



Annex III

Technical Specifications

Project Title: Resurfacing non-structural works at Enguri Bridge

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1. GENERAL DESCRIPTION OF THE PROJECT

1.1. PRESENTATION/SCOPE OF WORKS

The Enguri Bridge is a multiple-span mixed steel and concrete bridge built between 1944 and 1948. It is located on the road E97 between Zugdidi and Gali crossing the Enguri River, the bridge is made of 4 girders with a reinforced concrete deck slab. The bridge has 20 spans, 19 piers and 2 abutments. Its overall length is 628.9m, and overall width 8.7m consisting of a 7 m wide road surface with two sidewalks of 0.70 m separated by 0.35 m high kerbs. The 20 spans form 5 expansion sections of 4 spans each. During the conflict in the 1990ies, the West-sided abutment wall [no. 21] and the last span on the same side [no. 20, l = 29.7 m] were destroyed. The missing span is temporarily bridged by a modular steel structure covered by a steel deck plate.

The condition of the road surface is in a serious state of dilapidation, but the structural elements are generally in good condition according to relevant report from bridge specialists (Assessment report Stucky Draft version 27.09.2013). It is however stated in the same report that **the structural condition of the bridge has to be further evaluated in more detail.**

The present Technical Specifications refer only to the resurfacing works to take place to the above mentioned bridge in order to ensure temporary smooth traffic conditions and protection of the structure from corrosion. Structural works have not been foreseen at this phase.

Therefore, UNDP wishes to draw bid documents from qualified contractors with experience on the following types of works:

Rehabilitation and surfacing of bridge decks with asphalt concrete pavements and all related works for water tightness.

The main works required are the following:

- Removal of existing fractured asphalt pavement and kerbs
- Laying of new asphalt concrete pavement on the bridge deck including levelling concrete layer cambered transversely 2% (to be kept to absolute minimum thickness) and waterproofing
- Concreting of new kerbs
- Repair/Paint of existing steel railing
- Repair/Paint and reinstallation of existing steel expansion joints (**BOQ-Option I**)
- Installing of new expansion joints (**BOQ-Option II**)
- Installing of new gullies - water drainage pipes

The pavement works (Laying of new asphalt pavement) shall take place from span No 1 up until and including span No 19. The modular temporary metal slab on span No 20 is not included in the scope of works.

The Contractor shall ensure smooth and gradual connection of the new paved carriageway with the span No 20 (modular steel structure).

1.2. Considerations

This intervention does not assess the structural capacity of the bridge and focus on the resurfacing works as per UNDP's requirements. However, since there has been no detailed structural assessment carried out on the bridge at the time of writing this TS the Contractor shall exercise extreme caution during the demolition and construction works and be responsible for choosing the optimum methods, tools and equipment (i.e. demolition hummers/pneumatic drills or mechanical means) to minimize the disturbance of the substructure. The method to be followed and tools and equipment to be used shall be subject to approval by the Supervising Engineer.

In this regard and according to assessment carried out by an engineering company the following should

be considered:

- It is suggested the removal/demolition of existing asphalt concrete pavement to be carried out with demolition hummers. Light milling machine can also be used on a case by case subject to approval by the Supervising Engineer.
- During the milling, placement of concrete leveling layer and asphalt-concrete pavement, on the superstructure, from span No 1 until and including No 16 , the machinery overall weight must not exceed 50.0 tones. **For spans 17,18 and 19 should not exceed 35.0 tones**
- During the placement of asphalt concrete pavement, the use of vibration is not permitted
- Extreme caution should be exercised while working on the cantilever part of the bridge (sidewalk)
- The mentioned restrictions must be strictly controlled by the Supervising Engineer

During the works the bridge should remain open for vehicular and pedestrian traffic at all times. The traffic arrangements on the bridge should be agreed and coordinated with UNDP and with relevant authorities. The Contractor shall install prohibitory traffic sign of agreed weight limit.

This intervention is non-structural and focuses on the re-surfacing / cosmetic works that will provide a temporary solution to the traffic problem and protect the bridge for further deteriorating. Therefore as it is stated elsewhere in this document it is not implied that the structure meets the current structural regulations as per the EuroCodes. This has to be assessed in detail by specialist structural engineers in compliance with owner's requirements.

