he shall excavate over the area in question to a further level approved by the Client, such additional excavation and the consequential additional backfilling being at no extra cost.

2.1.4 Make Good Settlements and Damage

The Contractor shall take all necessary precautions, and shall make good all settlements or damage to buildings, footpaths, roads and services caused by his excavations or other construction activities.

The Contractor must allow to protect the existing boundary fences and any neighboring properties from damage due to excavation works or any other construction works.

2.1.5 Monitoring of vertical and lateral movements

The contractor is to set up monitor stations to record the movement of the temporary shoring in the vertical and horizontal planes. The rate of movement is to monitored using approved method to be submitted by the basement contractor. If the rate of movement exceeds 20 mm/day then the works are to be stopped and the supervising engineer contacted. The contractor shall submit manufacturers' specifications for inclinometers and piezometers to the clients appointed project manager for approval.
The contractor is to employ a specialist sub-contractor to setup monitoring devices and collect displacement data.

2.2 FILLING UNDER SLABS

2.2.1 Sub Grade Filling Materials

Any make up material required because of over excavation shall be good quality laterite or clean sand approved by the Client.

2.2.3 Contamination

Should any filling material become contaminated (with excavated material or the like) or should any placed filling be disturbed (by any cause whatsoever) such material shall be dug out, replaced and recompacted to the Client's directive, at no extra cost.

2.3 AGGREGATE

2.3.1 Basecourse Aggregate Materials

Basecourse material shall be crushed Basalt aggregate or an approved Andesite and is to conform to the following grading limits:

<table>
<thead>
<tr>
<th>Test Sieve</th>
<th>Percentage by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 mm</td>
<td>100 %</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>65-85 %</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>50-65 %</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>40-52 %</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>29-43 %</td>
</tr>
<tr>
<td>600 micron</td>
<td>20-32 %</td>
</tr>
<tr>
<td>300 micron</td>
<td>13-23 %</td>
</tr>
<tr>
<td>150 micron</td>
<td>8-16 %</td>
</tr>
<tr>
<td>75 micron</td>
<td>4-10 %</td>
</tr>
</tbody>
</table>

Weathering Resistance - CB or better.

Sand Equivalent - Not less than 25.

2.4 AGGREGATE TESTING

2.4.1 Prior to delivery

Prior to the delivery of aggregate to the site for use in the underslab construction works, the Contractor shall deliver to the Client the results of quality control tests carried out by a registered testing laboratory in accordance with the relevant British Standards to confirm compliance with the requirements specified in the above paragraphs of this clause.

2.4.2 During construction

During the construction of the pavement the Contractor shall arrange for quality control testing of the aggregates delivered to the site to be carried out by a registered testing laboratory in accordance with the relevant British Standards to confirm compliance with the requirements specified in the above paragraphs of this Clause.

2.4.3 Frequency

Aggregate testing shall be carried out at a minimum frequency of one complete set of tests for every 1000 cubic metres of aggregate delivered to the site of the Works.
2.4.4 Sampling

Any time during the course of pavement layer construction the Client reserves the right to sample aggregate materials at the site of the Works and have tests carried out to verify compliance of the aggregate with the requirements specified in the above paragraph of this Clause.

Failure of any aggregate material to meet the specified requirements may result in the Client ordering the removal of such material from the site of the Works.

2.4.5 Costs of testing

The cost of any aggregate testing carried out on the instruction of the Client, and which confirms non-compliance of the aggregate with the requirements specified in the above paragraphs of this clause, shall be deducted from the Contract Price.

3 Installation

3.1 SUB-GRADE PREPARATION – UNDER SLABS

3.1.1 General

No under slab material shall be placed until the sub-grade has been prepared and accepted as specified below:

- Inspection of sub-grade surface jointly by the Client and the Contractor.
- Confirmation of sub-grade surface levels, gradients and crossfalls by “stringing” or spot leveling.

3.1.2 Rain inspection

Should rain fall on the sub-grade between the time of initial acceptance of the sub-grade and the commencement of the under slab construction, a further inspection of the sub-grade surface shall be carried out to confirm that the sub-grade is still suitable for placing of stone aggregate to proceed.

3.2 BASECOURSE LAYER CONSTRUCTION

3.2.1 Materials

Materials complying with Clause B.7 the requirements for basecourse aggregate shall be used for the construction of the basecourse layer under concrete slabs in accordance with the details shown on the Drawings.

3.2.2 Thickness

Where the sub-basecourse layer is detailed as having an overall compacted thickness of 150mm or less, the sub-basecourse aggregate shall be placed as a single layer.

