



Exploration & Production

GENERAL SPECIFICATION

CIVIL WORKS

GS EP CIV 101

General earthworks

05	10/08	General review
04	10/07	Update of references - Revision of § 4 and 5
03	10/05	Addition of "EP" root to GS identification
02	10/04	Revised & 2, 3.2.2
01	09/03	Change of Group name and logo
00	03/01	First issue
Rev.	Date	Notes

Contents

1. Scope	4
2. Reference documents.....	4
3. Organisation of working design and execution phases	9
3.1 Basic data	9
3.2 Earthwork project study	9
3.3 Mapping Requirements:.....	9
3.4 Particular Specifications	13
4. Type, origin and quality of materials and products	14
4.1 General principles	14
4.2 Site verification	14
4.3 Organization of in situ and laboratory tests	15
4.4 Backfill Materials	16
4.5 Materials for drainage layers	17
4.6 Surfacing.....	18
4.7 Topsoil	18
4.8 Miscellaneous products	18
5. Performance of works.....	18
5.1 Pegging-out	18
5.2 Obstacles encountered during works	19
5.3 Clearing	20
5.4 Demolitions	21
5.5 Deviation of existing underground structures and utilities	23
5.6 Preparation of the area for earthworks	24
5.7 Earth moving.....	24
5.8 Pits, quarries and material deposits.....	25
5.9 Performance of excavation works.....	26
5.10 Performance of backfilling works	29
5.11 Temporary stop in earthworks	32
5.12 Soil treatments	33
5.13 Earthwork finishing	33



6. Material take off.....	34
6.1 Lengths.....	34
6.2 Areas	35
6.3 Volumes.....	35
6.4 Weights.....	35
Appendix 1 Granulometric distribution of earth	36
Appendix 2 Test for sand equivalence	37
Appendix 3 Sieve analysis.....	38
Appendix 4 Determination of Atterberg limits	39
Appendix 5 CBR test	40

1. Scope

This specification covers general earthworks including:

- Cut and fill and related works for basis of roads
- Cut and fill and related works for basis of foundations.

Earthworks carried out underwater (dredging, rock excavation, etc.) as well as underground digging are excluded.

General Specifications define what the COMPANY considers as an acceptable minimum. Nonetheless certain equipment and/or works may present particular problems. In such a case the COMPANY reserves the right to modify General Specifications or supplement them with Particular Specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise specified, the applicable version of these documents, including relevant appendices and supplements, shall be the latest revision published at the EFFECTIVE DATE of the CONTRACT.

When local national standards, regulations and codes exist, all design, engineering, materials and construction shall conform to their latest requirements, which complete or modify the present specifications.

In case of lack of mandatory local national standards, international norms and standards will be applied.

In case of lack of international norms and standards, national norms and standards listed hereafter will be applied

In all cases the system adopted shall be coherent, i.e. the various texts shall present no incompatibility. Any dispute shall be resolved by basing works on the most stringent text for the CONTRACTOR and at his expense.

The list of specifications and norms quoted is not exhaustive: the CONTRACTOR shall respect the secondary standards and regulations, which cover the works described in the present specification.

Certain specifications and standards may be indicated with an issue date. This is for information only. It must be understood that the most recent issue shall be used.

Standards

Reference	Title
Eurocode 7	European standards and codes Calcul géotechnique, Partie 1 : Règles générales (Geotechnical design, Part 1 : General rules)
Fascicule n° 2 du CCTG	French standards and codes Terrassements Généraux (General Earthworks) – 14 mars 1979 (Ministère de l'Environnement et du Cadre de vie, Ministère des Transports)

Reference	Title
DTU 12	Travaux de terrassement pour le bâtiment (Earthworks for building) (Centre Scientifique et Technique du Bâtiment)
Fascicule n° 70 du CCTG	Canalisations d'assainissement et ouvrages annexes (Sewerage pipes and related works)
NF P 11-300	Exécution des terrassements – Classification des matériaux utilisables dans la construction des remblais et des couches de forme d'infrastructures routières (Earthworks – Classification of usable materials in construction of backfilling and base course of roads)
NF P 11-301	Exécution des terrassements – Terminologie. Earthworks - Terminology
NF P 98-736	Matériel de construction et d'entretien des routes. Compacteurs. Classification (Material for roads construction and maintenance. Rollers)
NF P 98-102	Assises de chaussées – Chaux aérienne calcique pour sols et route – Essai de réactivité de la chaux vive à l'eau (Roads course – Rich lime for soils and roads – Test for water reactivity of unhydrated lime)
	International Standards
ISO 9862	Geosynthetics Sampling and preparation of test specimens
ISO 9863-1	Geosynthetics - Determination of Thickness at Specified Pressures - Part 1: Single layers
ISO 9863-2	Geotextiles and Geotextile-Related Products - Determination of Thickness at Specified Pressures Part 2: Procedure for Determination of Thickness of Single Layers of Multilayer Products
ISO 9864	Geotextiles and Geotextile-Related Products - Determination of Thickness at Specified Pressures Part 2: Procedure for Determination of Thickness of Single Layers of Multilayer Products
ISO 10321	Geotextiles - Tensile Test for Joints/Seams by Wide-Width Method
ISO 11058	Geotextiles and Geotextile-Related Products - Determination of Water Permeability Characteristics Normal to the Plane, without Load
ISO 12956	Geotextiles and Geotextile-Related Products - Determination of the Characteristic Opening Size
ISO 12957-1	Geosynthetics Determination of friction characteristics Part 1: Direct shear test
ISO 12957-2	Geosynthetics Determination of friction characteristics Part 2: Inclined plane test

Reference	Title
ISO 12958	Geotextiles and Geotextile-Related Products - Determination of Water Flow Capacity in Their Plane-CORR 16433: June 2006
ISO 13426-1	Geotextiles and geotextile-related products Strength of internal structural junctions Part 1: Geocells
ISO 13426-2	Geotextiles and geotextile-related products Strength of internal structural junctions Part 2: Geocomposites
ISO 13431	Geotextiles and Geotextile-Related Products - Determination of Tensile Creep and Creep Rupture Behaviour
	American standards
ASTM D 421	Practice for Dry preparation of Soil Samples for Particle-size. Analysis and Determination of Soil Constant
ASTM D 422	Test Method for Particle-Size Analysis of Soils
ASTM D 854	Test Method for Specific Gravity of Soil Solids by Water Pycnometer
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 Kn-m/m ³))
ASTM D 1883	Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2167	Test Method for Density and Unit Weight of Soil in Place by Rubber Balloon Method
ASTM D 2216	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3282	Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 4318	Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils

Reference	Title
ASTM D 4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D 4429	Standard Test Method for CBR (California Bearing Ratio) of soil in place.
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4545	Standard Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes
ASTM D 4594	Standard Test Method for Effects of Temperature on Stability of Geotextiles
ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
British standards and codes	
BS 5906	Waste management in buildings code of practice
BS 6031	Code of Practice for Earthworks
BS 6068 Series	Water Quality

Professional Documents

Reference	Title
French documents	
LCPC	Réalisation des remblais et des couches de forme (Backfilling and base course execution) – September 92 (LCPC, Service d'Etudes Techniques des Routes et Autoroutes)
LCPC / SETRA	Note d'information technique : Reconnaissance géologique et géotechnique des tracés de routes et autoroutes (Geological and geotechnical survey for roads and highways alignment) – 1982 (Ministère de l'Urbanisme et du Logement, Ministère des Transports, LCPC)

Reference	Title
LCPC	Recommandations : Caractéristiques des matériaux de remblai supports de fondations (Characteristics of materials for backfilling supporting foundations) – 1980 (LCPC, Comité Professionnel de la prévention et du contrôle technique)
SETRA D 8629	Recommandation : Météorologie et terrassements (Meteorology and earthworks) – LCPC/SETRA 1986
Comité Français des Géotextiles et Géomembranes	Recommandations pour l'emploi des géotextiles sous remblais sur sols compressibles (Recommendations for use of bonded fibre textiles under backfilling over compressible soils)
LCPC/SETRA D9061	Guide technique : Utilisation de expansé en remblai routier (Polystyrene use in roads backfilling) – LCPC/SETRA 1990

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP CIV 102	Dredging and filling up
GS EP CIV 201	Design and construction of roads and stabilised areas
GS EP GEO 102	Onshore geotechnical soil survey
GS EP GEO 303	Onshore land surveying and positioning works

3. Organisation of working design and execution phases

3.1 Basic data

The COMPANY shall provide the Engineering CONTRACTOR with basic data, which shall enable the latter to compile the documents required by the Construction CONTRACTORS for the performance of works.