1.3. Duration

The duration of the contract is 4 (four) months, plus a Defects Liability Period of 12 months, that is 365 calendar days upon substantial completion and issuing of the relevant Certificate of Substantial Completion.

1.4. Variant solutions

Alternative methods may be proposed by the Contractor for parts of the works, if relevant but should not be used in pricing and they will not be used for the purpose of selection of a bidder. They may be considered only after the selection of a bidder and reviewed by the Supervising Engineer.

1.5. Designs

The bridges shall be rehabilitated according to the design provided in the Contract, and as shown on the Drawings.

However, the Contractor shall carry out a detailed topographic survey of the existing substructure and superstructure in order to supplement (i.e. levels of the carriageway) or confirm the dimensions shown on the Drawings. The levels shown are indicative and concern the level of the existing asphalt surface only. The Contractor shall ensure the existence of relevant equipment (dumpy level) for the proper control of the levels of the carriageway so that comfort traffic conditions to be ensured considering:

- The level of the existing concrete slab could not be verified. This can be checked only after the removal of the existing asphalt layer (please see also Article 2.7 – Surveying)
- The concrete levelling layer should be kept to a minimum thickness so that the dead load not to be increased. The concrete layer shall be maximum 3cm at the edges of the bridge and the thickness in the center of the bridge shall be calculated considering 2% inclination for the camber. The camber can also be created 2% transversely with the binding course should the Contractor possess the proper equipment.
- The Contractor should aim that the final level of the bridge to be 30+70= 100mm of surfacing at the edges of the bridge road deck. Deviations in the range of ± 20 mm are acceptable.

Moreover, the surfacing works need to be complemented with adequate measures in order to ensure water tightness in the pier sections, where the concrete slab has construction joints or gaps made during construction (Stucky report) up to 5cm in width. Following the removal of the existing pavement and prior to implementing of the new surface the Contractor shall ensure that the gaps are properly sealed to for the installation of the waterproofing layer.

The Contractor shall envisage smooth connection of the newly paved part of the bridge with the unpaved part in the West side.

The Contract shall be executed according to valid **EN** (European Norms) or equivalent authoritative norms approved by the Supervising Engineer.

The Contractor is free to propose products/materials with quality corresponding to the accepted official international standards and specifications other than stated herein, under the condition that the qualities of the products proposed are equivalent or better than the minimum required in these Specifications.

1.6. Photo Record

The Contractor is advised to examine the relevant photo record included in the bidding documents in order to be acquainted and familiarized better with the scope of works.

2. GENERAL PROVISIONS

The following general provisions apply to all the types of Works described in these Technical Specifications, or in the Bill of Quantities, as well as to the Works that could arise and could be accepted as necessary for the complete performance of the agreed Works. This section covers the matters related to the construction works as a whole.

2.1. GENERAL

The Conditions of Contract, the Drawings and other Contract Documents shall be read in conjunction with these requirements, and matters referred to, shown or described in any of the former are not necessarily repeated in the latter.

Notwithstanding the sub-division of the specification under different headings, every part of it shall be deemed supplementary to and complementary of every other part and shall be read with it or into it so far, as it may be practicable to do so.

The works specified under this Contract shall include:

- All general preparatory works to carry out the project including diversions,
- Demolition, removal and general works,
- Materials and work of any kind required for due and satisfactory construction,
- Completion and maintenance of the Works to the intent and meaning of the BoQs, design drawings and this Specification,
- Further drawings and data to be prepared by the Contractor, and further drawings and orders that may be issued by the Supervising Engineer from time to time,
- Compliance by the Contractor with all General Conditions of Contract, whether specifically mentioned or not in the Clauses of this Specification,
- All materials, apparatus, plant machinery, tools, fuel, water, strutting, timbering and tackle of every description;
- Transport, offices, stores, workshops, staff, labor and the provision of proper and sufficient protective works, temporary fencing, lighting and watching required for the safety of the public and protection of the Works and adjoining land;
- First aid equipment, sanitary accommodation for the staff and workmen,
- The effecting and maintenance of all insurance, the payment of all wages, salaries, fees, royalties, duties or other charges arising out of erection of the Works and,

- The regular clearance of rubbish, reinstatement and clearing up and leaving the site in good condition.

2.1.1. Responsibility of the Contractor

Where the certification of the Supervising Engineer's approval of the UNDP is required under these Specifications, such approval shall not relieve the Contractor of his duties or responsibilities under the Contract.