Where the overall compacted thickness is detailed as being greater than 150mm, then the sub-basecourse aggregate shall be placed in layers of equal thickness with each layer being not more than 150mm nor less than 100 mm in thickness.

3.2.3 Spreading and Compaction

Sub-basecourse aggregate shall be placed in tailing out from trucks to form layers of uniform thickness that when compacted, will be true to the grades or levels required.

Trucks, whether laden or unladen shall not be permitted to traverse the bare upgrade.

Spreading by graders will not be permitted.

The least surface disturbance possible shall be made during the shaping and compacting process.

The laying procedures shall be carried out in a manner to minimize segregation and the use of graders shall be restricted to essential shaping and final trimming.

3.2.4 Surface Finish

The finished basecourse surface shall conform to the levels, gradients and crossfalls indicated in the Drawings.
The finished level of the basecourse shall be within a tolerance of 10mm low to 5mm high when compared to the design level, provided that the average level shall not be higher than the average design level.

In addition the basecourse surface shall not show any irregularity greater than 5mm when tested with a 3 meter straight edge.

The surface shall be smooth and tight and, when broomed, shall present a mosaic pattern of large and small aggregate particles well bonded with fines.

3.2.5 Inspection

Should the finished surface be loose or “bony”, the Client in his absolute discretion will either require the whole of the basecourse in a particular area to be taken up, replaced and recompacted or he may permit any small areas to be tightened up with the addition of a small amount of approved binder fraction followed by just sufficient watering to ensure optimum compaction. Such work shall be at no extra cost.

On no account shall a skin of fines be allowed to form on the basecourse surface.

3.2.6 Testing

On completion of the construction of the basecourse layer and prior to laying of the DPC layer and slab the Contractor shall carry out the following tests on the basecourse surface in the presence of the Client or his representative:

- Confirmation of the levels, gradients and crossfall of the basecourse surface by “stringing” or spot leveling.

3.2.7 Compaction testing of material

Compaction tests should be carried out by an independent agency to be approved by the clients project manager.

The maximum dry density and optimum moisture content should be in accordance with BS 1377:1975.

4 COMPLETION

4.1 GENERAL

4.1.1 Acceptance of Pavement Prior to Surfacing.

The slab area will be considered acceptable for surfacing if the results of at least 20 deflection measurements meet the following criteria:

- Not more than 5% of the deflection exceeds 1.0mm and
- No single deflection exceeds 1.5mm

4.1.2 Further testing.

Should any section of the under slab construction fail to meet the above specified criteria, additional Benkelman beam tests shall be carried out at closer intervals as directed by the Client to define areas of excessive deflection.

The Client may then direct that the Contractor arrange for further testing to be carried out on the under slab construction in the defined area of excessive deflection to verify that:

- The actual thickness of the underslab construction layers complies with the design thickness shown on the typical cross section drawings.
- The basecourse and sub-basecourse material comply with the specified requirements for grading and plasticity given in Clause "3.3.1 – Basecourse Aggregate Materials".
- The in-situ dry density of the sub-basecourse and basecourse layers is not less than 102% of the maximum dry density as determined by test on representative samples of the materials.

4.1.3 Testing results

Should the results of the above tests prove satisfactory, the Client may authorize that surfacing proceeds, or he may direct that an additional thickness of basecourse overlay be
placed and compacted on specified sections of pavement.

Should the results of the above tests not prove satisfactory the Client may define a section of the underslab construction which he requires the basecourse and sub-basecourse layers to be completely excavated and reconstructed in accordance with this specification.

In the event that the test results prove that the pavement construction does not comply with this Specification then such reconstruction shall be at no additional cost.

4.2 MAINTENANCE

4.2.1 General

The finished basecourse surface shall, at all times prior to sealing, be maintained true to grade and cross-section by watering as required, trimming, planning, rolling and by taking appropriate measures to ensure the even distribution of traffic.

Every precaution shall be taken to ensure that the surface of the basecourse does not pothole, ravel, rut or become uneven, but should any of these conditions become apparent, the surface shall be patched with suitable aggregate or completely scarified and recompacked to the entire satisfaction of the Client.

Any defects or damage of any nature caused by the operation of the Contractor during the construction or maintenance of the basecourse shall be made good immediately by the Contractor at no extra cost.

4.3 WATERPROOFING

4.3.1 General

The whole of the underground basement is to be waterproofed.

4.3.2 Samples

A Sample of the waterproofing membrane must be submitted to the clients appointed Project Manager for approval.