Basic data shall generally include:

- COMPANY's General Specifications
- Particular Specifications providing information relative to the project
- Technical files of basic data:
 - Site topography
 - Geological and geotechnical details
 - Hydrological and climatic details
 - Local seismicity
 - Current or previous industrial activities
 - Human activities around the site
- Regulation relative to air and water protection.

The Construction CONTRACTOR shall study the basic data and either accept them or inform the COMPANY in writing, within a time limit previously agreed on by both parties, of any observations or technical reservations which it considers of interest.

Should these observations involve supplementary studies, these shall be precisely defined along with their impact on cost and delay.

The COMPANY shall take a decision concerning these supplementary studies and give instructions to the Engineering CONTRACTOR.

3.2 Earthwork project study

Prior to execution of any work or part of work, the following documents must be established and transmitted to the COMPANY.

3.3 Mapping Requirements:

The general layouts of the site of earthworks shall be geo referenced using the Project Coordinate Reference System parameters provided by COMPANY.

The following features shall be included on each charts, but not limited to:

- A title, a graphic scale (Bar scale) and Numeric scale, specify the drawing format for which the numeric scale is applicable, a legend
- The projected Company Coordinate System Grid, the geographic coordinate system ticks and Local Engineering Grid, when applicable
- A situation Map
- The reference of the source drawings

- Full Company Coordinate system parameters, transformation parameters between the Company Coordinate system and the Local Engineering Grid when applicable

The native files shall be provided in AUTOCAD or MICROSTATION and PDF formats. The CAD files shall be georeferenced using the project coordinate system and structured thus:

- Separate layers for each feature type (contours lines, elevation roads, etc...)
- Continuous lines (e.g. contours lines) shall be drawn as continuous 2D or 3D polylines

CONTRACTOR may also propose to provide data in GIS formats (as ESRI shapefile or Geodatabase).

3.3.1 Geometrical survey

The geometrical survey to be carried out by the Engineering CONTRACTOR includes:

3.3.1.1 Location plan

The situation plan indicates the work site in the concerned area, making it possible for somebody unfamiliar with the country to locate easily the geographical zone in question.

3.3.1.2 Layout plan

The layout plan is the work plan, which defines the boundary of the work site with its topographical environment, viability and natural landmarks.

Scales of 1/5000, 1/2000, 1/1000, 1/500 may be used depending on the nature of works.

The layout plan makes it possible to easily find landmarks for the construction of all sections of the works and give planimetric data for construction.

This plan must be provided with a system of coordinates and elevation benchmarks, linked to the general systems of the country.

3.3.1.3 Longitudinal section

The longitudinal section gives all the linear and altimetric data for the works, partial and cumulative lengths between points on the axis, altitude of the natural ground, altitude of project, giving the project's stage of completion.

Generally speaking, the scale for the longitudinal section is that of the plan view for lengths. For heights it is ten times that for lengths.

As a general rule the scales for longitudinal sections are 1/2000 (or 1/1000) for lengths and 1/200 (or 1/100) for heights.

No longitudinal section is required in case of stabilized areas of non-linear shapes. Multiple cross-sections, carefully located according to the shape of the stabilized area, are used instead.

3.3.1.4 Cross-sections

The natural ground topography is defined by spot heights, established either systematically from cross-sections perpendicular to the axis of the works (the most common case), or from a series of spot heights along typical lines of natural slope change. In the latter case, interpolation is required between known spot heights on the natural ground for establishing cross-sections.

The vertical layout of the intended project is added to the cross-section drawing.

Cross-sections may be drawn and/or tabulated for data processing purposes.

3.3.1.5 Boundary posts

Boundaries shall be marked out in two ways by the Construction CONTRACTOR under the Engineering CONTRACTOR responsibility:

- By concrete or plastic posts meeting with COMPANY approval.

Concrete posts shall be either pre-cast or cast in place.

They shall have the following minimum dimensions (truncated pyramid with square base):

- Bottom base: 0.20 x 0.20 m
- Top base: 0.12 x 0.12 m
- Height: 0.30 m.

A marker shall be located in the centre of the superior base of the post and the top of this marker should be flat.

The Engineering CONTRACTOR will submit boundary posts and basic layout plan to the COMPANY. After approval they shall be handed over to the Construction CONTRACTOR.

- Wooden or iron posts for detailed layout shall be placed by the Construction CONTRACTOR for execution of the works. The positioning of the posts shall be made known to the COMPANY or its representative.

The Construction CONTRACTOR shall be able to check the accuracy of layout and levels of works from these markings.

3.3.2 Geological and geotechnical surveys

The geological survey shall supply data relative to underground structure, nature and morphology, including natural characteristics (fossil laying, karstic zones, tectonic, seismicity, etc.) and artificial characteristics (mines, water pumpi, etc.). It shall enable the Engineering CONTRACTOR to proceed with the selection of borrowed material supplies.

The geotechnical survey, to be in agreement with **GS EP GEO 102**, shall provide soil mechanics information and groundwater characteristics to the Engineering CONTRACTOR so that he may proceed with the selection of materials and earthworks sizing (slopes for excavation and backfilling, form layer, etc.).

Specific rules for situations and actions may be defined by the COMPANY in the Particular Specifications or proposed by the Construction CONTRACTOR to COMPANY approval. These rules must cover provisional actions during works and works schedule.

When Particular Specifications do not include special conditions, situations and actions to be considered in earthworks sizing must be in agreement with reference documents listed in § 2.

3.3.3 Definition of platforms and levelling

The Engineering CONTRACTOR shall define the platforms, providing planimetric and levelling data. He shall define the methods required to maintain form layer soil quality under the effects of bad weather or traffic (protection, borrowed material supplies, etc.).

The Engineering CONTRACTOR shall also define slope sections (gradients, berms, etc.) and their protection.

3.3.4 Roads to be kept, moved or demolished (see para. 5.2)

The Engineering CONTRACTOR shall provide:

- Survey of existing roads (layout, condition, etc.)
- Layout and structure of planned roads
- Layout of drainage (temporary and final drainage)
- Definition of means for road protection during works, or means for removal
- Definition of the means of maintaining road traffic while undergoing removal or reconstruction works (deviations, etc.).

3.3.5 Geometrical design, volume, earth movement

3.3.5.1 Geometrical design

The geometrical design for the earthwork project shall be carried out by the Engineering CONTRACTOR, taking into account the data provided in the geological and geotechnical surveys. Rights of way shall be indicated on the layout plans. The geometrical design should enable an evaluation of the earth material volume to be moved.

3.3.5.2 Volume calculation - Earth movement

The volumes and movements of soil masses shall be calculated from existing ground sections, taking into account possible levelling works and the project profile. A theoretical volume for quantities to be added, in the case of backfilling, or quantities to be removed, in the case of excavation, shall be used, without taking bulking factor into consideration. Excavated volumes shall be distributed into categories, depending on the nature of earth materials and the difficulty involved in handling them, as described in Section 5.9 of this document.

The number of cross-sections to be drawn shall be defined according to the required precision and in agreement with the COMPANY.

The Engineering CONTRACTOR shall carry out an earth movement study in order to establish estimations for the hypothesis envisaged and to set up the program of the works. The study is of a provisional nature. However, certain aspects of earth movements may become contractual if the quality of the works implies so, or if availability date for roads is imposed. In that case the Engineering CONTRACTOR shall stipulate the requirements for earth movement in Particular Specifications.

3.3.6 Origin of borrowed materials/Depositing of borrowed materials

(Reference to be made to Section 5.8).

The conditions for use of borrowed materials shall receive approval from the COMPANY.

3.3.7 Special conditions

In case works are undertaken on an operational industrial site, the performance of works shall be defined in agreement with the operational industry concerned along with the COMPANY (in particular Safety department).

3.3.8 Performance of works programme

Before starting works, the Engineering CONTRACTOR shall establish a programme for the performance of works taking COMPANY requirements into consideration.

The programme shall be made up under graphic format and shall indicate the interrelationships between the various project aspects (e.g. networks deviations). Climatic conditions should be taken into consideration. Availability dates for main equipment and materials shall be indicated.

As works start, the performance programme may be revised according to the available means or the Construction CONTRACTOR suggestions. The revised programme will then become contractual.

Programme follow-up and periodical up dating shall be the Engineering CONTRACTOR responsibility. It is understood that he, in turn, shall keep the COMPANY informed.

