



Exploration & Production

GENERAL SPECIFICATION

CIVIL WORKS

GS EP CIV 201

Design and construction of roads and stabilized areas
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04	10/08	General review
03	10/07	Update of reference documents and modifications of § 3 and 4
02	10/05	Addition of "EP" root to GS identification
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1. Scope

This general specification covers design and construction work for:

- Roads and runways
- Stabilized areas for parking vehicles and storing materials or equipment.

This specification defines what the COMPANY considers as an acceptable minimum. However, the COMPANY reserves the right to modify or supplement this general specification with particular specifications.

It is intended for use in Exploration and Production facilities (gas plants, camps, etc.).

This General Specification must be use with **GS EP CIV 101** for General Earthworks.

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.

Where there are national regulations, their particular requirements, and those of the standards or codes to which they refer, must be applied, supplementing or amending the provisions of this document.

If there are no mandatory national regulations, international regulations, standards and codes shall be applied.

If there are no applicable international standards and codes, the national standards and codes shall be chosen from those listed below according to the projects in hand and shall be defined in the job specification.

In the absence of any particular specifications from the OWNER, French national regulations shall be applied.

In the absence of a specific exemption, duly justified by the CONTRACTOR and agreed by the OWNER, codes and standards of different origins may not be used in whole or in part.

If certain points in these regulations need to be clarified, the CONTRACTOR shall describe and justify the changes and/or additions to be made so that they can be adapted to the nature and environment of the structure. Such proposals shall be considered acceptable only when they have been examined and approved by the COMPANY.

A definitive list of regulations, standards and codes proposed by the CONTRACTOR shall be taken from the reference documents defined in this specification and the project's job specification.

Only the main standards are mentioned; the CONTRACTOR shall be responsible for compliance with any secondary standards. The list provided in this document should not be regarded as exhaustive.

Unless otherwise indicated in specific contractual conditions, for all documents cited for reference and their addenda, the latest issue applies.

Standards

International standards and codes

Reference	Title
ISO 8608	Mechanical vibration. Road surface profiles. Reporting of measured data

European standards and codes

Reference	Title
XP ENV 1997	Eurocode 7 - Geotechnical Design
EN 40	Lighting columns
EN 124	Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control
EN 500	Mobile road construction machinery
EN 1097	Tests for mechanical and physical properties of aggregates
EN 1317	Road restraint systems
EN 1341	Slabs of natural stone for external paving - Requirements and test methods
EN 1342	Setts of natural stone for external paving - Requirements and test methods
EN 1343	Kerbs of natural stone for external paving - Requirements and test methods
EN 1423	Road marking materials. Drop on materials. Glass beads, antiskid aggregates and mixtures of the two
EN 1436	Road marking materials. Road marking performance for road users
EN 1463	Road marking materials. Retroreflecting road studs
EN 1790	Road marking materials. Preformed road markings
EN 1793	Road traffic noise reducing devices. Test method for determining the acoustic performance
EN 1794	Road traffic noise reducing devices. Non-acoustic performance
EN 1824	Road marking materials. Road trials
EN 1871	Road marking materials - Physical properties
EN 10277	Bright steel products. Technical delivery conditions
EN 12368	Traffic control equipment - Signal heads
EN 12591	Bitumen and bituminous binders - Specifications for paving grade bitumen
EN 12676	Road equipment - Anti-glare systems for roads

Reference	Title
EN 12697	Bituminous mixtures - Test methods for hot mix asphalt
EN 12767	Passive safety of support structures for road equipment - Requirements and test methods
EN 12802	Road marking materials - Laboratory methods for identification
EN 13036-1	Road and airfield surface characteristics - Test methods - Part 1: measurement of pavement surface macrotexture depth using a volumetric patch technique
EN 13197	Road marking materials - Wear simulators
EN 13212	Road marking materials. Requirements for factory production control
EN 13249	Geotextiles and geotextile-related products. Characteristics required for use in the construction of roads and other trafficked areas (excluding railways and asphalt inclusion)
EN 60598	Luminaires

French standards and codes

Reference	Title
NF A 91-131	Hot-galvanized steel wire. Zinc coating specification
NF B 13-001	Raw, crushed and ground natural rock asphalt
NF C 17-200	External lighting installations. Requirements
NF C 70-238	Road traffic signal systems
NF P 15-108	Hydraulic binders - Hydraulic road binders - Composition, specifications and conformity criteria
NF P 16-341	Drainage, sewerage. Precast concrete cylindrical pipes, steel reinforced or not reinforced for sewerage networks without pressure. Definitions, specifications, testing methods, marking, basis for acceptance
NF P 16-351	Plastics. Plastics piping system for civil engineering subsoil drainage. Specification
NF P 18-598	Aggregates. Sand equivalent
NF P 94-102	Soils: investigation and testing - Soil treated with hydraulic binder, possibly combined with lime, for use as a selected fill
NF P 98-080-1	Pavements. Earthworks. Terminology
NF P 98-082	Pavements. Earthworks. Road pavement structural design. Road traffic evaluation for pavement structural design
NF P 98-086	Pavements. Earthworks. Road pavement structural design. Design elements
NF P 98-100	Road foundations. Waters for foundations. Classification

Reference	Title
NF P 98-101	Road foundations. High-calcium lime for soils and roads. Specifications
NF P 98-102	Road foundations. High-calcium lime for soils and roads. Water reactivity test for quicklime
NF P 98-103	Road foundations. Pozzolana. Specifications
NF P 98-104	Road foundations. Testing of reactivity of pozzolana to lime
NF P 98-106	Road foundations. Blast furnace (granulated or pelletized) vitrified slag. Definitions, characteristics and specifications
NF P 98-107	Road foundations. Activation of vitrified slag. Definitions, characteristics and specifications
NF P 98-110	Road foundations. Alumo-silicate fly ashes. Specifications
NF P 98-111	Road foundations. Testing of reactivity of silico-aluminous fly ash to lime
NF P 98-112	Road foundations. Hydraulic fly ashes. Definitions, specifications
NF P 98-113	Road foundations. Sand with hydraulic and puzzolanic binders. Definition. Composition. Classification
NF P 98-114	Roadway foundations. Methodology for laboratory study of materials treated with hydraulic binders
NF P 98-115	Road foundations. Construction of pavement structures. Components. Mix components and formulae. Performance and control
NF P 98-116	Road foundations - Granular material with hydraulic binder - Definition - Composition
NF P 98-121	Base course. Grave emulsion. Bound granular material. Definition. Classification. Characteristics. Laying
NF P 98-124	Road foundations. Fly ashes-lime-gypsum. Definition, composition, classification
NF P 98-125	Road foundations. Untreated sand-gravel mix. Methodology for laboratory study
NF P 98-128	Road foundations. Road roller compacted concretes and high performances cementitious granular material. Definition. Composition. Classification
NF P 98-129	Road foundations. Untreated sand-gravel mix. Definition. Composition. Classification
NF P 98-130	Asphalt - Wearing course and base course: thick layer asphalt concrete - Definition - Classification - Characteristics - Fabrication - Laying
NF P 98-131	Asphalt - Asphalt concrete for airfields pavements - Definition - Classification - Characteristics - Fabrication - Laying