2.1.2. Workmanship, Goods and Materials

All workmanship, goods and materials shall meet these Specifications. Where no description has been made in these Specifications, all workmanship, goods and material shall be in accordance with best practice for such workmanship and material, and to a standard not less than specified in the appropriate EU standard.

All goods and materials to be incorporated in the Works shall be new, unused, of the most recent or current models, and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

2.1.3. Tools and Equipment

All types of tools and equipment shall be to a standard as specified in these Specifications. Where no description has been made in these Specifications, all tools and equipment shall be to a best standard related to task, design and maintenance and shall be appropriate to current EU standard.

All tools and equipment have to be used in proper accordance to, by authorities approved, user's manual.

2.2. LICENCES AND PERMITS

The Contractor, as his own expense, shall obtain permits required from relevant Authorities. Such permits include residence and work permits, permits for radio communications, permits for installation quarries and borrow-pits, plants and secondary structures necessary for accomplishment the Works outside the Site, to relocate utilities, etc.

Within 14 days of receipt of the signed Agreement from the UNDP the Contractor shall submit to the UNDP a list of all permits required to perform and complete the Works in accordance with the agreed Construction Programme. The UNDP shall use its contacts at the relevant Authorities where difficulties are encountered in obtaining such permits but the prime responsibility is with the Contractor.

Any failure by the UNDP to assist shall not release the Contractor of any of his responsibilities and obligations under Contract and he shall not be granted an extension of time as a result of the Contractor applying late for permits.

The Contractor shall comply with requirements of such permits and shall give the issuing Authorities full opportunity to inspect and examine the Works or to participate in testing and checking procedures. This shall not release the Contractor of any of his responsibilities under the Contract.

No important operation of any kind, especially cutting through or closing existing roads, water and electrical conduits, or other public utility shall be carried out without the written consent of the Supervising Engineer. The Contractor shall inform the Supervising Engineer in writing in due time and not less than seven days before commencing such works in order that the Supervising Engineer may ensure adequate supervision and safety precautions are being taken.

2.3. LAND FOR THE CONTRACTOR'S OWN PURPOSES

It is the Contractor's responsibility to obtain and provide suitable land for working areas, for himself, offices, including land temporarily acquired outside the bridge areas and temporary way leaves necessary for the works, whether specifically required by the Supervising Engineer or the Contract or not.

The Contractor shall not take possession of the site, not enter any land or commence any operations until such time as he receives formal confirmation from the Supervising Engineer/UNDP Project Manager. Should the Contractor enter land or commence any operations without first obtaining this confirmation he

shall be solely liable for all additional costs and/or legal charges which might arise therefore.

2.4. SITE OFFICE

No later than one week from the start of works on site, or such later date as instructed by the Supervising Engineer, the Contractor shall provide and maintain, including heating, lightning and cleaning, the following site office for himself and the Supervising Engineer:

- (a) Two separate rooms one for the Contractor (Contractor's facilities) one for the Supervising Engineer not less than 10 m² each. The room for the Supervising Engineer shall be furnished with 1 desk with lockable drawers and table suitable for laying out the Contractor's drawings, a minimum of 3 office chairs, electrical storage heaters.
- (b) The cost of all amenities (electricity, water, sewage, disposal of waste), office supplies, and cleaning, shall be borne by the Contractor;
- (c) All facilities, incidentals and other temporary works that have been purpose built for the project are to be removed upon completion of the Contract and the Site made clean and tidy;
- (d) Provide the necessary level of security required to prevent the site office from being burgled, damaged or otherwise interfered with;
- (e) The office shall be equipped with fire prevention and control equipment and with basic first aid equipment.

2.5. CONSTRUCTION SITE

2.5.1. General Requirements

If necessary, the Contractor prior to the commencing of the works on site shall prepare drawings and descriptions of the Site and other working areas, this includes: access roads, traffic regulation, cranes and lifting equipment, containers for personnel, material, tools, waste etc.

2.5.2. Site Cleaning and Final Clean Up

The Contractor shall take over the working site as it appears as at the date of receipt of the signed contract from the UNDP. It is the Contractor's assignment and responsibility to perform a clearing. All waste shall be collected and delivered to approved disposal plant or site.