Assuming that programme deviations may have harmful effects on other sequences of works, the Engineering CONTRACTOR shall propose all the necessary corrective actions. With the COMPANY approval, the Engineering CONTRACTOR shall ensure that the Construction CONTRACTOR performs the proposed corrective action.

3.3.9 Required equipment

The Construction CONTRACTOR shall back up his bid by submitting the list of equipment he is ready to supply for the performance of the works. The Construction CONTRACTOR must justify that the list fits with the works programme, in terms of quality and time schedule. After COMPANY approval, this list becomes part of the contract. However, the Construction CONTRACTOR may be requested to modify his equipment in order to comply with the contract schedule.

The materials and equipment indicated on this list shall be on site and operational for the dates which have been fixed in the performance of works programme.

If, for any reason, the Construction CONTRACTOR wishes to modify or take away a piece of equipment before the completion of the works for which the said piece of equipment is being used, he may only do so after the COMPANY has given written approval. Even if this approval is granted, this action shall be considered as the Construction CONTRACTOR entire responsibility.

3.4 Particular Specifications

The Engineering CONTRACTOR shall prepare all the necessary Particular Specifications requested for the project.

These will contain information related to the project and specific site conditions, along with local regulations, when available.

The Particular Specifications are meant to modify or supplement the General Specifications and will be the contractual specification for the performance of the works.

The Particular Specifications shall specify the maximum loads and slopes for each roads or platforms in accordance with the basis of design.

4. Type, origin and quality of materials and products

4.1 General principles

The Construction CONTRACTOR shall supply all the materials and products necessary to perform the works. They shall be submitted to COMPANY approval.

The tests, which materials fabrication and supply shall undergo, include approval tests, operational tests and acceptance tests.

4.2 Site verification

CONTRACTOR shall be responsible for identification and execution of all additional investigation as necessary to ensure complete familiarity with all conditions, which might affect the work.

Prior to commencement of the work, CONTRACTOR shall ascertain the nature and location of all existing above and underground services and facilities on site and in adjacent areas. Hand excavation is mandatory to locate all incoming utilities, which need isolation before plot clearing can commence.

The following existing facilities are currently identified

- Barbed wire boundary fence
- Roads
- Various power cables
- Wells
- Small shanty town dwellings

If any other un-identified artificial facilities are found, COMPANY shall be notified for confirmation of removal.

CONTRACTOR shall be responsible for confirmation, or otherwise, of any such information given and shall mark on as-built drawings locations of termination's or rerouting.

CONTRACTOR shall verify the quantities of earthworks based on actual topography and compare it with the information contained in the Contract, prior to the commencement of the Work.

CONTRACTOR shall submit detailed survey report, if site topography significantly differs with the information contained in the Contract. CONTRACTOR will not be entitled to claim any change in the work related to the difference in site topography without above mentioned detailed survey report.

4.2.1 Approval tests

All materials to be approved by the COMPANY for the performance of the contract works shall be presented in due time so that, should the materials not be approved, the Construction CONTRACTOR is able to supply new materials without creating delays in the works schedule. Approval tests shall be particularly carried out on materials borrowed from new areas not planned in the project.

The materials shall comply with the requirements stipulated in Section 4.4, relative to their use. The Construction CONTRACTOR should also submit the products other than earth materials that are to be included in the works: cements, stabilizer products, etc., to COMPANY approval.

4.2.2 Operational tests

Including mainly:

- Pumping equipment tests
- Crushing equipment tests (if required)
- Compaction equipment tests.

4.2.3 Acceptance tests

Acceptance tests, carried out on materials before they are set to use, are tests that enable the determination of the quality of materials. Tests and required results are defined in Sections 4.4 and 4.5.

Tests carried out on materials in place are used to check the quality of the works. Tests and required results are defined in Section 5.10.

4.3 Organization of in situ and laboratory tests

As a general rule, all approval tests, operational tests and acceptance tests that enable the COMPANY to approve or reject the Construction CONTRACTOR supplies are performed at the Construction CONTRACTOR expense. This also applies to any additional test that the Construction CONTRACTOR may consider necessary in order to improve his working methods or check for quality.

The laboratory tests shall be carried out according to methods approved by the COMPANY.

4.3.1 COMPANY and THIRD PARTY laboratory

The COMPANY may request tests to be performed by a **third party**, if the importance of the works justifies it. This requirement, along with the installation date for the laboratory, shall be stipulated in the Particular Specifications.

This laboratory shall be fitted with all the necessary equipment. A laboratory head shall be in charge and work with assistants. The COMPANY shall approve the selection of the head of laboratory. The COMPANY representative shall have access to the laboratory and access at all times to test data.

The results of contractual tests shall be presented on the forms supplied by the COMPANY (Models of forms attached in the appendices).

The COMPANY shall pay the expenses incurred for the installation and operation of this laboratory.

This laboratory shall carry out all the operational tests, fabrication control tests, material supply and implementation tests required for correct performance of works, in compliance with this specification.

The COMPANY reserves the right to check the controls made, either directly himself, or by using the laboratory equipment and personnel. In case the results are not satisfactory the **third party** will be asked to make adjustments.

The list of equipment required for the performance of the tests shall be stipulated in the Particular Specifications. Purchasing this equipment will be under the COMPANY responsibility.

4.3.2 Construction CONTRACTOR laboratory

The Construction CONTRACTOR shall install his own laboratory on site, which shall enable him to check the quality of equipment and materials and their use. It will allow him to propose adjustments to the COMPANY with respect to quality and use.

The site laboratory shall be run at the Construction CONTRACTOR expense. It shall include:

- The installation, fitting, maintenance and dismantling of a building on an area suitable for laboratory use, as defined in the Particular Specifications
- The laboratory operation and personnel required to perform tests.

4.4 Backfill Materials

All fill material shall be either suitable excavated material or suitable imported material.

A prior geotechnical investigation shall be done to prove the suitability of excavated material use.

All materials must be approved by COMPANY before use.

4.4.1 Ordinary backfill materials

This material shall be used only where no road, paving or installation is planned. Ordinary fill material will be used for filling up to a level located 2.0 m below final grade elevation and at minimum 1.0 m or beneath foundations bed levels. These levels shall not be exceeded. Moreover, general fill shall be used when the thickness of backfill does not exceed 5.0 m to 6.0 m.

The extent of areas where Ordinary backfilling material is used shall be approved by COMPANY.

The material used shall present the following characteristics:

- Particle Size distribution: 150 mm maximum, percentage of fines (< 0.075 mm) $< 35\%$
- Liquid limit less than or equal to 60%
- Plasticity Index less than or equal to 30%
- Organic matter less than or equal to 30%
- Soluble sulfate content less or equal to 2.5 g/l
- CBR of Laboratory-Compacted Soils (as per ASTM D 1883) more than or equal to 8 %
- CBR in Situ (as per ASTM D 4429) more than 10%

Particular Specifications may provide different characteristics according to work site to be taken into account.

4.4.2 Selected backfilling materials

These materials shall be used for the top 30 cm of platforms (up to the final level of the project), in open areas and under roads and paving. They shall the following characteristics:

- Particle size distribution:
 - 150 mm maximum
 - Passing at 4 mm: 20 to 100 %

- Percentage of fines (< 0.075 mm): < 35 %
- Atterberg limits
 - Liquid limit $\leq$ 40 %
 - Plasticity Index $\leq$ 15 %
- Organic matter $\leq$ 1%
- Soluble sulfate content $\leq$ 2.5 g/l
- CBR of Laboratory-Compacted Soils (as per ASTM D 1883) $\geq$ 25 %
- CBR in Situ (as per ASTM D 4429) $\geq$ 15% and $\geq$ 20% for the top layer

Particular Specifications may provide more stringent characteristics to be taken into account.

4.4.3 Backfilling materials for foundation pits

Materials for backfilling of foundation pits shall have the following characteristics:

- Particle size distribution:
 - 75 mm maximum
 - Passing at 4 mm: 30 to 80 %
 - Percentage of fines (< 0.075 mm): < 4 to 12%
- Atterberg limits
 - Liquid limit $\leq$ 25 %
 - Plasticity Index $\leq$ 10 %
- Organic matter $\leq$ 1%
- Soluble sulfate content $\leq$ 2.5 g/l
- CBR of Laboratory-Compacted Soils (as per ASTM D 1883) $\geq$ 35 %
- CBR in Situ (as per ASTM D 4429) $\geq$ 25 %

Particular Specifications may provide more stringent characteristics to be taken into account

4.5 Materials for drainage layers

Drainage works design shall take account of all data necessary for their construction, i.e. meteorology, hydrology, hydraulics, geographical aspects and the procedure adopted for deciding on the choice and dimensions of the structure; along with all the plans and standard drawings. Design and construction of drainage system shall perform in accordance with the requirements of **GS EP CIV 202**.