Reference	Title
NF P 98-132	Asphalt - Wearing course and base courses: thin layer asphalt concrete - Definition - Classification - Characteristics - Manufacturing - Laying
NF P 98-133	Asphalt. Coated chippings asphalt concrete. Definition. Classification. Characteristics. Fabrication. Laying
NF P 98-134	Bituminous mixes - Wearing courses: porous asphalt - Definition - Classification - Characteristics - Manufacturing - Laying
NF P 98-136	Asphalt. Asphalt concrete for light traffic flexible pavement. Definition. Classification. Fabrication. Characteristics. Laying
NF P 98-138	Asphalt – Road base courses: road base asphalt concrete - Definition - Classification - Characteristics - Manufacturing - Laying
NF P 98-139	Asphalt. Wearing course: cold asphalt concrete. Definition. Classification. Characteristics. Manufacturing. Laying
NF P 98-140	Asphalt - Road base courses: road base high modulus asphalt concrete - Definition - Classification - Characteristics - Fabrication - Laying
NF P 98-141	Asphalt - Wearing course and base courses: high modulus asphalt concrete - Definition - Classification - Characteristics - Fabrication - Laying
NF P 98-145	Bituminous mixes. Mastic asphalt for footways and pavement wearing courses. Definition. Classification. Characteristics. Fabrication. Laying
NF P 98-149	Asphalt - Terminology - Components and composition of mixtures - Implementation - Products - Techniques and processes
NF P 98-150	Bituminous asphalt. Laying of base, binder and surface courses. Components. Mix contents. Performance and checks
NF P 98-160	Wearing courses. Surface dressing. Specifications
NF P 98-170	Concrete pavements. Construction and controls
NF P 98-200	Road testing. Measurement of a rolling load deflection
NF P 98-203	Tests relating to pavements. Deformations in pavement layers
NF P 98-205	Tests relating to pavements. Measurements of frost effects
NF P 98-216	Test relating to pavements. Measurement of the macrotexture
NF P 98-217	Tests relating to pavements. Tests relating to macrotexture
NF P 98-218	Tests relating to pavements. Evenness test
NF P 98-219	Tests relating to pavements. Evenness test
NF P 98-220	Test relating to pavements. Measurements of skid resistance
NF P 98-230	Tests relating to pavements. Preparation of materials bound with cementitious binders or aggregates mixes

Reference	Title
NF P 98-231	Test relating to pavements. Compaction tests on non bituminous materials
NF P 98-232	Test relating to pavements. Determination of the mechanical. Characteristics on material bound with hydraulic binders
NF P 98-233	Tests relating to pavements. Determination of fatigue resistance on material bound with hydraulic binders
NF P 98-234	Tests relating to pavements. Freezing behaviour of materials treated with hydraulic binders
NF P 98-235	Test relating to pavements. Unbound granular materials
NF P 98-240	Road testing. Measurement of the rate of hydraulic binders and additives in the cementitious materials
NF P 98-241	Test relating to pavements. Determination of the apparent specific gravity of the materials in situ
NF P 98-244	Test relating to pavements. Measurement of the position of steel in cement concrete
NF P 98-245	Tests relating to pavements. Spilling of a product on the surface of a layer of cement concrete
NF P 98-246	Tests relating to pavements. Measurement of the watertightness of joints on cement concrete pavements
NF P 98-248	Test relating to pavements. Tests for concrete with D superior 40 mm
NF P 98-250	Test relating to pavements. Preparation of bituminous mixtures
NF P 98-251	Tests relating to pavements. Static test on bituminous mixtures
NF P 98-252	Tests relating to pavements. Determination of bituminous mixtures response under compaction. Compaction test with rotating shear press
NF P 98-253	Tests relating to pavements. Bituminous mixtures permanent deformation
NF P 98-254	Tests relating to pavements. Surface drainage properties on pervious pavements
NF P 98-256	Tests relating to pavements. Tests on constituents of bituminous mixtures
NF P 98-260	Test relating to pavements - Measurements of rheological properties on bituminous mixtures
NF P 98-261	Test relating to pavements - Determination of the fatigue resistance of bituminous mixtures
NF P 98-274	Tests relating to pavements. Surface dressing characteristics

Reference	Title
NF P 98-275-1	Test relating to pavements. Determination of the rate of binder spray. Part 1: measurement of the mean value of spray rate and transversal homogeneity
NF P 98-276	Tests relating to pavements. Measurement of chipping aggregates rate
NF P 98-280	Tests relating to pavements. Waterproofing materials for structures. Samples conditioning
NF P 98-282	Tests relating to pavement. Waterproofing materials for structures. Adhesion test
NF P 98-283	Tests relating to pavements. Waterproofing materials for structures. Determination of tensile strength and deformation
NF P 98-284	Tests relating to pavements. Waterproofing materials for structures. Determination of cracking strength
NF P 98-285	Tests relating to pavements. Waterproofing materials for structures. Determination of shore hardness
NF P 98-300	Humpback or trapezoidal speed bumps. Geometric characteristics and situation parameters
NF P 98-302	Concrete kerb stones and gullies
NF P 98-303	Concrete paving blocks
NF P 98-304	Roadways. Granite and sandstone kerbstone and gutters
NF P 98-409	Road safety barriers. Performance, classification and qualification criteria
NF P 98-410	Road safety barriers. Steel guard rails (profiles A and B). Operation and holding performances
NF P 98-411	Road safety barriers. Steel guard rails (profiles A and B). Dimensions and manufacturing specifications for sliding elements
NF P 98-412	Road safety barriers. Steel devices. Fixing accessories. Dimensional characteristics. Manufacturing and delivery specifications
NF P 98-413	Road safety barriers. Steel guard rails (profiles A and B). Installation and assembly requirements
NF P 98-420	Road safety barriers. Bho safety barriers. Composition, operation, holding performances, installation and mounting conditions, components
NF P 98-430	Road safety barriers. In-situ concrete partition walls and low walls. Definitions, operation and dimensions
NF P 98-431	Road safety barriers. In-situ concrete partition walls and low walls. Specifications and control
NF P 98-432	Road safety barriers. In-situ concrete partition walls and low walls. Implantation conditions