The Contractor shall maintain the Site, including adjacent roads, clean and in good order during the whole construction period. All waste shall be collected and delivered to approved disposal plant or site.

The entire Site shall be delivered upon completion of the Works, in a clean, neat and presentable condition, all structures completely repaired and landscape re-established to a standard at least as good as it was immediately before execution of Works.

2.5.3. Access to and Maintenance of Roads

The existing roads shall be used for access to site. The Contractor shall ensure that his traffic outside the defined work area obeys all applicable rules and load restrictions. He shall, every day, clean any spillage he may have caused on roads within or around the Site. Should any damage that may occur on the access roads by Contractor's activity it shall be repaired and reinstated to the previous condition by the Contractor at his own cost.

2.5.4. Information Boards

If and when instructed by UNDP the Contractor shall install two Information Boards at a location to be specified by UNDP. The size, material, text information and language shall be as per UNDP's instructions. The Contractor shall clean and maintain the Information Boards and dismantle and remove them on the completion of the Contract. No advertising material whatever will be permitted to be displayed on the site. The cost of these boards will be deemed to be included in the Contractor's bid.

2.6. ALTERATION TO AND PRESERVATION OF SERVICES

The Contractor shall make himself acquainted with the position of all existing works such as sewers, storm water drains, cables for electricity and telephone lines, telephone and lighting poles, water mains, etc. before any work, likely to effect the existing services, is commenced.

The Contractor shall be held responsible for damage to existing works or services. In all cases where such works are exposed, they shall be properly shored or otherwise supported.

The Contractor shall be responsible for arranging and removing services subject to the agreement of the appropriate authorities and with the approval of the Supervising Engineer and/or UNDP project Manager, and where necessitated by the Works and shall pay for the removal of, and alteration to, services such as power lines, telephone lines, water lines, etc.

2.7. SURVEYING

The different levels given in this Contract are indicatives. The Contractor shall satisfy himself that the existing ground and levels of underpasses and overpasses as described in the original design drawings are correct. The Contractor and the Supervising Engineer shall agree either to disregard erroneous data or to substitute new values of co-ordinates and/or levels. The Contractor shall prepare relevant drawings showing the actual level of the concrete slab of the structure of the bridge.

The Contractor shall carry out detailed topographic survey of the existing structures and establish relevant reference points for subsequent follow up of construction.

This shall be presented within Topographic Survey Report containing not less than:

- Longitudinal profile, plan view
- Limit of the Works
- Reference marks plan

The Contractor shall be responsible for the topographical survey of the site particularly with reference to the already existing elevations of the road, position of axes, for the establishment of a system of reference markers and temporary bench marks which shall be carefully maintained for the duration of the contract.

The protection of markers and benchmarks shall be the responsibility of the Contractor. In case of destruction of any of the references, they shall be re-established by a re-survey approved and controlled by the Supervising Engineer.

The general pegging out of the bridge axes shall be carried out by the Contractor before the commencement of the Works. The Contractor shall regularly check the references and marks.

2.8. COMMUNICATIONS AND RECORDS

2.8.1. Programme for Health and Safety

The Contractor shall submit detailed programme as per the article 2.11 of the present technical specifications for the approval of the Supervising Engineer, within the same time limits as the Contractor's Programme of Work.

2.8.2. Programme for Environment Protection

The Contractor shall submit detailed programme for the approval of the Supervising Engineer, within the same time limits as the Contractor's Programme of Work. This shall include information about noise reduction, effluent, waste and air pollution reduction. Information about disposal plants/sites and recycling plants, which are intended to be used by the Contractor, shall be submitted for Approval by the Supervising Engineer. For more information please refer to Article 2.12 of the present technical specifications.

2.8.3. Contractor's Programme of Work

The Contractor shall submit his Programme of Work to the Supervising Engineer as per the article 13 of the general conditions. The execution of works shall be planned in order to minimize disruption to traffic and environment.

The Programme of Work shall be produced in a form approved by the Supervising Engineer and shall comply with the following conditions:

- The Programme shall include all of the principal activities and present the proposed organization of all the Works by the Contractor, encompassing all temporary works and assembly of all the major items of plant and equipment for supply of the basic materials and for the construction;
- The duration of each activity shall be expressed in calendar days;
- The time schedule shall be in the form of a Gantt chart;
- The date of commencement shall be shown as zero date.
- Should show all the works which need to be done and all the activities showing their interdependence
- The programme shall take due account of probable climatic conditions, which can be expected to affect progress of the Works.