4.4 TEMPOARY WORKS

4.3.1 General

The contractor can submit alternative temporary works systems for consideration.

The contractor will be responsible for the design of the temporary works.

The contractor shall submit documentation validating the serviceability and ultimate requirements of the temporary shoring system including detailed shop drawings, construction method statement and engineering calculations for comment and approval from the client’s project management. The contractor is to hold all works until approval is granted.

The contractor will be responsible for the design, specification and monitoring of the effects from de-watering operations if required during construction.

The contractor is to ensure that the basement works are dewatered before placing the fill material on to the top slab (of the basement) to the specified level shown on the infrastructure engineering consultant’s drawings and specifications. This is to ensure that the hydrostatic uplift force from the groundwater does not result in the rupture and flotation of the single storey underground basement. The contractor is to ensure that he understands the construction sequence and the engineering mechanics of the buoyancy of the structure built within the ground water. For the purposes of the construction sequencing the contractor is to assume that the ground water will be able to rise to the level of the natural ground.

4.3.2 Method Statement

The Contractor shall submit for the Engineer’s consent a Method Statement giving full details of materials, plant and timing and sequence of operations involved in the construction of Temporary Works.

4.3.3 Consent
The Contractor shall obtain the consent of the Engineer before constructing or removing any Temporary Works.

4.3.4 Construction and Removal

Temporary Works shall be constructed to the same standards as the Permanent Works unless otherwise consented to by the Engineer.

Temporary Works shall be dismantled and removed after completion of the Permanent Works unless otherwise consented to by the Engineer.

4.3.5 Scaffolding and Staging

Scaffolding and staging shall be of such strength and rigidity to safely carry the maximum combination of dead loads and live loads. The loading shall be distributed in such manner as to avoid unacceptable settlement.

Scaffold boards shall be of sound timber throughout and shall be periodically inspected and all unsound timber removed and replaced with sound timber. Scaffold runs and platforms shall be close boarded with boards of a thickness such that unacceptable deflections shall not occur. The boarding and hand-railing shall be provided on all external edges. Ladders between platforms and scaffold runs at different levels shall be securely fixed in place, rigidly constructed and with rungs at centres not greater than 300mm.

4.3.6 Welding

Welding shall be electric arc welding. Welding machines shall be direct current (DC) or alternating current (AC). Welding work shall comply with B.S 449 and B.S 5135. The Contractor shall submit for approval welding procedures in accordance with B.S 4870 Part 1.

Electrodes shall comply with B.S 639.

The Contractor shall arrange for all welders to be tested to the satisfaction of the Engineer. Welders shall be tested in accordance with B.S 4871 Part 1.

The surface to be welded shall be free from all scale, grease, paint and rust and other matter. After every run of weld, slags shall be chipped out and surfaces shall be thoroughly wire brushed.

Welding shall not be carried out under adverse weather conditions as determined by the Engineer. Any defects in a weld such as distortion, patter, cracks, undercut, slag holes, unequal width of bead, irregular ripple, etc. shall be made good to the satisfaction of the Engineer.

Etched sections cut from extension plates fixed to working piles at splices or from other positions as directed by the Engineer shall be submitted to the Engineer for examination when required.

Gas welding will NOT be permitted.

4.3.7 Ground Treatment

Ground treatment is a Temporary Works process except as may be expressly provided in the Contract.

The term ‘ground treatment’ shall mean the grouting or other methods used to stabilize the ground where adjacent structures may be affected by construction of the Works in order to permit the safe and efficient progress of the Works.

Ground treatment by means of cement or chemical grouting, freezing, well pointing or by other means may be used subject to the consent of the Engineer. The Contractor shall submit for the consent of the Engineer details of the treatment to be carried out prior to its use. The Contractor shall also satisfy the Engineer that adequate expertise is available for the design and application or ground treatment to ensure the safety of the Works and other adjoining property.

The bias method of grouting materials other than rock (alluvial, colluviums and weathered rock) shall be such that grout can be injected at various points along the grout hole in a multi-stage operation. The method shall employ perforated pipes with rubber sleeve
valves.

The Contractor shall submit for the Engineer’s consent full details of his proposed grouting procedures including details for grouting equipment, location and depth of grout holes, grouting methods, grout composition and a time scaled programme for each sequence of grouting operation. The depth and means of drilling shall be such that the holes can be located accurately along the zone to be grouted.

The Contractor may be required to carry out grouting tests to satisfy the Engineer that the ground treatment proposals are acceptable. Such tests shall be so designed as to allow visual inspection of the treated mass.