Reference	Title
NF P 98-433	Road safety barriers. Cast in place concrete separators and walls. Special steel accessories
NF P 98-490	Road equipment. Longitudinal safety aqueduct heads. Design and installation
NF P 98-491	Products in manufactured concrete. Safety aqueduct head in precast concrete
NF P 98-501	Road traffic signs. General
NF P 98-523	Road traffic signs. Retroreflective coatings. Methods of measuring photometric characteristics of retroreflectors
NF P 98-524	Road traffic signs. Retroreflective coatings. Test method for measuring coefficient of retroreflection
NF P 98-527	Road traffic signs. Retroreflective coatings. Method of measuring coefficient of retroreflection using a portable retroreflectometer
NF P 98-528	Road traffic signs. Retroreflective coatings. Test method for measuring coefficient of retroreflection using a portable retroreflectometer
NF P 98-609	Horizontal road marking. Markings applied on roads. Designation

American standards and codes

Reference	Title
AASHTO ALFD-2	Guide Specifications for Alternate Load Factor Design Procedures for Steel Beam Bridges Using Compact Sections
AASHTO CM-4	Manual for Highway Construction
AASHTO FIM-2	Foundation Investigation Manual
AASHTO GDPS-4	Guide for Design of Pavement Structures
AASHTO GHC-4	Guide Specifications for Horizontally Curved Highway Bridges
AASHTO GSDL	Guide Specifications for Distribution of Loads for Highway Bridges
AASHTO GSH-8	Guide Specifications for Highway Construction
AASHTO HB-16	Standard Specifications for Highway Bridges
AASHTO HDG - 07	Highway Drainage Guidelines
AASHTO HM-21	Standard Specifications for Transportation Materials and Methods of Sampling and Testing
AASHTO LPH - 80	A Guide to Standardized Highway Lighting Pole Hardware
AASHTO LTS-4	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
AASHTO MSI	Manual on Subsurface Investigation
AASHTO SRPD-1	Guidelines for Skid Resistant Pavement Design

Reference	Title
AASHTO TF-31	Guide Specifications for Polymer Modified Asphalt
AASHTO VLVLR-1	Guidelines for Geometric Design of Very Low-Volume Local Roads, ADT $\leq$ 400
ACI 345R	Guide for Concrete Highway Bridge Deck Construction
AISC H001	Highway Structures Design Handbook
ANSI/ASTM C977	Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization
ASTM D8	Standard Terminology Relating to Materials for Roads and Pavements
ASTM D20	Standard Test Method for Distillation of Road Tars
ASTM D345	Standard Test Method for Sampling and Testing Calcium Chloride for Roads and Structural Applications
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D490	Standard Specification for Road Tar
ASTM D546	Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D633	Standard Volume Correction Table for Road Tar
ASTM D868	Standard Test Method for Evaluating Degree of Bleeding of Traffic Paint
ASTM D913	Standard Test Method for Evaluating Degree of Resistance to Wear of Traffic Paint
ASTM D1195	Standard Test Method for Repetitive Static Plate Load Tests of Soils and Flexible Pavement Components, for Use in Evaluation and Design of Airport and Highway Pavements
ASTM D1411	Standard Test Methods for Water-Soluble Chlorides Present as Admixtures in Graded Aggregate Road Mixes
ASTM D 1883	Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2026	Standard Specification for Cutback Asphalt (Slow-Curing Type)
ASTM D2027	Standard Specification for Cutback Asphalt (Medium-Curing Type)
ASTM D2028	Standard Specification for Cutback Asphalt (Rapid-Curing Type)
ASTM D2170	Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens)
ASTM D2399	Standard Practice for Selection of Cutback Asphalts
ASTM D2728	Standard Practice for Paving Uses and Application Temperatures for Road Tars

Reference	Title
ASTM D2844	Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D2940	Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports
ASTM D3282	Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 4429	Standard Test Method for CBR (California Bearing Ratio) of soil in place.
ASTM D4505	Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life
ASTM D5918	Standard Test Methods for Frost Heave and Thaw Weakening Susceptibility of Soils
ASTM D6432	Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation
ASTM D6628	Standard Specification for Color of Pavement Marking Materials
ASTM E1337	Standard Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire
ASTM E1364	Standard Test Method for Measuring Road Roughness by Static Level Method
ASTM E1489	Standard Practice for Computing Ride Number of Roads from Longitudinal Profile Measurements Made by an Inertial Profile Measuring Device
ASTM E1859	Standard Test Method for Friction Coefficient Measurements Between Tire and Pavement Using a Variable Slip Technique
ASTM E1889	Standard Guide for Pavement Management Implementation
ASTM E1926	Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements
ASTM F758	Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

British standards and codes

Reference	Title
BS 63	Road aggregates
BS 76	Specification for tars for road purposes
BS 434	Bitumen road emulsions (anionic and cationic)
BS 594	Hot rolled asphalt for roads and other paved areas

Reference	Title
BS 598	Sampling and examination of bituminous mixtures for roads and other paved areas
BS 812	Testing aggregates
BS 873	Road traffic signs and internally illuminated bollards
BS 1446	Specification for mastic asphalt (natural rock asphalt fine aggregate) for roads and footways
BS 1447	Specification for mastic asphalt (limestone fine aggregate) for roads, footways and pavings in building
BS 1707	Specification for hot binder distributors for road surface dressing
BS 2499	Hot-applied joint sealant systems for concrete pavements
BS 3262	Hot-Applied Thermoplastic Road Marking Materials
BS 3690	Bitumens for building and civil engineering
BS 4987	Coated macadam (asphalt concrete) for roads and other paved areas
BS 5212	Cold applied joint sealant systems for concrete pavements
BS 5273	Specification. Dense tar surfacing for roads and other paved areas
BS 5400	Steel, concrete and composite bridges
BS 5489	Road lighting
BS 5649	Lighting columns
BS 5911	Precast concrete pipes, fittings and ancillary products
BS 5931	Code of practice for machine laid in situ edge details for paved areas
BS 6717	Precast, unreinforced concrete paving blocks. Requirements and test methods
BS 6779	Highway parapets for bridges and other structures
BS 7533	Pavements constructed with clay, natural stone or concrete pavers
BS 7669	Vehicle restraint systems
BS 7903	Guide to selection and use of gully tops and manhole covers for installation within the highway
BS 7941	Methods for measuring the skid resistance of pavement surfaces

Professional Documents

Reference	Title
British Highways Agency	Specification for highway works
PCA EB003	Soil-Cement Construction Handbook (1995)
PIARC 02.06.B	Guidelines for Selecting and Carrying Out Tests on Marking Products (1991)
PIARC 03.03.B	Roads in Desert Areas (1991)
PIARC 07.02.B	Concrete Roads (1987)
PIARC 07.06.B	Continuously Reinforced Concrete Pavements (1994)
PIARC 07.07.B	Airfield Pavements (1995)
PIARC 08.06.B	Choice of Materials and Design of Flexible Pavements for Severe Traffic and Climates (2000)
PIARC 19.02.B	Testing of Road Materials (1991)

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP CIV 101	General earthworks
GS EP CIV 103	Fences
GS EP CIV 202	Drainage and underground networks

Reference	Title
GS EP CIV 204	Design of airports and helicopters areas
GS EP CIV 300	Reinforced and prestressed concrete
GS EP GEO 102	Onshore geotechnical soil survey
GS EP GEO 303	Onshore land surveying and positioning works

3. Design

3.1 Design data

The COMPANY shall define the initial and forecast intensity of traffic that roads and stabilized areas will be designed to when in use. The geometrical parameters of the project shall take these data into account.