Unless otherwise agreed with the Supervising Engineer, the Contractor shall do the work on the locations, in the succession as shown in the plan. If the Contractor, for whatever reason, fails to comply with the Programme of Work, the Contractor shall submit a revised plan, showing the changes in the original programme, which are needed to ensure the completion of any part of the works within the Time for Completion

2.8.4. Quality Assurance Plan and Inspection Plan

The Contractor shall submit plans for the approval of the Supervising Engineer, within the same time limits as the Contractor's Programme of Work. For more information please refer to Article 2.10 of the present technical specifications.

2.8.5. Commencement Order and Notice of Operations

The works shall commence following the written order by the Supervising Engineer on behalf of the Employer as per the article 41.1 of the general conditions of the contract. Similarly, no operation, which is required to be approved by the Supervising Engineer, may start before such approval is given.

2.8.6. Registering of existing structures and buildings

The Contractor may inspect, register damages and take photos of surrounding existing structures and buildings prior to commencement of the work and after the completion of the work. This as the Contractors documentation related to possible claims from the owners of the properties

The Contractor is fully responsible for any damage it causes on the properties of others, during execution of the work.

2.8.7. Site Meetings

The Contractor shall attend all meetings as per article 14 of the general conditions of contract and other meetings requested by the Supervising Engineer and the Contractor shall submit information in relation to the agenda of such meetings. The Contractor shall likewise be entitled to request a meeting with the Supervising Engineer when relevant for the work execution. Such meetings will be held on site.

2.8.8. Bi-Weekly Programme

The Contractor shall submit to the Supervising Engineer, on the first working day of every two weeks or on such other day as may be mutually agreed, a programme detailing the works that the Contractor intends to undertake during the following fourteen days.

2.8.9. Monthly Progress Reports

The Contractor shall submit to the Supervising Engineer in the first week of each month, the report about the work accomplishment for the previous month.

2.9. REGULATION OF ROAD TRAFFIC

2.9.1. Provision for Traffic

The Contractor is responsible for the regulation of the traffic stream on the bridge which should always remain accessible from both sides.

The Contractor's attention is drawn to the fact that no alternate routes are foreseen and temporary diversions for all traffic is not possible. Therefore, one lane should always be open allowing the vehicular and pedestrian traffic at all times.

2.9.2. Preparation of the Traffic Management Plan

The Traffic Management Plan must be submitted for the Supervising Engineer's approval within 14 days of receipt of the signed contract.

The Traffic Management Plan shall include inter alia:

- (a) Describe traffic arrangements which provide for any necessary sequencing of the work under the Contract while minimizing disruption to road users, local traffic, emergency vehicles, pedestrians and cyclists;
- (b) Where required, describe how the construction work zone shall be physically and visually isolated from road users;
- (c) Provide details of all road closures and/or restrictions required to undertake the work under the Contract;
- (d) Include the names and contact details of the nominated out-of-hours representatives;

On a daily basis, the Contractor shall ensure that all applicable traffic redirection and/or warning measures and safety requirements are implemented prior to proceeding with any relevant work under the Contract.

The Contractor shall monitor the continued effectiveness of the Traffic Management Plan during the Contract and shall revise and update the Plan where necessary.

No traffic rearrangements shall be carried out until the relevant Traffic Management Plan has been approved by the Supervising Engineer or/and UNDP management.

2.9.3. Traffic Control Devices

Traffic control devices shall conform with all applicable regulations and to the requirements of the Contract and shall be supplied and placed as directed by the Supervising Engineer in accordance with the requirements of the Contract.

All traffic control devices shall be maintained in an effective and clean condition whilst employed on the work under the Contract. Devices which are damaged or worn, or which do not conform to the above requirements, shall not be used.

2.9.4. Restrictions to Traffic Lanes

The traffic shall be performed on one lane, so the regulation is to be carried out at the beginning and the end of the site. The traffic shall be performed in such a way that no road user is delayed in excess of 15 minutes and be regulated with traffic device and/or signs.