Materials used for drainage or anticontamination layer shall be clean sand or gravel. They shall be approved by the COMPANY.

4.6 Surfacing

Products used for surfacing shall be submitted to COMPANY for approval.

4.7 Topsoil

After scrapping, topsoil shall be put aside and stored for later use.

Used topsoil shall allow a normal growth of vegetables and grass.

The Construction CONTRACTOR shall proceed, if necessary, to conditioning and fertilisation after COMPANY information.

4.8 Miscellaneous products

The COMPANY's approval is required for all products used for the project.

This particularly applies to:

- Concrete pipes, plastic pipes, etc.
- Drains
- Seeds for grass areas: the Construction CONTRACTOR must justify the origin of seeds by supplying labels of sacks. These labels must include conditioning number and details on species and varieties of components in case of mix
- Products for slope stabilisation
- Lime and hydraulic binders: in case of use of hydraulic binders or lime, compatibility with soil to be treated must be checked by the Construction CONTRACTOR using laboratory tests
- Bonded fibre textiles: the Construction CONTRACTOR shall present to COMPANY approval the certificates, which define the maximal strength, the breaking elongation (in the two directions), indentation resistance and permittivity
- Grass: products used as fixative for seeds shall be approved by the COMPANY
- Seeds for sowing
- Riprap
- Polystyrene and cellular products: the Construction CONTRACTOR must justify the volumetric weight and yield resistance
- Etc.

5. Performance of works

5.1 Pegging-out

5.1.1 General marking system

It is particularly reminded that:

- The COMPANY shall supply the Construction CONTRACTOR with fixed boundary markings (monuments), which shall be used for the general site layout

- Once this system has been provided to the Construction CONTRACTOR he should make sure that it is maintained or replaced if necessary. It is reminded that even accidental destruction of marker posts shall involve their replacement, levelling and reconstruction at the Construction CONTRACTOR expense, but also reimbursement of the COMPANY expenses for the control checks of the replacement.

5.1.2 General pegging-out

General pegging-out consists of marking on site the positions defined in the layout documents (axes and earth entrances for each section) and all the points necessary for the project structural works.

The COMPANY shall supply the Construction CONTRACTOR with the documents required for this pegging-out operation.

The Construction CONTRACTOR shall proceed with the setting out of numbered pegs or stakes, which he shall solidly drive into the ground, protect, maintain and replace if necessary. Contradictory visits involving the COMPANY and the Construction CONTRACTOR will be carried out for pegging-out approval. The COMPANY will define the frequency of inspections. The expenses for the above operations are in charge of the Construction CONTRACTOR.

The general co-ordinates system shall be indicated in the Particular Specifications. These specifications will define units to be used and geometrical tolerances to be obtained.

5.1.3 Boundaries for underground networks

When works are carried out near underground networks, the Construction CONTRACTOR shall perform a special marking along the location of the underground networks. The COMPANY and the concerned official department(s) shall approve this marking.

5.2 Obstacles encountered during works

The Construction CONTRACTOR is reminded that he may meet obstacles over the area where the works are to be performed. He shall be responsible for ascertaining the presence of such obstacles and shall take all necessary steps to prevent damages.

The obstacles may hinder or delay site operations.

These obstacles may include:

- Electrical lines, masts and pylons: LT, MT, HT (low, medium and high-voltage)
- Telephone poles and lines
- Rail tracks
- Dispossessed houses
- Trees
- Potable, sewage and rainwater networks
- Graves, underground obstacles, monuments of historical interest or remains of archaeological value
- Septic tank pits not indicated in the project, fuel tank pits
- Unstable land and water sources
- Access roads

- Local road system
- Temporary deviations made necessary by construction works
- Existing concrete conduit or concrete conduit under construction near project area.

Precise definition of these obstacles and the remuneration for relative work on these obstacles shall be defined in the Particular Specifications.

5.3 Clearing

Preliminary site preparation concern borrowing areas, storage and maintenance areas, site tracks and works areas.

5.3.1 Tree felling and uprooting

The Construction CONTRACTOR shall proceed with the felling and uprooting of existing trees within the areas on layout plans.

Tree felling includes the uprooting and removal of all large roots and clearing or destruction on site of all products from these works.

As far as branches are concerned, they may be burned on the spot. However, the Construction CONTRACTOR shall be responsible for ensuring that the required safety precautions have been taken. To this effect he shall consult the safety department.

As far as the trunks of big trees are concerned, the COMPANY reserves the right to recover them. The COMPANY shall give instructions to the Construction CONTRACTOR concerning the cutting, transportation and deposit of trunks in an area situated at a distance no farther than the normal waste area. All the remains such as stumps, roots and debris that have not been burned shall be taken away to the waste area.

During the performance of these works the Construction CONTRACTOR shall take all the necessary precautions to ensure that overhanging lines, underground cables, conduits of any sort and nearby constructions are not damaged. The holes made by the removal of stumps and large roots shall be refilled by successive carefully compacted layers.

Trees that are to be stored shall be carefully marked during the initial survey and specially protected.

Burying of vegetable is not allowed on site.

5.3.2 Removal of undergrowth

On arrival on site the Construction CONTRACTOR shall proceed with the removal of hedgerows, undergrowth and miscellaneous vegetation growing on site, as well as bushes of any sort which have a circumference of less than 1.00 m (measurement taken at 1.00 m from the ground). The undergrowth and brushwood shall be gathered and burned on the spot as works progress. It shall be the Construction CONTRACTOR responsibility to ensure that the required safety measures prescribed by the safety department are taken. He shall consult the latter to this effect.

The stumps shall be incinerated, or gathered at the waste areas chosen by the Engineering CONTRACTOR with COMPANY approval.

The limits for removal of undergrowth and felling of trees shall be defined on the drawing for site preparation.

5.4 Demolitions

5.4.1 General method

5.4.1.1 Definition of limits for demolition

Once the contract has been signed, the COMPANY shall provide the Construction CONTRACTOR with a drawing for the preparation of the area, showing the demolitions to be carried out.

All extensions or reductions in the area, whether requested or not by the Construction CONTRACTOR, shall be subject to COMPANY prior approval.

The boundary marking of the area shall have been carried out by the COMPANY. The Construction CONTRACTOR shall check these boundary markings and, from them, plot the lines marking out areas to be demolished within the project limits.

The Construction CONTRACTOR shall be held responsible for any discrepancy in plotting or limits, and he shall repair financially or materially his errors. In addition, he shall be the only party to bear the consequences of any mistake and shall not involve the COMPANY representative on site by trying to partially blame the latter. The Construction CONTRACTOR shall, at his own cost, employ a process-server to draw up an official inventory of the constructions that have been affected and the constructions between those affected.

5.4.1.2 Structures to be completely demolished for the project

The Construction CONTRACTOR shall demolish structures that are to be completely demolished for the project and the corresponding area shall be cleaned.

The Engineering CONTRACTOR shall check on site the accuracy of the drawing for site preparation, the exact number of demolitions to be made and the importance of each one. He shall not be able to make complaints at a later date because of omissions or unawareness of the number or importance of demolitions involved.

During the demolition period, the Construction CONTRACTOR shall be responsible for the support and strengthening of the constructions surrounding those that are to be demolished.

Moreover, after demolition, he shall be responsible for providing the permanent support for the surrounding structures so that they shall remain fitted for use. The Construction CONTRACTOR shall submit to the COMPANY approval the methods that he intends to use.

5.4.1.3 Structures to be partially demolished for the project

Before demolition starts, the Construction CONTRACTOR shall carefully examine structures that shall be partially demolished so that the programme and procedures for demolition may be defined, and, above all, the parts that are not to be demolished remain intact.

The Construction CONTRACTOR shall submit a study report to the COMPANY, who shall make a decision within the following 15 days.

The Construction CONTRACTOR shall be obliged to respect any remark the COMPANY may make about modifications to the planned project arrangements. He may not make complaints concerning delays or cost increase caused by these modifications.

In all cases, the Construction CONTRACTOR remains entirely responsible for the works and their correct performance. The COMPANY approval of his project shall not reduce in any the Construction CONTRACTOR responsibility.