Should traffic vary significantly as time goes on, particularly during the construction of installations, the Engineering CONTRACTOR shall advise the COMPANY of the characteristic parameters of the traffic to be taken into account. Such a proposal shall be economically justified.

Load rates per vehicle, according to the periods in the service life of the roadway, shall be broken down into: light vehicles, trucks, buses and articulated vehicles. Maximum axle loads shall be given where necessary, bearing in mind legal limits in force.

For unusually wide or heavy vehicles, the COMPANY shall provide the corresponding characteristics.

The Engineering CONTRACTOR shall use this information to justify the layout proposed and, in particular, the structure of roads.

The COMPANY shall determine which areas may be polluted by hydrocarbon products so that special pavement and drainage systems may be provided; the surface may be either a superstabilized bituminous coating or a hydraulic binder based cover.

Taking into account the topographical features of the intended area, the Engineering CONTRACTOR shall propose, with the approval of the COMPANY, the project parameters. These parameters shall make it possible to define the minimum characteristics at any point of the road layout.

The Engineering CONTRACTOR shall study the possibility of varying the parameters per section of a given road. This study shall be economically justified.

Transition zones between categories shall be carefully designed to ensure that the changeover from one category to the next is clear to the user, thereby ensuring his safety.

In horizontal alignment, curves with a gradual radius of curvature (clothoid) will be introduced between straight runs and arcs of circle.

Crossroads shall be designed taking into account:

- The right of way on each of the roads
- The extent of visibility

- The crossing of exceptionally long vehicles
- The minimum turning radius of emergency vehicles.

Standard cross-sections are given in a particular specification. Nevertheless, the following minimum widths shall be complied with:

- Main roads: 8 m
- Plant heavy-duty roads: 8 m
- Plant light-duty roads: 6 m
- Patrol roads: 4 m

The width of shoulder on each side of the road shall be at least:

- Main roads: 1.5 m
- Heavy-duty roads: 1.0 m
- Light-duty roads: 1.0 m

Roads shall be provided with a crown at the centre line. Patrol and trucks roads shall be provided with at least one slope.

Transverse slope shall be a minimum of 2.0%.

The maximum slope in the longitudinal direction shall be:

- 5 % for access roads
- 10% for access ways (ramps) to utilities and equipment areas
- 10% for patrol roads and tracks

Crash barriers shall be provided where considered to protect personnel and/or equipment and piping, i.e. at road crossings over and under pipe racks and pipe tracks, roads adjacent to pipe tracks, roads adjacent to steep slopes, T-junctions and sharp bends along bridges. They shall also be provided where roads run along deep ditches or slopes.

Geotechnical characteristics of the base and sub-base courses will be determined according to the types of material available, the kind of traffic and the expected loads.

3.2 Project features

3.2.1 Studies

The COMPANY shall make available to the Engineering CONTRACTOR all the basic technical documents in its possession:

- Topographical surveys
- Geological, geotechnical and hydrological studies, etc.
- General specifications
- Data specific to the project, etc.

The Engineering CONTRACTOR shall provide all other documents required by the Construction CONTRACTOR to enable him to:

- Have a complete understanding of the project
- Make a clear and precise cost estimate
- Ensure satisfactory performance of works.

The file to be drawn up by the Engineering CONTRACTOR shall specifically include:

- Drawings for all works (plan views, longitudinal and cross-sections, crossroad details, detailed drainage drawings, etc.).
- Earth movements and yardage (see also [GS EP CIV 101](#))
- Calculation notes
- Quantity estimates of all the works
- Unit price definition
- Cost estimate forms to be completed by the Construction CONTRACTOR
- Cost of works.

3.2.2 Acceptance of basic documents by the Engineering CONTRACTOR

The Engineering CONTRACTOR shall scrutinise the basic documents and either accept them or let the COMPANY have, in writing, his comments or any technical reservations he considers necessary.

If his remarks require further studies to be made, they shall be defined in respect of contents, resources required, cost and completion date.

The COMPANY shall decide whether the studies are needed and shall advise the Engineering CONTRACTOR accordingly.

3.3 Mapping Requirements:

The general layouts of roads and stabilized areas 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 studies

a) Situation plan

The situation plan for works in the concerned country shall allow to locate easily the geographical zone in question.

Scales of 1:1,000,000 or 1:5,000,000 may be used (to be adapted according to the region or size of works).

b) Layout plan

The layout plan is the work plan, which defines the boundary of the roads or stabilized areas with their topographical environment, viability and natural landmarks.

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

The layout plan shall allow to find landmarks for the construction of all sections of the road and gives planimetric data for construction.

This plan must be provided with a system of coordinates and level indication, which may be linked to the general system of the country.

c) Longitudinal section

The longitudinal section gives all the linear and altimetric data of the road, partial and cumulative lengths between points on the axis (or offset), altitude of the existing ground, altitude of the project after completion (with or without surfacing course).

Generally speaking, the scale for the longitudinal section is that of the plan view in the horizontal direction, and ten times higher in the vertical direction.

Longitudinal sections are not required in case of stabilized areas of non-linear shape. Multiple cross-sections, carefully located according to the shape of the stabilized area, may be used instead.

d) Cross-sections

The existing ground surface is defined by means of spot heights, established either systematically from cross-sections perpendicular to the axis of the road (the most common case), or from a series of spot heights along lines of natural slope changes characteristic of the topography.

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 road is added to the cross-section drawing.

Cross-sections may be drawn and/or tabulated for data processing purposes. Tables shall be sufficiently detailed to give length, elevation and gradient for each section without any further calculation.

3.3.2 Base and sub-base courses

a) Materials

The characteristics of materials used for surfaced roads are as follows:

- High load bearing capacity (mechanical characteristics)
- Resistance to abrasion (as a function of time)
- Sensitivity to water
- Sensitivity to freezing/thawing.

For non-surfaced roads, the properties required for the surface layer are as follows:

- Sufficient and durable mechanical properties to bear high stress (particularly shear stress)
- Resistance to corrugations
- Regular surface
- No excessive amounts of dust under traffic load
- Not slippery in wet conditions
- Resistance to erosion.

The origin and quality of materials used shall be defined in the particular specifications.

b) Sizing

Access roads and roads shall be designed in accordance to Standards requirements. If the COMPANY judges it necessary, design shall be carried out for the tracks and patrol roads.

The thickness of base and foundation courses shall be defined at the project stage. The choice and method of sizing (empirical and theoretical) shall be approved by the COMPANY.