The following minimum requirements for various time periods and for various locations on the site shall be respected:

- a) the trafficable width of the lanes shall be a minimum of 3 meters;
- b) the posted speed shall be 20 km/h

The Contractor may stop traffic in both directions simultaneously only for the purposes of construction of specific work with the consent of the Supervising Engineer. The maximum delay to any road user shall be 15 minutes.

2.9.5. Pedestrian Movements

Where it is necessary to provide for pedestrian and/or cyclist access along or across portions of the work under the Contract, the Contractor shall provide such temporary pathways as necessary. Where a large volume of pedestrian traffic has to cross the site, consideration shall be given to directing pedestrians to suitably constructed and protected crossings.

2.9.6. Delineation of Trafficked Corridors

Bollards, barrels, hazard markers, temporary raised reflective pavement markers, line marking, reflective mesh fencing and/or other such delineation devices shall be used in addition to the requirements of the Contract to delineate trafficked corridors.

Bollards or barrels used shall be constructed of lightweight, flexible and deformable material. Bollards or barrels shall be a minimum of 1 meter in height. Barrels shall have a diameter of at least 500mm, regardless of orientation. Steel drums shall not be used.

The markings on bollards and barrels shall comprise reflective strips 100mm to 150mm wide. Each bollard or barrel shall have a minimum of two reflective strips.

Under no circumstances shall temporary painted or thermoplastic line-marking materials be used on the surface of a final pavement layer.

Temporary delineation devices shall not damage the surface of the works.

2.10. QUALITY ASSURANCE PLAN AND STANDARDS

2.10.1. Standards

The Contractor shall make sure that the quality control complies with International standards. Guidance from the following international standards shall be taken by the Contractor:

- ISO 9000 Standards for the quality control and assurance – Guideline for selection and utilization.
- ISO 9001 Quality system - Model for the quality assurance in conception development, production, installation, and after-sales support.
- ISO 9002 Quality system - Model for the quality assurance in production and installation.
- ISO 9003 Quality system - Model for the quality assurance in controlling and final tests.
- ISO 9004 Quality control and element of the quality system – Guidelines.
- ISO 8402 Quality management and quality assurance - Vocabulary.

Where reference is made in this Specification to a Standard or Code of Practice issued by the EN, DIN, and IEC or equivalent, this shall be deemed to refer to any of the standards organizations referred to in the section below. Such references do not purport to be an exhaustive list of those with which the Contractor is required to be familiar.

Standards used shall be those current 30 days before the date of the tender. Where not stated in any reference to a standard, the words “or equivalent” shall be deemed to apply.

The design, workmanship, materials, strength and dimensions of all parts shall be the satisfaction of the Supervising Engineer and shall comply with one or more of the standards, regulations and codes issued by the following:

- European Committee for standardization (CEN), German Industrial Standards (DIN)

- Internationally recognized and technically equal standards subject to the approval of the Supervisor, (such as ISO, IEC, BSS)
- British Standards Institution (B.S.)

Alternative standards may be adopted, provided that:

- a) They are appropriate and do not conflict with any requirement of the Specification.
- b) That an English translation of each such standard is supplied to the Supervising Engineer by the Contractor; and
- c) That a list of such standards is submitted with the tender.

Therefore, the Contract shall be executed primarily according to valid EN Standards. The Technical Specifications are aimed to define the quality of the materials and the Contractor is free to propose products with quality corresponding to some other official international standards and specifications other than stated under the condition that the qualities of the products proposed are equivalent or higher than the minimum qualities required. In such cases the Contractor shall submit to the Supervising Engineer for approval documentation regarding details and material properties of materials intended for use for his evaluation of compliance.

2.10.2. Quality Assurance Plan and Quality Control

Within 14 days of receipt of the signed contract, the Contractor must provide to the Supervising Engineer a quality plan.

This quality plan must show how the Contractor will implement quality control on site in order to guarantee to the UNDP that all works are performed according to the Contract requirements and meet the expected quality standards.

The quality plan will describe precisely how all the phases of the work will be carried out (equipment, methods and manpower organization), who will be responsible for it, and how the internal control will be organized for guaranteeing the necessary quality of Works. The Supervising Engineer will be allowed to proceed to an external audit of the quality scheme, whenever he judges it necessary.

The Contractor will perform tests for his own needs and for the needs of the UNDP at his own laboratories or specialized institutions. The Contractor covers the costs of all specified tests (preliminary, parallel and control) within the unit rate quoted in the BoQs.