Where ground treatment from the surface is expressly provided in the Contract a sufficient number of pits to locate all underground utilities and artificial obstructions shall be excavated and the drilling pattern for ground treatment shall take account of the location of such.

Water acceptance tests of grout holes shall be carried out before grouting as directed by the Engineer and in a manner that shall permit the measurement of the volume of the flow of water at various pressures.

The need for ground treatment in addition to the ground treatment indicated on the Drawings shall be based on soil investigations, probes, the amount of water-making at the face, or other indications that the ground to be excavated is soft, shattered, fissured or heavily water bearing, together with the information contained in the Contract.

Where ground treatment by grouting is to be carried out ahead of excavation, holes shall be drilled to a distance and to a pattern into the zone to be treated and grout injected under pressure, all subject to the consent of the Engineer. Secondary grouting shall be carried out by drilling out and flushing with water a previously drilled hole and re-injection with grout. Gauges shall be installed adjacent to the point of injection and used to measure the pressure of the grout. The design pressure of the grouting shall not be exceeded without the consent of the Engineer.

Chemical grouting shall comply with the following methods unless otherwise consented to by the Engineer.

a. The injection pumping rate shall allow continuous adjustment and shall allow a variable grouting rate within a range of 2 – 8 liters per minute in accordance with the permeability of the soil to be grouted.

b. The reagent shall be such as to allow the gelling time of the grout to be varied between 15 and 90 minutes. The type, temperature and means of mixing the grout constituents shall be such that the gel time can be kept constant.

c. The chemical grout shall be nontoxic and shall be such that it confers to a standard fine sand infected in a test tube under a pressure of 0.5 N/mm^2 an unconfined compressive strength of 0.2 to 0.3 N/mm^2. The test samples shall have a height to diameter ratio of 2.

    Standard fine sand has a uniformity.

    \[
    \frac{D_{60}}{D_{10}} = 1.5 \text{ to } 2
    \]

With 100% of grains passing the 0.4mm Sieve and 100% of grains retained on the 0.0083mm Sieve.

d. The viscosity of such chemical grout shall be kept constant and to a minimum until gelling time (less than 5 centipoises).

e. A harder gel which shall give under the above tests an unconfined compressive strength of 0.8 to 1.0 N/mm^2 may be used with the consent of the Engineer. For such a harder gel the maximum viscosity before setting shall be less than 8 centipoises.

f. Chemical grout shall be so designed as to remain effective for at least a period of 30 months.
The Contractor shall keep a careful record of each point of injection of grout with the quantity and type of grout used, the pressure applied and the depth of the hole. All grouting records shall be available for inspection by the Engineer.

### 4.3.8 Dewatering

The lowered groundwater level should be kept under full control at all times, to avoid fluctuations which could affect the stability of the excavation.

The method adopted should be chosen so that the excavation remains stable at all times, i.e. slips do not occur in the sides of the excavation and excessive heaving of the base does not arise.

When the aquifer to be drained consists of a fairly uniformly graded granular material, it can establish itself as a natural filter to prevent loss of ground as a result of the pumping. If this is not the case, or there is a double, adequate filters need to be provided around the sumps or wells to ensure that there is no transporation of soils, fine-grained in particular, with the pumped water. It is necessary to collect pumped water in a tank and to check if any soil settles to the bottom of the container. Such a test should be undertaken on all groundwater and near structures, services, etc., that can be affected by loss of ground, the test being carried out at the beginning of the pumping. If some soil is being removed, the period of the works and a decision taken on the adequacy of the filter and measures to be taken to mitigate any undesirable effects.

It is prudent to carry out such checks frequently to ensure that the filters around the well are working properly.

There should be an adequate margin of pumping capacity standby power and plant should be available in case of breakdown and to facilitate maintenance.

Water removed by pumps should be discharged well clear of the excavation area in a manner that does not cause erosion, silting or contamination of existing drains and watercourses.

The pumping methods adopted for groundwater lowering should not lead to damage of adjacent structures.

The method adopted should avoid excessive loss of ground by seepage from the sides of base of the excavation.

Wells of a diameter large enough to accommodate submersible pumps are bored to the required depth and filter tubes surrounded by single or multi-layer gravel filters are installed as described in 6.4.4.2.3, B.S 8004.

Duplication of pumping plant should be provided for the well point, shallow well or deep well systems in all cases where breakdown of the plant would cause costly delays in construction or damage to partially completed work or danger to operative or the public.