All parameters involved in this choice shall be specified:

- Type and intensity of traffic and likely development
- Quality of subgrade
- Quantity and quality of provided materials
- Climate.

In the design of roads, the following minimum thickness shall be taken:

- Road base: 200 mm
- Road sub-base: 230 mm
- Surfacing:
 - o Surfacing base course: 50 mm
 - o Wearing course: 30 mm

3.3.3 Dewatering and drainage

The road surface shall have a minimum lateral slope of 2% to provide proper drainage under all weather conditions.

Drainage system 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 as mentioned in section 3.2.1. Design and construction of drainage system shall be performed in accordance with the requirements of **GS EP CIV 202**.

3.3.4 Equipment

Road equipment shall be adapted to the project and shall be covered by technical project specifications.

The following are included under equipment:

- Traffic signs and pavement marking
- Public lighting
- Crash barriers
- Reflecting marker posts
- Fences
- Kilometre posts
- Etc.

4. Type, origin and quality of materials

4.1 Approval of materials

Before materials, supplies and equipment are used, the approval of the COMPANY shall be requested in respect of type, origin and quality.

The COMPANY approval does not relieve the Construction CONTRACTOR of his responsibility as regards to quality and quantity of supplies and works.

4.2 Organization of tests

All tests shall be performed in accordance with terms and conditions approved by the COMPANY and include the following for equipment and materials to be used for works:

- Approval tests for natural materials and manufactured products supplied
- Composition tests for those products requiring on-site mixing
- Acceptance tests on supplies in accordance with the specifications of the MANUFACTURER or the COMPANY
- Operation tests for construction equipment, such as pumps, rollers, crushers, etc.

4.3 Laboratory

Wherever justified by the extent of the works, the Construction CONTRACTOR shall install a site laboratory fitted out with all the equipment required for tests.

The personnel and equipment necessary for operation of the laboratory shall be indicated in the particular specifications.

Test results shall be supplied on sheets provided by the COMPANY, examples of which are given in the appendix. For special tests, which are not covered by this specification, record sheets shall be on a format approved by the COMPANY.

4.4 Origin of the materials

All materials and equipment used for works shall comply with specifications and have COMPANY's approval. The Construction CONTRACTOR shall supply all certificates of origin and qualification documents when applying for approval.

4.4.1 Road materials

Materials selected for road layers, particularly natural or crushed ungraded stones, aggregates, sand and fillers shall come from a borrow pit or quarry already existing or to be opened.

Depending on completion time specified in the Contract, the Construction CONTRACTOR shall set up, equip and organize quarries as per Section 5.6.1 so that initial production and storage of crushed material may take place immediately after approval from the COMPANY.

Additives and fillers not coming from quarries shall come from approved factories. Certificates shall be provided to the COMPANY.

Supplies of hydrocarbon binders shall come from refineries or factories approved by the COMPANY. Transportation shall be included in the supply and shall be ensured in bulk or in barrels, on the COMPANY authority as need arises.

4.4.2 Equipment and supplies

The Construction CONTRACTOR shall specify the origin of all equipment and supplies required for the completion of the project and comply with approval specifications given in Section 4.5 of this specification.

4.5 Quality and preparation of materials

Unless otherwise indicated in the particular specifications, all materials shall comply with Section 4.4 above.

Once the Contract is signed, the Construction CONTRACTOR shall submit to the COMPANY for approval all samples and fabrication certificates for supplies and equipment. Equipment shall be consigned until the end of works and shall not be changed without the COMPANY approval.

4.5.1 Roadway materials

a) Selected natural materials for sub-base layer

a.1) Subgrade

The strength of the prepared subgrade shall be evaluated from the results of CBR tests in the laboratory (as per [ASTM D 1883](#)) or CBR in situ (as per [ASTM D 4429](#)). A CBR value equal to or greater than 30% shall be considered in laboratory and more than 25% in situ.

a.2) Sub Base layer

Gravel materials shall come from sites indicated in the particular specifications, or from new sites proposed by the Construction CONTRACTOR and approved by the COMPANY.

The sub base shall consist of granular (maximum aggregate size 50 mm), free-draining material such as clinker, natural or crushed gravel, with the following properties:

- CBR, at 97% of the Modified Proctor maximum dry density (after four days of soaking), shall be equal to or greater than 30. The Engineering CONTRACTOR may request the CBR be measured without soaking
- Dry density, at 100% Modified Proctor maximum dry density, shall be greater than 2.00
- Plasticity Characteristics:
 - Liquid limit shall be equal to or lower than 45
 - Plasticity index shall be equal to or lower than 25
- Grading (as a percentage by mass of total aggregate passing through test sieve):
 - 80 micron: 5 to 30
 - 2 mm: 10 to 40
 - 5 mm: 15 to 65
 - 10 mm: 15 to 100
 - 50 mm: 100

b) Materials for base layer

The base layer shall consist of natural graded granular material or crushed material.

b.1) Natural material

The selected materials are gravels (maximum aggregate size 50 mm) coming from sites indicated by the special specifications, or new sites proposed by the Construction CONTRACTOR and approved by the COMPANY. They shall satisfy the following requirements:

- CBR, at 98% of the Modified Proctor maximum dry density (after four days of soaking), shall be equal to or greater than 80. The Engineering CONTRACTOR may request the CBR be measured without soaking
- Dry density, at 100% Modified Proctor maximum dry density, shall be greater than 2.05
- Plasticity index shall be less than 20

- Granulometry (as a percentage by mass of total aggregate passing through test sieve):
 - 80 micron: 5 to 20
 - 2 mm: 20 to 55
 - 5 mm: 35 to 65
 - 10 mm: 50 to 80
 - 50 mm: 100

b.2) Crushed materials

Crushed materials for the base layer shall come from quarries approved by the COMPANY. The quality of the materials shall be the Construction CONTRACTOR responsibility.

These materials shall comply with the grain size distribution requirements as laid down in the special specifications, or where no such requirements are given, shall be as follows:

- Either 0/D crushed, non-graded material where D is the upper diameter of the largest element, variable between 30 and 60 mm
- Or in d/D calibrated crushed material, where d is the size of the lower sieve used in the adopted granular measurement process.

In the case of a 0/31.5 material, the range could be as follows:

- Maximum size of elements: 31.5 mm
- 20 mm element: 85-100%
- 10 mm element: 47-77%
- 6.3 mm element: 35-60%
- 2.0 mm element: 18-38%
- 0.08 mm element: 2-10%
- Los Angeles coefficient: less than 30

During the period of tests prior to works, the Construction CONTRACTOR shall propose a grading curve, for the COMPANY's approval, representing the mean production of his installation, operating on the deposit to be exploited. This curve shall have a shape similar to that for the range limit curve.

Once COMPANY's approval has been obtained for crushed materials and stocks, samples of materials will be taken from the piles at various points and will undergo 20 grading analyses and 20 sand equivalent tests for approximately 5000 m³ of material.