Works to be performed for each construction are as follows:

- Support of the structure parts to be retained, so as to ensure their stability during the performance of works. If needed, surveys in order to determine foundations for new structures
- Excavation for new foundations. The setting up of supports required to ensure a stability which corresponds to normal safety coefficients and which is fitted to the usual finished works
- Re-connection to water, electricity, gas and sewage networks in case these utilities have been cut-off for the performance of Construction CONTRACTOR works.

5.4.2 Demolition of existing constructions

These are classified in five categories:

- a) Constructions of earth, wood, metal plate, etc., which may be easily demolished, and which have a surface area of more than 50 m²; classified as light buildings.
- b) Constructions of stonework or brick masonry of average size; classified as solid buildings.
- c) Constructions considered as modern buildings, including masonry, reinforced concrete, slabs, pillars, lintel, flooring, etc.: classified as modern buildings.
- d) Constructions of the same type as those above, but particularly used for the storage of hydrocarbons or dangerous products, shall be studied in particular by the COMPANY safety department.
- e) Constructions made of reinforced concrete of an average size.

Demolition works include, for structures to be completely demolished:

- The demolitions of the construction and the removal of all the contents from site, such as: trees, miscellaneous plantations, fences, sewers, huts, concrete or stone walls, installations, etc.
- The demolition should be carried out underground to the inferior foundation limit or at least to a level of 1 m underneath the earthwork platform

In special cases, provided for in the Particular Specifications, the demolition may be carried out to a further underground level. Stopping demolishing operations at this lower level shall involve contradictory inspection

- The loading, transportation and deposit of demolished materials in an off-site area. The investigation for waste deposit areas is carried out by the Construction CONTRACTOR and submitted to COMPANY for approval. The Construction CONTRACTOR shall be responsible for all costs and shall obtain any special permit that may be required
- Plots shall be handed over completely clean and cleared of all debris or traces of construction
- As far as underground pits are concerned: they shall either be removed taking the necessary precautions and handed over to the COMPANY, or taken away to the waste deposit according to the COMPANY instructions. Excavation areas shall be refilled with good materials, compacted in successive, well-drained layers, according to the same procedure as for backfilling after earthworks.

5.4.3 Finding installations not indicated on the drawings

The Construction CONTRACTOR shall particularly make sure to inform the COMPANY within 24 hours if he finds any gas, water, telephone or electrical installations, historical or archaeological remains, etc., which have not been indicated on the drawings.

The official departments concerned, with the Construction CONTRACTOR and the COMPANY shall decide upon a programme for works to change the location or to carry out temporary or permanent deviations of such installations. The CONTRACTOR shall be responsible for calling this meeting.

These changes in location, permanent and temporary deviations should be carried out within a reasonable time delay.

These works shall be carried out in compliance with Section 5.5 hereafter.

5.4.4 Back-filling of excavations

Any hole, such as cellars, wells, quarries, pits and miscellaneous excavations within the site area shall be back-filled according to conditions stipulated by the COMPANY (and according to Section 5.4.2).

5.5 Deviation of existing underground structures and utilities

5.5.1 Provisional maintenance

If during the performance of the works, the Construction CONTRACTOR is obliged to stop the operation or to destroy existing installations such as:

- Sewage networks
- Drainage pipes
- Water or gas pipes, electrical or telephone cables, and generally speaking any public or private installation, which may be encountered on the works site, he shall ensure the correct operation of these systems by temporary works which shall be used until the permanent system is operational.

The Construction CONTRACTOR shall, with COMPANY agreement, contact the concerned official departments in order to obtain approval for the temporary shutdown programme before starting works. The Construction CONTRACTOR shall make sure that the competent department is informed in due time of the shutdown works to be performed. The Construction CONTRACTOR shall be held responsible for any delay caused by these works and shall not put forward complaints of any sort.

5.5.2 Temporary deviations for existing roads

The organization of earthworks and the construction of some structures may involve the demolition of existing roads over a certain length. As a consequence the road traffic shall be suspended on these sections.

To resolve this situation the CONTRACTOR shall carry out temporary works so that road traffic can be re-routed to deviations and be maintained.

The COMPANY appropriate department shall approve the programme and the nature of the works involved.

5.5.3 Final repair of existing roads

After performance of the works, the Construction CONTRACTOR shall put back into operation the roads that have been impacted by the project.

The appropriate official departments and the COMPANY shall approve the final project and methods for these repairs.

These works shall be in compliance with the specification **GS EP CIV 201**.

5.6 Preparation of the area for earthworks

5.6.1 Scrapping

The CONTRACTOR shall carry out topsoil scrapping over the project area. The scrapping i.e. removal of topsoil (not fit for fill-in) shall be carried out according to its nature and thickness.

If, after scrapping of topsoil, the soil underneath is still not fit for backfilling, it shall be removed and considered as waste. Deposit areas for topsoil shall be defined by the COMPANY and the Construction CONTRACTOR must insure good conditions of storage. Soil that cannot be used shall be sent to waste areas. These works shall only be carried out with the COMPANY approval and shall be checked.

5.6.2 Initial preparation

Besides the works defined in Sections 5.3 and 5.4 hereabove, and where the highest slope of the land is more than 0.15 m per m, the Construction CONTRACTOR shall make benches or furrows over the backfilling support layer, running perpendicular to the slope. The dimensions and extent of these graduations shall be defined in accordance with the COMPANY.

5.6.3 Compaction of soil under the fill

All soils situated under the fill, having been scraped, shall be scarified, moisture conditioned and compacted to an average density of 95% of the normal optimum proctor, with no individual test result less than 90%.

In case the soil under the fill is made of compressible materials, steps shall be taken to ensure the stability of the fill after COMPANY approval, as indicated in Section 5.10.4 hereafter.

5.6.4 Local substitution

In case the soil in place presents local zones with unsuitable characteristics, the Construction CONTRACTOR shall purge them and refill with good materials.

Preparation works include also provisional works, which must be done to avoid water retention under fill-bed.

5.7 Earth moving

The Construction CONTRACTOR shall submit within 30 days prior to start-up of works any earth movement proposal for COMPANY approval. This shall show the relationship between:

- On the one hand, excavation and backfilling or deposits, and
- On the other hand, backfilling and excavation or borrowing.

Materials shall be classified according to categories defined Section 4.4 (Materials for ordinary backfilling or for selected backfilling. For the latter provisional deposit areas shall be indicated).

The earth movement project shall meet with the following requirements:

- Topsoil coming from ground not suitable for plantation shall be permanently removed
- Topsoil that is to be re-used on slopes and bankings shall be temporarily put aside and stored for later use.

The Construction CONTRACTOR shall distinctly show in his earth movement project, two types of transportation:

- On the one hand, transportation within the project
- On the other hand, transportation outside the project, using site tracks or existing roads.

Wherever the deposit area may be, the Construction CONTRACTOR shall avoid running transport vehicles over topsoil.

After COMPANY agreement on earth movement the Construction CONTRACTOR may undertake general earthworks.

Any modifications to actual earth movements in comparison to the programme shall be made based on COMPANY instruction following Construction CONTRACTOR suggestion.

The Construction CONTRACTOR may not protest against any variations in the average transportation distance.

5.8 Pits, quarries and material deposits

5.8.1 Investigation for borrow areas

In case the Construction CONTRACTOR decides to open up a borrow area, he shall obtain prior COMPANY authorization.

Such authorization shall only be granted provided that the following requirements are met:

- The Construction CONTRACTOR shall not ask for a price supplement for this operation if the yardage is not modified
- The Construction CONTRACTOR deals with earth excavated in excess (excess due to borrowed earth that was not originally calculated in the cubing). He arranges a deposit area for this excess, either outside or inside the project area, as long as the aesthetic quality of the works is not affected
- Operation must be consistent with local laws, especially as regards water, harm and existing roads
- When the borrow area was provided for in the Particular Specifications, the Construction CONTRACTOR must submit to COMPANY approval a study including geological layers description, material characteristics and water table localisation.

When using borrow areas for earth, whether they are provided for in the Particular Specifications or not, the following considerations shall be made:

- In forested areas, undergrowth and stumps shall be removed. Trees shall be uprooted
- Underwood shall be gathered and burned on site. The Construction CONTRACTOR shall be responsible for safety. He shall consult the appropriate official departments concerned and apply their prescribed safety measures
- Trees and stumps shall be dealt with as described in Section 5.3.1

- In forested areas, as in cultivated areas, digging shall be carried out to a level where there are no more roots and borrowed materials comply with COMPANY stipulations
- Earth from these diggings shall be put in deposits within the project area
- To this effect, the Construction CONTRACTOR shall draw up a borrowing plan, which he shall submit for COMPANY approval fifteen days before the respective material is borrowed
- The criteria for the use of backfilling or excavated materials as defined in this specification, are applicable to borrowed materials
- After borrowing operations, the borrow area shall not present any slopes of more than 2/3, subsidences or ditches. The topsoil from excavation shall be respread uniformly over the area. The final arrangement shall be submitted to COMPANY approval.