The tests are performed to verify:

- the quality of material used (asphalt pavement and concrete and other if directed by the Supervisor);
- the quality of workmanship;
- the quality of finished material;
- the quality of freshly incorporated material.

The Contractor places at the disposal of the Supervising Engineer, all the test results and data from the tests, in the required scope and form.

The tests are performed in compliance with the corresponding standards stated in the technical conditions.

To control the quality of materials and the works, the EU standards and regulations as well as other regulations and standards stated in the technical conditions apply. With the consent of the Supervising Engineer, the Contractor may use the equivalent DIN, BS NF or AASHTO standards.

For the works under each item, the conditions for the quality of the material and the works are defined.

Prior to the use of mechanical equipment and devices affecting the quality of the works, testing of the uniformity and the quality of the works shall be performed.

2.10.3. Material Proposal Forms

Prior to the initiation of the works or part of the works, the Contractor shall submit to the Supervising Engineer for approval Material Proposal Forms that will include complete test certificates, certificates of conformity and technical characteristics demonstrating the quality of all the materials to be used in construction.

2.10.4. Method Statements

The Contractor shall provide in writing a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.

Detailed method statements shall show in detail the methods proposed by the Contractor for carrying out the main construction-related activities. In particular, the Contractor shall indicate the resources (plant, personnel, materials) to be allocated, their timing and sequencing, emergency/contingency measures, and any other information required to clearly detail the proposed methods.

2.10.5. Operation and Maintenance Manuals

Operation and Maintenance Manuals detailing all the maintenance requirements of every detail of the works – as the case may be - will be prepared by the Contractor and submitted to the Supervising Engineer after the handover of the works or section of works.

2.11. HEALTH AND SAFETY AT WORK

In line with the requirements of the Contract, the Contractor shall be responsible for the safety of all activities on site. The Contractor shall ensure the security of sites during the whole period of execution and shall be responsible for taking the necessary steps in line with best international practice, in the interests of the staff and workers on the Site, agents of the UNDP and third parties, to prevent any loss or accident which may result from carrying out the Works.

If, during the performance of the Contract, urgent measures are necessary to obviate any risk of accident or damage or to ensure guarantee following any accident or damage, the Supervising Engineer shall give formal notice to the Contractor to do what is necessary.

The cost of all measures associated with safety of the site shall be borne by the Contractor.

The Contractor is reminded that it is obliged to insure its equipment and the Works up until Provisional Acceptance.

2.12. ENVIRONMENTAL MANAGEMENT

2.12.1. Environmental Management Plan

The Contractor is required to prepare and submit an Environmental Management Plan (EMP), for the approval of the Supervising Engineer, within 4 days of the receipt of the signed contract from the UNDP, outlining how the Contractor intends to ensure compliance with each of the requirements given below.

No work on site will be permitted until the Supervising Engineer approves the Environmental Management Plan.

2.12.2. Water Quality

The Contractor shall ensure that construction works do not result in unacceptable deterioration of existing water quality of bodies of water and watercourses traversed by or adjacent to the work under the Contract.

The EMP shall include the control and safety measures to be undertaken to prevent the construction from affecting the water quality of storm water and natural drainage systems. Where applicable, the plan shall include procedures to be implemented when sourcing water for construction purposes from local water sources whether or not a permit has been obtained to extract water.

The Contractor shall prevent the discharge of fuels, oils, chemicals, paints, bitumen, emulsions, herbicides, detergents (whether biodegradable or non-biodegradable) or other similar materials into water courses and bodies of water or on to agricultural land.

2.12.3. Noise

The Contractor shall ensure that noise from the construction site does not cause an environmental nuisance. If complaints regarding noise are received, the UNDP or Supervising Engineer may direct noise control methods to be implemented. No extra payment will be made to the Contractor if the complaint is validated as an environmental nuisance.

2.12.4. Vibration

The Contractor shall take reasonable actions to ensure that construction works do not result in vibration causing damage adjacent to the Site.

As a guide, the zone of influence whereby vibration could cause damage is defined as within a radius of three times the safe distance as outlined in following table:

Type of Activity	Safe Distance
heavy vibratory rolling	20 meters
blasting	Contractor to provide calculations dependent on size of blast
pile driving	60 meters
other	Contractor to calculate

2.12.5. Air Quality

The Contractor shall take all reasonable actions to ensure that construction works do not result in sustained deterioration in local air quality.