Storage shall be in 0.80 m thick horizontal layers and once one batch has been accepted, the Construction CONTRACTOR may go ahead with the whole batch.

At least nineteen of the twenty tests shall give results within the required tolerances for the stock to be accepted.

If a batch is rejected, it shall be completely removed from the storage area.

d) Materials for bituminous concrete and bituminous mix

d.1) Crushed materials

For bituminous concrete:

The mineral mix shall be obtained by the recomposition of at least three granular categories defined by the granularity limits (d, D).

These categories might be: 0 - 2 - 6,3 - 12.5 - 16 mm.

Following the preliminary material acceptance tests, the Construction CONTRACTOR shall propose the reference grading curve. It shall satisfy the following requirements:

- Rejection at D shall be less than or equal to 10% in weight
- Rejection at 1.25 D shall be nil
- Acceptance at d shall be less than or equal to 10% in weight
- Acceptance at 0.63 d shall be nil
- Acceptance at $\frac{D + d}{2}$ shall be between 1/3 and 2/3 in weight.

For bituminous mix:

The mineral mix shall be obtained by the recomposition of at least two granular categories defined by the granularity limits d/D. The Construction CONTRACTOR shall use the following categories: 0/6.3 and 6.3/20 mm.

The category 6.3/20 may be broken down into 6.3/12.5 and 12.5/20

- Refusal at D shall be less than or equal to 15% in weight
- For 0/D categories, refusal at 1.25 D shall be nil
- Acceptance at d ($\neq 0$) shall be less than or equal to 10% in weight
- Acceptance at $\frac{D + d}{2}$ shall be between 1/3 and 2/3 in weight.

Checks:

After obtaining COMPANY approval for each type of manufactured material, materials are stored in batches of 1500 m³ per category.

From the first day of manufacture the following will be performed in acceptance tests:

- Establishment of the Los Angeles coefficient which should be less than 25
- 20 granular measurement analyses
- 20 sand equivalent tests (the fraction of aggregates passing through a 5 mm sieve shall have a minimum value of 40)
- 10 cleanliness tests
- Determination of flakiness index.

If a batch is refused, the Construction CONTRACTOR shall remove it from the storage area.

d.2) Granular correction material for bituminous mix and concrete

Any granular correction materials required include clean, fine sands as well as fillers.

Quantities shall be determined by the composition formula, which will be submitted to the COMPANY for approval along with production.

Correction sand:

Correction sand shall preferably have a sand equivalent value greater than 80%; the sand should come from the crushing of clean rocks free from pollution by soils.

Natural sand with a low salt content and identical sand equivalent value is also acceptable.

Fillers:

The granularity of fillers shall be such that at least 80% of elements pass through a 0.08 mm sieve and 100% through a 0.2 mm sieve. The grading curve shall be measured by sediment measurements and its Blain specific surface shall be at least 3500 cm²/gramme.

Fillers may be either cement or lime.

e) Gravel for surfacing course

Gravels used for gravelled surfaces shall have a d/D value selected from the range of sieves: 2 - 6.3 - 12.5 - 16 - 20 mm.

The Los Angeles coefficient shall be less than or equal to 25.

The table below gives the imposed tolerances (column 1), the percentage value of Construction CONTRACTOR price reduction for each percent outside the tolerances (column 2) and the tolerance limits beyond which the supply will be rejected (column 3).

Designation	Tolerance (1)	Price reduction (2)	Rejection limit (3)
Weight % of rejection at D	10%	2%	15%
Weight % of acceptance at d	15%	2%	20%
Total of the two above %	20%	3%	25%
Weight % of rejection at $\frac{D + d}{2}$	Between 1/3 and 2/3	Less than 1/3 and more than 2/3	
Weight % of acceptance at 0.5 d	2%	3%	5%
Weight of acceptance at 1 mm	2%	3%	3%
Weight % of friable and/or spoiled grains	4%	3%	6%
Weight % of long and/or flat grains	10%	1%	20%

For double-layer type surface courses, the gravel size will generally be as follows:

- First layer: 12.5/16
- Second layer: 6.3/12.5

12.5/18 and 8/12.5 or 10/20 and 5/10 may also be used.

g) Binders for bituminous mix, bituminous concrete, impregnation and gravelling

In the absence of special instructions, the binder used in bituminous mix or bituminous concrete shall be pure 60/70 or 80/100 bitumen.

The binder for impregnation and gravelling shall be fluidified bitumen or a bitumen emulsion, as described in Section 5.6.3.

4.5.2 Equipment

The Construction CONTRACTOR shall indicate the checks or tests performed by him, either in the factory or on-site, on all materials for equipment (crash barriers, fencing, sign boards, lighting, paints and markings, etc.). The results of these tests shall be submitted to the COMPANY for its approval as to their use.

5. Performance of works

5.1 Resources used in performance of Contract

Before work starts, the Construction CONTRACTOR shall confirm in writing the list of the personnel, equipment, site installation plans and the detailed schedule of works he has supplied to the COMPANY with his submission.

These documents require COMPANY approval.

5.1.1 Personnel

The Construction CONTRACTOR shall provide the COMPANY with staffing proposals, indicating the qualification of each member of managerial staff and the position he is to fill.

5.1.2 Site installation

The Construction CONTRACTOR shall provide site installation plans showing the proposed location of premises, offices, laboratories, stores, workshops, storage areas, crushing installation area, equipment parking areas and storage areas for fuel and explosives, etc.

5.1.3 Equipment

The Construction CONTRACTOR shall provide the list and the status of the main equipment to be used in the performance of works, with the year of acquisition, expected date of availability on site in working order for each item and the duration of the work.

5.2 Preparation

In addition to Section 2, on notification of the Contract and within the time indicated in the particular specifications, the Construction CONTRACTOR shall submit to the COMPANY the detailed supply schedule for the materials required for works on site, and a work schedule which is compatible with the contractual deadlines.

5.3 Preparatory works

As regards to pegging out, layout, distance marking, obstacles encountered, clearing of the area, demolition and detours, the Construction CONTRACTOR should refer to general specification **GS EP CIV 101**.

5.4 Programme of works

The Construction CONTRACTOR shall keep the schedule of works up to date taking into account the progress of the works.

No modification may be made to this schedule without the approval of the COMPANY; this approval shall not commit the COMPANY in any way.

At the end of each month, the Construction CONTRACTOR shall provide a statement of progress as per the model required by the COMPANY.

5.5 Dewatering and drainage works

For the manufacture, composition and storage of cement and aggregates and the use of concrete, the Construction CONTRACTOR should refer to general specification **GS EP CIV 300**. For the construction of drainage network, the Construction CONTRACTOR should refer to general specification **GS EP CIV 202**.