5.8.2 Provisional deposits

The height of provisional deposits is limited to 3 m.

The positioning of these provisional deposits shall be arranged in agreement with the COMPANY and preferably free project areas shall be selected. They shall not hinder water flow.

5.8.3 Permanent deposits

The Construction CONTRACTOR shall be responsible for all permanent deposits. This applies not only to soils that are not suitable for re-use as fill-in material but also for excess soil.

Site areas where project works are not to be undertaken may possibly be used for such deposits. This shall depend on COMPANY approval and on the condition that the deposits do not hinder water flow and drainage structures.

The COMPANY, taking into account the following requirements, shall agree on the use of these deposits:

- The Construction CONTRACTOR shall carry out preparatory works for the removal of undergrowth from forested deposit areas. The shrubbery and underwood shall be gathered and burned on site. The Construction CONTRACTOR shall be responsible for safety. He shall consult the appropriate official departments concerned and apply their prescribed safety measures
- The Construction CONTRACTOR shall obtain COMPANY approval concerning the acceptable heights and gradient slopes for deposits.

5.9 Performance of excavation works

5.9.1 General instructions

Unless otherwise specified, earthworks shall be carried out mechanically by the Construction CONTRACTOR selected methods.

It is reminded that the Construction CONTRACTOR shall provide the COMPANY with a list of equipment.

The Construction CONTRACTOR shall construct site tracks on the area made available to him at start-up of works. He shall ensure the maintenance of these tracks at his own expense throughout the works.

The location plan of these roads shall be within the project area wherever possible. They shall be subject to COMPANY approval. Earthwork machinery shall run on these tracks and use of public roads should be avoided. However should the use of public roads be unavoidable, the Construction CONTRACTOR shall ensure the permanent maintenance and cleanliness and, if called for, repairs on these roads.

Gradient slopes shall be those defined for the project. Acceptable tolerances for slopes and platforms are defined in Section 5.12. If during works, slopes are not consistent with ground characteristics or if excavation stability is not insured, the Construction CONTRACTOR must inform immediately the COMPANY and take measures in case of emergency.

For excavation works in unstable areas, slopes shall be stabilised: in this case, excavation should be performed with merlons (alternate dots). Moreover, in the case of excavations in a water table area, the Construction CONTRACTOR shall take steps to ensure the stability of slopes and platforms in compliance with Section 5.9.3 of this specification.

Excavation methods shall be subject to COMPANY approval.

Any over-excavation will be refilled to Construction CONTRACTOR expenses according to present specifications.

5.9.2 Types of excavation

5.9.2.1 Excavation in soft soil

These are excavations that do not require use of single toothed ripper with 380 CV engine.

5.9.2.2 Rippable rock excavation

Earthworks for non-compact rock shall involve the use of single-toothed ripper with 380 CV engine. However explosives shall not be required.

Excavation in non-compact rock may only be carried out after contradictory inspection on sections involved.

5.9.2.3 Compact rock excavation

Compact rock excavation requires the use of explosives.

Compact rock excavation may only be carried out after contradictory inspection on sections involved.

The Construction CONTRACTOR shall issue his blasting plan to the COMPANY for safety department and civil engineering departments approval.

The Construction CONTRACTOR shall take all the necessary precautions to ensure that the use of explosive does not involve danger for his or for third parties personnel, and that surrounding structures are not damaged.

In all cases the Construction CONTRACTOR shall comply with local regulations for the use of explosives and it shall be his responsibility to obtain all the authorizations from the safety departments involved, particularly concerning storage, handling and utilization.

The Particular Specifications shall define, if need be, the areas in which the use of explosives is restricted or forbidden. In all cases the Construction CONTRACTOR should limit the use of explosives according to the inconvenience they may cause for the construction that is to be undertaken.

5.9.3 Excavation in the presence of water

In case groundwater is present in the earth to be excavated, the site should be organized in order to carry out works in a dry environment. The Engineering CONTRACTOR shall propose pumps or other provisional or definitive methods for COMPANY approval, before starting excavation works.

In case of dewatering of the excavation, the Engineering CONTRACTOR should ensure that the lowering of the water table would cause no harmful effect (landslide, drying up of wells, etc.).

During the works, the Construction CONTRACTOR will take all measures to control storm-water or water table to avoid damages or unsafe situations. Groundwater level shall be maintained not less than 0.5 m below the bottom of excavation.

In all cases the procedures for works shall be submitted to COMPANY approval.

In compliance with Section 3.3.9 the list of equipment for the works should be submitted to COMPANY approval.

Particular Specifications could describe construction of decantation chambers to collect fine elements.

5.9.4 Drainage of bottom of excavation

Crests shall be surrounded by ditches or gutters, which collect outside stream water. Outlets shall evacuate this water away from the excavation area.

Water coming from outside the excavation shall be collected in order to avoid landslides.

Once collected, this water shall be evacuated by means of gravity if the slope of the land allows so. Should this not be the case, the water shall be collected in sumps.

The positioning of these sumps shall be defined in the Particular Specifications, and shall be submitted to COMPANY approval.

Pumping equipment shall include the emergency equipment required for continual pumping.

5.9.5 Excavation for foundations

These are the excavation works for the foundations on which structures will take their support.

- Performance of excavation

Excavation shall be performed in compliance with instructions given in Sections 5.9.3 and 5.9.4 hereabove.

All excavations shall be kept free from water from whatever source so that the works shall be constructed in dry conditions. Ground water shall be maintained not less than 0.5 m below the bottom of excavation as indicated here above.

Excavations shall be adequately supported, taking into account the nature of the ground to be excavated, any adjacent structures and any other relevant information relating to the stability of the excavation in order to ensure protection of workers.

Every precaution shall be taken to prevent slips and falls of excavated or other material into the excavations.

The bottom of the excavation shall be levelled of any boulder in excess of 0.4 m³ size on a minimum depth of 300 mm, trimmed and mechanically compacted to a dry density of not

less than 95% of the normal optimal proctor for all measures, using a vibrating plate or suitable sized roller.

The Construction CONTRACTOR should obtain COMPANY acceptance of the excavation bottom before casting concrete.

However, in areas effected by air and water, such as some marls, clays or shales or materials which do not meet the bearing capacity requirements, the Construction CONTRACTOR shall take all necessary steps to obtain COMPANY approval and cast concrete as quickly as possible after the excavation bottom has been prepared.

Where excavation is carried out by mechanical means the extraction of excavated material is stopped before the required depth is reached, in order to avoid that the ripper tooth loosens the bottom and the walls of the excavated pit.

The excavation shall be completed manually or by a method that does not involve the inconvenience mentioned hereabove.

All hard elements found at the bottom of excavation pit such as rocks, foundation remains, etc. shall be removed.

In the same way, pockets that are of a softer nature than the rest of the excavation pit bottom shall be purged and replaced by good materials in accordance with backfilling specifications.

Excavated materials shall not be deposited within 1 m of the edge of the excavation and the proximity and height of the excavated material shall be controlled so as to prevent danger to workmen, instability or damage to other structures and service.

These arrangements shall be submitted to COMPANY for approval. Material from excavation shall be put in temporary deposit areas and may be re-used for backfilling or sent to the permanent deposit area if they are considered unsuitable for re-use.

Arrangement of the excavated material in deposit areas shall be controlled by the Construction CONTRACTOR so as to prevent danger to workmen, instability or damage to other structures.

If a foundation is excavated deeper than the planned level, then the over excavated depth shall be filled with suitable material and re-compacted to a dry density of not less than 95% of the Normal Optimal Proctor.

- Shoring and enclosure for excavation pits, and if necessary for existing constructions, shall be such that earth shall not move. Any damage to existing constructions must be avoided, and moreover, any accident involving persons.

Shoring and enclosure shall be removed as works progress, taking into account the hardening times for mortar and concrete.

The details of the methods proposed by the Engineering CONTRACTOR shall be submitted to COMPANY for approval.

5.10 Performance of backfilling works

5.10.1 General instructions

Backfilling shall be made up of one or several uniform earth layers.

The material used for backfilling shall meet the quality requirements stipulated in Section 4.4. It will be moisture-conditioned and spread to the appropriate loose layer thickness.