5.6 Performance of road works

5.6.1 Preparation of quarries and deposits

The Construction CONTRACTOR shall exploit the best areas of the adopted quarries and deposits. In the event of a single quarry having to be used for both base and sub-base layers, the Construction CONTRACTOR shall carry out a special study to define the limits of areas to be used.

The deposit or quarry areas shall be cleared of trees and vegetation and the overburden shall be stored so as to avoid any contamination of extracted material.

The selected materials shall be piled in heaps of at least 1000 m³ so as to facilitate the acquisition of uniform quality.

5.6.2 Road construction

The foundation layer shall only be installed on an accepted earthwork grade and the base layer on an accepted sub-base layer.

The materials shall be spread in layers of uniform thickness, not exceeding 20 cm after compacting. They shall be wetted to the water content corresponding to 95% of the Modified Proctor Optimum for the base layer, and compacted uniformly and homogeneously for the entire width of the layer. Compaction should be up to 95% of the Modified Proctor dry density, without tolerances, for the sub-base, and 98% for the base. 95% is acceptable for hard shoulders and certain parking areas with low traffic.

Any addition of material in a thin layer on a sub-base or base layer already surfaced is prohibited.

Any layer considered unacceptable by the COMPANY shall be completely removed and replaced, with moisturising and compacting at the Construction CONTRACTOR expense.

Levelling shall comply with the standard profile defined in the Contract; there shall be no depression greater than 2 cm at the sub-base and 1 cm at the base beneath a 3 m ruler.

The Construction CONTRACTOR shall carry out full size compaction tests on a test strip, so as to determine the composition of the compaction equipment and the number of passes required by equipment to obtain the required compaction rate. At least 20 in situ dry density tests will be necessary.

5.6.3 Surfacing

On output from the crusher, materials shall be stored in piles with a simple geometric form not exceeding 5 metres in height.

The storage area shall be prepared by the Construction CONTRACTOR so as to avoid any contamination of the stocks.

The advance stock requirement shall be a one-month use at full rate.

a) Binders

The Construction CONTRACTOR shall ensure a permanent stock greater than the average daily consumption.

b) Impregnation

Surfaces for impregnation shall be carefully swept by sweeping machine and finished off by hand brush; impurities shall be removed from the grade.

Impregnation may only take place on a base layer satisfying the required technical specifications.

The Construction CONTRACTOR shall spread the priming coat binder uniformly after slight moisturising of the surface to be impregnated. Unless otherwise stated, the mix used shall be as follows, depending on the surface: between 1 and 1.2 kg/m² of fluidified bitumen, or 1.2 kg/m² cationic impregnation emulsion at 65 to 70% of residual bitumen.

These proportions may be modified by the COMPANY, if it considers that the modification will lead to a better result.

Penetration should be complete within 24 hours. The Construction CONTRACTOR shall take every precaution to prevent traffic movement on impregnated surfaces. No spreading operation shall take place if there is a likelihood of rain or on an excessively wet surface.

Any excess binder shall be sanded by the Construction CONTRACTOR at his expense.

Further, the Construction CONTRACTOR shall take all necessary precautions to avoid pollution of the environment.

c) Multi-layer surfacing (surfacing course)

Method:

The type of binder to be used shall be determined by the kind of gravel and the product available. The binder used shall provide satisfactory adhesion. This adhesion shall be measured in tests approved by the COMPANY and one of the following binders could be stipulated:

- Fluidified bitumen (cut back 400/600) spread hot and doped when required
- Emulsion with 65 to 70% residual bitumen, which may be:
 - Anionic
 - Cationic
 - Superstabilized (for surfaces requiring special anti-kerosene treatment).

Spreading operations shall be carried out mechanically and shall involve test strips of approximately 300 square metres, which will make it possible to master the technique and proportion requirements.

The COMPANY shall be at liberty to modify any of the proportions proposed.

The surfacing course shall be laid within 3 to 6 days following impregnation.

Unless otherwise stated in the particular specification, proportions for a double-layer may be as follows (per 1 m²):

- **For fluidified bitumen**

- **First layer:** 1.2 kg of 400/600 viscosity fluidified bitumen covered with 14 litres of 12.5/16 gravel, or 15 litres of 12.5/18 or 10/20 gravel
- **Second layer:** 1.1 kg of 400/600 viscosity fluidified bitumen covered with 10 litres of 6.3/12.5 gravel or 7 litres of 5/10 gravel.

This second layer may be laid immediately after the first one. When the adhesion of the binder on the gravel is insufficient, the use of dope shall be suggested by the Construction CONTRACTOR, with COMPANY approval.

- **For an emulsion**

- **First layer:** 1.0 kg of residual bitumen covered with 14 litres of 12.5/16 gravel, or 15 litres of 12.5/18 or 10/20 gravel
- **Second layer:** 1.0 kg of residual bitumen, covered by 10 litres of 6.3/12.5, or 7 litres of 8/10 gravel.

The spreading of gravel should not be more than 50 metres behind binder spreading. In the event of a chipping spreader breakdown, the spraying machine shall be stopped immediately and the non-gravelled surfaces covered.

Every time binder spreading is resumed, a mask placed across and at the beginning of the strip to be surfaced is obligatory. Where half the road is surfaced at a time, the first layer shall extend for 0.20 m beyond the axis.

Rolling shall begin immediately after gravel spreading. This shall include one pass by a light, flat-steel roller (less than 10 tonnes) and at least five passes by smooth pneumatic-tyred roller.

Use of broom-drag equipment is recommended. In all cases, rolling shall be continued until the gravel has been perfectly incorporated into the binder.

The finished surface should be uniform. It may be opened to traffic immediately. Any excess shall be swept and spread on the hard shoulders 15 days at the earliest after surfacing.

Tolerances:

1 - Temperatures

Spreading temperatures should ensure maximum fluidity, without reaching dangerous levels.

The 400/600 cutback should be heated to a temperature between 115°C and 130°C before spreading.

2 - Quantity checks

Binder spreading regularity shall be checked according to relevant standards.

During works, the COMPANY may go ahead with gravel and binder quantity checks, at any time.

The Construction CONTRACTOR shall submit a checking method, obligatorily based on the weight of supply spread over a given surface.

Binder spreading regularity shall be assessed in accordance with the ratio value:

$$r = \frac{D - d}{D + d}$$

where D represents the maximum and d the minimum weight proportions observed in the section under consideration.

The ratio shall be less than 0.20.

Gravel spreading regularity shall be checked by tests before the opening of the site. Successive weight readings resulting from these tests shall not deviate more than 15% from their average value on the section under consideration.

d) Bituminous concrete and bituminous mix

Use:

The use of materials shall be conditioned by notification given to the Construction CONTRACTOR to begin the works, following COMPANY agreement on the composition formulas.

The bituminous mix shall be spread by a finishing machine. The use of a grader or any other equipment is strictly forbidden. The COMPANY may require the Engineering CONTRACTOR to ensure continuous radio contact between the worksite and the manufacturing unit.