The backfilling material shall not contain clods, grass, stumps, debris, damp products, frozen material or snow. The use of mud, runny or swelling soils and peats is always forbidden in backfilling materials.

Backfilling operations shall be stopped in case the minimum requirements cannot be met because of bad weather (ice, rain, etc.). Operations may only be restarted after a delay, which shall be fixed by the COMPANY.

Where frost is likely to occur the use of material susceptible to be effected by frost shall be forbidden.

The Construction CONTRACTOR must maintain a slope on each layer in order to allow water to drain. The value retained for this slope has to be approved by the COMPANY.

5.10.2 Placement of ordinary backfilling material

Backfilling material shall be placed over a width as large as possible, in layers with a thickness identical to that determined during tests and compacted according to COMPANY approved conditions.

Elementary layers shall have a transverse slope at least equal to 4% after compaction (except for levelling of earthworks or form). Gradients shall have a slope of two vertical for three horizontal.

The Construction CONTRACTOR shall protect the area in which backfilling is in progress before rain or when there is a risk of rain. The COMPANY may request that area be protected if it considers necessary. After rainfall, or when starting earthworks, the Construction CONTRACTOR shall ventilate the material before restarting compaction or a new layer.

Form finishing shall be carried out as described in Section 5.13. Working tolerances are stipulated in the same Section or in the Particular Specifications.

Once the backfilling is completed, the Construction CONTRACTOR shall make set offs on the crest of the slope. Their dimensions and resistance shall be adapted to leading trickling water towards provisional water descent.

5.10.3 Placement of high backfilling

Where platforms are at an elevation from the natural ground of 15 m or more, high backfilling is involved.

Special precautions should be taken for the compaction and the methodical elevation of this backfilling material, independent of the instructions given above which must be applied.

Backfilling shall be carried out by thick constant layers over the whole area so as to reduce differential settlements to a minimum.

5.10.4 Placement of backfilling in compressible areas

In areas where the earth at fill-in level is likely to settle under backfilling action, operations shall be carried out following a precise calendar and the settlement measured and recorded. The Construction CONTRACTOR shall submit to COMPANY approval a special monitoring program.

The fill-in shall be made to a level higher than the project level and shall be completed as settlement occurs. Once the settlement is stable the fill-in shall be completed to the planned project level.

The methods used to speed up settlements must be submitted to the COMPANY for approval.

5.10.5 Compaction of fill

Unless otherwise indicated in the Particular Specifications, the fill compaction control may be carried out using one of the methods indicated herebelow. The COMPANY shall give its approval.

5.10.5.1 Control by density measurement

Control measurements shall be taken on each layer. The values obtained should be:

- 95% of the normal optimum Proctor density in the body of the fill-in
- 100% of the normal optimum Proctor density in the upper layer.

Controls shall be carried out according to the following frequencies:

- 1 Proctor test for 2000 m³
- 1 water retention measurement for 500 m³
- 1 density measurement for 500 m³.
- 1 In situ CBR or Plate Load test for 2000 m³

Additional tests shall be performed when the quality of moisture control or compaction is suspected. Requirements for additional tests shall be requested and determined by COMPANY.

5.10.5.2 Control by measurement of compaction energy

Compaction energy to be applied to a layer of material is defined by the value Q/S (Q: volume measured after compaction, S: surface swept by compactors in m²).

The control includes:

- Checking the thickness of layers as they are laid
- Surveying the operation of compactors and the utilization of approved equipment at start-up of works. (Speed and vibration frequency of machinery, uniform distribution of compaction energy over the surface to be treated. This shall be in accordance with the programme proposed by the Construction CONTRACTOR, which has received COMPANY approval)
- The periodical measurement of the volume of materials used, the surface covered by the compactors (distance covered by the compactors x width of soil compacted), and the calculation of Q/S ratio.

5.10.5.3 Test bed

In case the value of the Q/S ratio (minimal value), as well as the thickness of primary layers (maximal value), are not defined in the project, these parameters shall be determined before start-up of works by the Construction CONTRACTOR, via the performance of a test bed.

The dimensions of this test bed shall be defined according to the project characteristics and shall be stipulated in the Particular Specifications.

Once the equipment has been defined, the Construction CONTRACTOR can no longer change compaction equipment in use on site, without COMPANY's approval. In this case the COMPANY may request a new test bed.

It is reminded that, in compliance with Section 3.3.9, the Construction CONTRACTOR should set up on site the equipment indicated in the contractual list.

During the test bed performance and while varying the number of compactor passes, the composition of compaction team and the thickness of successive layers, dry density measurements shall be taken, using a large membraned densitometer or any other COMPANY approved method. COMPANY shall grant its approval of other methods after comparison of proposed method with membraned densitometer testing.

5.10.6 Backfilling of wells and excavations

In case excavations, wells or pits are found on the site, the Construction CONTRACTOR shall find a method, which receives COMPANY approval, to have these areas carefully filled-in by successively compacted layers.

5.10.7 Backfilling around works

These backfilling works shall be made around and along buried works, which have been protected previously.

Boulders, lumps of concrete and other foreign matter shall be excluded.

This backfilling shall be compacted by means of pneumatic rammer, proposed by the Construction CONTRACTOR and approved by the COMPANY. Heavy compactor shall be excluded. Adequate drainage shall be arranged so that water is not left lying against hidden faces.

Care shall be taken during back-fill operations to prevent damage to permanent works. In particular, damage to waterproof membranes and other concrete protection shall be repaired before back filling is resumed.

5.10.8 Backfilling of trenches

Backfilling of trenches opened up for laying cables or conduits shall be carried out with materials that have been cleared of stones.

In case of underground galleries, sewage networks or conduits, the side fill-in shall be symmetrically carried out so as to avoid lateral pushing.

This backfilling shall be carried out with selected fill-in material. Layers with direct contact with a cable or a conduit shall be cleared of any element more than 5 cm in size.

The fill-in shall be energetically tampered after moistening.

5.11 Temporary stop in earthworks

5.11.1 Instruction applicable to all backfilling works

Backfilling operations that are stopped due to bad weather or any other reason shall be treated as a foundation layer when restarting works.

In case water content of the upper layer filled-in is out of the acceptable tolerances, this layer shall be ploughed away. The material shall be made uniform by using disc plough and the water content shall be corrected.

The Construction CONTRACTOR attention is drawn to the fact that backfilling protection from the rain is his own responsibility, as indicated in Section 5.10.

In case the Construction CONTRACTOR refuses to set up provisional protection, which the COMPANY considers necessary for correct backfilling protection, the COMPANY may have these works carried out at the Construction CONTRACTOR expense. The corresponding expense shall be immediately deducted from the payment due to the Construction CONTRACTOR.

5.11.2 Case of high backfilling

If high backfilling is being carried out during a period during which, according to Particular Specifications, such filling should not take place because of climatic conditions, the following precautions shall be taken immediately.

- Adjustment of the upper platform of the fill-in to a roof shape, with uniform lateral slopes of 5%
- Protection of the platform by a superficial pulverization of bituminous emulsion, creating a watertight film (density 3 kg/m²).

Works shall only be restarted after COMPANY approval has been granted and according to specifications defined in Section 5.11.1 hereabove.

5.12 Soil treatments

If the soil treatment is not stipulated in the project (slag, lime, bitumen), the Engineering CONTRACTOR or the Construction CONTRACTOR shall propose a method for COMPANY approval.

Particular Specifications shall cover these treatments: vertical drainage, dynamic compaction, ballasted columns, rigid inclusions, etc.

5.13 Earthwork finishing

5.13.1 Gradient adjustments

Excavation gradients shall be in accordance with the slopes and tolerances defined in the project, particularly in the case of rocky ground. The surfacing to be applied shall also be taken into consideration. The grades shall be carefully cleared of earth or stones that are not compactly incorporated and broken rock that is not perfectly stable.

Unless otherwise indicated in the Particular Specifications, the compaction and adjustment of gradients shall be by surplus backfill method.

The backfilling slopes shall be made in such a way that the compaction or settlement of materials results in the planned profiles. The acceptable tolerances shall be respected and consideration shall be made for the surfacing to be carried out, where applicable.

Tolerances shall be stipulated in the Particular Specifications.

5.13.2 Earthwork levelling adjustment

Dimension checking shall be made by the Construction CONTRACTOR from the planted stakes, according to COMPANY approved layout plan. Variations found at each point in comparison to the prescribed dimensions shall remain between -2 and +2 cm.

Maximum amount of deflection over a 3 m ruler should be no more than 3 cm. If during two consecutive days of work, more than 10% of the checked points do not correspond with

tolerances stipulated hereabove, the COMPANY reserves the right to stop works, to examine the methods and equipment used and to have them revised or replaced if necessary.

5.13.3 Top soil covering and grassing

5.13.3.1 Top soil covering

Where topsoil coating is applied to a slope, it should be vertically and horizontally graduated.

Topsoil shall be moistened before it is laid. It shall be spread in layers and the earth shall be rammed or lightly rolled as spreading is carried out. Unless otherwise indicated, the minimum thickness of the coating shall be 15 cm measured after settlement and perpendicular to the slope.

Placing of topsoil shall be stopped during rain or frost.

5.13.3.2 Grassing

Surfaces to be grassed, once covered by topsoil, shall be harrowed in such a way that a chemical fertilizer (10-20-10), 1100 kg/hectare may be ploughed into the land.

The grassing shall be carried out at the right time of the year and after COMPANY approval has been granted.

The choice of seed composition shall be subject to COMPANY approval.

Seed sowing, shall be either carried out manually or mechanically. Mechanical system used shall be either scattering machine or cross ran sowing gun (300 kg of seeds per hectare).

5.13.4 Slope fixing

In case local conditions do not allow topsoil coating or grassing to be carried out, slope fixing shall be in compliance with the project.

This fixing could consist of a hydrocarbon product spread over the slopes, fascine work, or any other method subject to COMPANY approval.

6. Material take off

6.1 Lengths

6.1.1 Transportation distances

Transportation distances are derived from the plans drawn up prior to performance of the works and issued to the Construction CONTRACTOR, or from the plans established during the performance of the works from contradictory inspections.

Transportation distances are taken horizontally taking the shortest way compatible with the mandatory passage points between the respective centres of gravity, on the one hand, from the excavation and borrowings, and on the other hand, from the backfilling and deposit areas.

In the case where borrowed earth or earth from an excavated area is to be distributed over several fill-in or deposit areas, a ponderation of distances depending on corresponding volumes shall be carried out by the Construction CONTRACTOR and approved by the COMPANY.

6.1.2 Drilling lengths

Drilling lengths shall be determined from plans drawn up before performance of the works or from contradictory inspections.

6.2 Areas

Areas are derived from plans drawn up before performance of works and issued to Construction CONTRACTOR, or from plans drawn up during performance of works from contradictory inspections.

Areas are measured depending on the case involved:

- Either by actual value
- Either by horizontal projection.

6.3 Volumes

6.3.1 Earthworks volumes

Earthwork volumes shall be derived from plans drawn-up before performance of the works or from plans made during the works from contradictory inspections.

Any difference found during the works in soil categories shall be examined contradictory for each cross-section.

6.3.2 Volume of pumped water

Volumes of pumped water shall be measured by meters which, if not in compliance with weights and measures department standards, shall be subject to COMPANY approval.

6.4 Weights

Weights shall be measured by scales or spring balance which, if not in compliance with weights and measures department standards, shall be subject to COMPANY's approval.



Appendix 1 Granulometric distribution of earth

Sieves	Sand																		Gravel						Stones						
Supplementary sets	0,090	0,112	0,140	0,180	0,224	0,280	0,355	0,45	0,50	0,71	0,90	1,12	1,40	1,80	2,24	2,80	3,55	4,50	5,60	7,10	9,0	11,2	14	18	22,4	28	35,5	45	56	71	
Elementary quantity en %																															
Cumulative quantity en %																															
100																															
90																															
80																															
70																															
60																															
50																															
40																															
30																															
20																															
10																															
0																															
Standards sets	0,09	0,10	0,125	0,16	0,20	0,25	0,315	0,4	0,5	0,63	0,8	1,0	1,25	1,60	2,0	2,5	3,15	4,0	5,0	6,3	8	10	12,5	16	20	25	31,5	40	50	63	80
Elementary quantity en %																															
Cumulative quantity en %																															

Laboratory :

Supervisor Engineer :

Date :

Date :



Appendix 2 Test for sand equivalence

Project No.:

Work:

Laboratory:

Date:

File:

Operator:

	Sample No. 1		Sample No. 2		Sample No. 3	
	Trial test No. 1	Trial test No. 2	Trial test No. 1	Trial test No. 2	Trial test No. 1	Trial test No. 2
Top level of the clay suspension (clay reading): h_1 (cm)						
Sand reading under weighed foot : h_2 (cm)						
Sand reading at sight h_2 (cm)						
SE on trial test						
Under weighed foot:						
At sight:						
SE on sample						
Under weighed foot:						
At sight:						
Temperature (°C)						

(CF NF P 18 598)

Laboratory:

Supervisor Engineer:

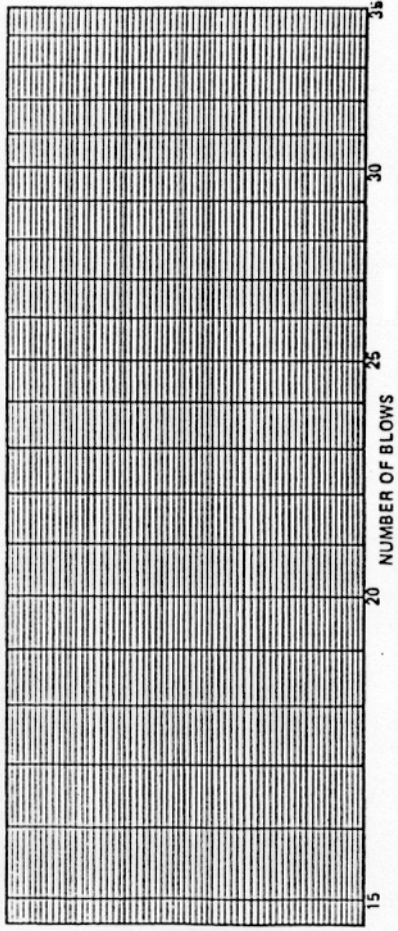
Date:

Date:

Appendix 3 Sieve analysis

PROJECT No. :		PURPOSE :										GRANULAR CONTENT ANALYSIS																																																	
Scale No. Scale No. Scale No.		COARSE GRAVEL 200 100 50 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ PERCENTAGE OF CUMULATED SIEVED										GRAVEL 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Internal opening of sieve grids (Sieving)										COARSE SAND 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										FINE SAND 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										LIMON : 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										CLAY : 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)									
		COARSE GRAVEL 200 100 50 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ PERCENTAGE OF CUMULATED SIEVED										GRAVEL 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Internal opening of sieve grids (Sieving)										COARSE SAND 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										FINE SAND 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										LIMON : 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)										CLAY : 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 5µ 2µ 1µ 0.5µ 0.2µ Equivalent diameter (measurement of sediments)									
Scale No. Scale No. Scale No.		ATTERBERG LIMITS W.L. P.I.										S.E.										CLASSIFICATION I.G. H.R.B. U.S.C.S.										GEOLOGICAL NAME																													
Scale No. Scale No. Scale No.		LABORATORY : DATE :										SUPERVISING ENGINEER : DATE :																																																	

Appendix 4 Determination of Atterberg limits

ATTERBERG LIMITS		Liquidity - Plasticity	
Apparatus : _____	Origin : _____	No. : _____	Object : _____
Sample : _____	Type : _____		
LIQUID LIMIT		PLASTICITY LIMIT	
NUMBER OF TARE			
TOTAL WET WEIGHT			
TOTAL DRY WEIGHT			
WEIGHT OF TARE			
WEIGHT OF WATER			
NET WEIGHT, DRY			
WATER CONTENT			
		LL = _____ LL = _____ PI = _____	

SUPERVISING ENGINEER :
DATE :

LABORATORY :
DATE :

Appendix 5 CBR test

PROJECT No. : _____

OBJECT : _____

COMPACTING IN 5 LAYERS WITH 4.500 KG RAM

SOAKING AND PENETRATION OVERLOAD : _____

CBR TEST

INDEX	DD	DURATION OF SOAKING	No. OF BLOWS PER LAYER	In % OF MOULDING	In % AFTER SOAKING on 29 cm	SWELLING %
			55			
			29			
			10			
			55			
			29			
			10			
			55			
			25			
			10			

Max. dry. density : _____

Optimum water content : _____ %

Specific weight : _____

LABORATORY

DATE

SUPERVISING ENGINEER :

Corrected CBR %

SCALE USED

Dry density

WATER CONTENT %