In order to avoid breaks in spreading or regulating, the speed of the finishing machines shall be calculated to take into account the production rate of the mixing plant. The Construction CONTRACTOR shall also ensure sufficient means of transport to ensure continuous supply to the worksite, independently of production by the plant. He shall propose for COMPANY's approval, a means of supply ensuring continuous operation.

The Construction CONTRACTOR shall establish a spreading method making it possible to obtain a regular upper surface satisfying levelling requirements.

The compaction equipment shall be determined after completion of a test strip and when the efficiency of the method used has been verified.

Compaction should be able to be completed by a team comprising, for each spreading machine:

- Two pneumatic-tyred rollers
- Two tandem flat-steel rollers (6 to 10 tonnes).

In the first days of the work or the implementation of a new coating method, the Construction CONTRACTOR shall carry out compaction tests aimed at selecting the best use of the equipment, taking into account the load of each machine, their plan of operation, with a view to ensuring for all points of the construction, a number of passes as constant as possible and also taking into account the speed at which machine operates, the inflation pressure of tyres for compactors, the maximum distance between finishing machine and the first pneumatic-tyred roller and the spreading machine.

During the entire test period and until the Construction CONTRACTOR proposes a compaction method, progress of the works shall be limited to 1000 m² per day.

The COMPANY reserves the right to a five days delay before making a final decision on the request for compaction plant approval, following which the Construction CONTRACTOR will be authorized to work at his optimum speed.

Check on implementation:

The COMPANY shall perform regular composition and quality checks on authorised coated materials. In case of lack of specifications, the following shall be supplied.

The check shall be particularly applied to the filler and bitumen content:

- Bitumen content: $\pm 5\%$ of relative value taken on the average of eight daily readings performed on test samples
- Fines content: $\pm 1\%$ absolute value of coated weight taken on the average of measurements performed for on week of manufacture on a basis of 8 daily measurements.

A reassessment of prices shall be made if these tolerances are exceeded.

Surfacing thickness and compaction tests shall be performed in situ by the Construction CONTRACTOR in the presence of the COMPANY.

• Surfacing

Dimensions shall be checked against markers placed every 15 meters on average. Deviation from project dimensions shall remain within ± 1 cm. Depressions in the final surface likely to retain water shall be unacceptable.

Maximum deflection beneath a three metre rule shall remain below 0.50 cm and the number of measurements greater than the tolerances shall not exceed 10%.

- **Thickness checks** shall be performed using the core samples used to verify in situ compactness.

Discrepancies observed shall remain within the limit of -10% to +20% and the mean of all measurements greater than or equal to the theoretical thickness.

The in situ compactness test shall be performed at a rate of one test for 1500 square metres approximately (one core sample in ten taken on possible joints); no result should be less than 91%.

Examination of work methods and equipment, its overhaul and replacement may be required by the COMPANY, if it proves necessary.

5.7 Installation of road equipment

Traffic signs, pavement markings and crash barriers shall be installed at locations defined on the signalling plans, and shall comply with regulations and requirements of the country. Anchoring blocks shall be large enough to resist forces to which the panels and supports will be subjected.

For his purpose, the Construction CONTRACTOR shall supply justification of the adopted dimensions.

The various items of equipment shall comply with the standards in force.



Appendix 1 Sieve analysis of aggregates

Project No.:

Subject:

Sieve	Sand																				Gravel						Stone					
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																																
SIEVES	0,080	0,10	0,125	0,16	0,2	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	
Standard's sets																																
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 weight 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)						

Laboratory:

Supervisor:

Date:

Date:

Appendix 3 Gradation of aggregates

PROJECT No. :		GRANULAR CONTENT ANALYSIS										PURPOSE :					
100	PERCENTAGE OF CUMULATED SIEVED	COARSE GRAVEL	GRAVEL	COARSE SAND	FINE SAND	LIMON :	CLAY :										
90																	
80																	
70																	
60																	
50																	
40																	
30																	
20																	
10																	
0																	
200		20	10	5	2	1	0.5	0.2	0.1	0.05	0.02	0.01	5 μ	2 μ	1 μ	0.5 μ	0.2 μ
		Internal opening of sieve grids (Sieving)										Equivalent diameter (measurement of sediments)					
		ATTERBERG LIMITS			S.E.			CLASSIFICATION			GEOLOGICAL NAME						
Scale	No.	W.L.	P.I.				I.G.	H.R.B.	U.S.C.S.								
Scale	No.																
Scale	No.																

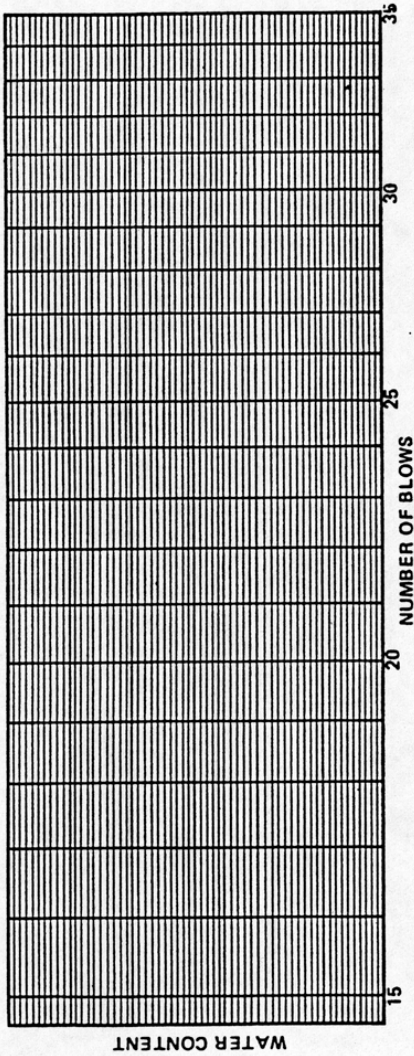
LABORATORY : _____

DATE : _____

SUPERVISING ENGINEER : _____

DATE : _____

Appendix 4 Atterberg limits

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

Appendix 5 CBR test

PROJECT No. : _____

OBJECT : _____

COMPACTING IN 5 LAYERS WITH 4500 KG RAM

CBR TEST

SOAKING AND PENETRATION OVERLOAD

INDEX	DD	DURATION OF SOAKING	No. OF BLOWS PER LAYER	In % OF MOULDOING	In % AFTER SOAKING on 2.9 cm	SWELLING %
			55			
			29			
			10			
			55			
			29			
			10			
			55			
			25			
			10			

Max. dry. density : _____

Optimum water content : _____ %

Specific weight : _____

LABORATORY DATE : _____

SUPERVISING ENGINEER : _____

DATE : _____

WATER CONTENT % : _____

Corrected CBR % : _____

SCALE USED : _____

Dry density : _____