The Contractor shall ensure that air quality on the site and any locations related to work on the site complies with the relevant European standards and is to the UNDP's and/or Supervising Engineer's satisfaction.

2.12.6. Flora and Fauna

The Contractor shall minimize the impact of the works on indigenous vegetation and fauna. Should any existing plants, which are to be retained, become damaged, repair work is to be performed to the approval of the Supervising Engineer.

Where existing plants, which are to be retained, are damaged beyond repair, the contractor shall remove the damaged plant and replace the plant by supplying and installing a plant of the same species as the damaged plant.

2.12.7. Flooding

The Contractor shall take all reasonable actions necessary to minimize the impact of afflux or flow velocities associated with floods. The proposed measures shall be outlined in the EMP.

2.12.8. Waste Management

The Contractor shall adopt a waste management strategy based on the philosophy of replace, reduce, reuse and recycle, in that order.

The Contractor shall ensure that all rubbish and waste materials (fuel, oil, chemicals, sewage, earth, etc.) are suitably contained on Site until disposal, and do not escape into watercourses, storm water drains and/or onto neighboring properties. The Contractor shall ensure that contaminants are kept separate from general waste.

The Contractor shall ensure that all waste is disposed of legally, in designated waste disposal areas, and in line with best practice.

The Contractor shall comply with the requirements of the relevant authorities when disposing of refuse.

All waste oil, chemicals and other regulated waste shall be disposed of site in accordance with requirements of the Supervising Engineer and/or the relevant local Authority.

The Contractor shall not cause the contamination of any land and all rubbish and waste materials are to be suitably contained (e.g. in a bounded compound for fuels, oils, chemicals etc.). Machinery shall be maintained to minimize the leakage of oil and diesel.

The Contractor on completion of the works shall clear the Site including any site compounds of all rubbish and waste and leave the Site in a clean and tidy condition.

Particular attention must be drawn to Health and Safety Measures at the demolition and removal of material containing Asbestos (Amianth). The Contractor must ensure proper disposal according to EU Directives 87/217/EEC, 89/391/EEC; 90/394/EEC; 98/24/EC and 2003/11/EC to protect workers, staff and pupils during and after demolition and rehabilitation works.

The cost of all measures covered under this item shall be borne by the Contractor

2.13. AS BUILT DRAWINGS AND RECORD KEEPING

The Contractor is to keep accurate record drawings of the positions and details of a work constructed by him. These drawings shall be of forms and to scales approved by the Supervising Engineer and shall be prepared regularly as the work proceeds.

As these record drawings are completed, they are to be handed to the Supervising Engineer and shall become the property of the UNDP

Any defaults or omission in the drawings and in the As-built Project submitted by the Contractor and approved and certified by the Supervising Engineer, and any defects and irregularities in the Works performed according to such drawings and As-built Project, shall not release the Contractor of any of his responsibilities and obligations under the Contract.

The Contractor shall keep permanent records, make daily entries into and sign the Work Register, which shall be certified by the Supervising Engineer. On completion of the works the original and one copy rests with the Supervising Engineer and one copy with the Contractor.

As a prerequisite for issuing of Certificate of Substantial Completion, the Contractor shall, at his own expense, prepare and submit to the Supervising Engineer as built drawings (paper and electronic form).

2.14. FAULTY WORK

Any work, which fails to comply with these Specifications, shall be rejected and the Contractor shall, at his own expense, make good any defects, as directed by and to the satisfaction of the Supervising Engineer.

3. MATERIALS, PRODUCTS AND COMPONENTS TECHNICAL SPECIFICATIONS

These Technical Specifications cover the proposed resurfacing works suggested in this Contract. If the Contractor wishes to diverge from the proposed technical suggestions, it is the obligation of the Contractor to specify which technical specification forms the basis of the work. These technical specifications are subject to the approval of the Supervising Engineer. Please see also article 1.4 of this Technical Specifications in relation to variant solutions.

In the following, different standards are listed for 1) Material, product or component and 2) Execution of Work. If these standards should not cover all matters within the scope of work, it is emphasized that the work should be based on a European Standard if such exist or another well documented international standard. The standards will only be accepted if the Supervising Engineer approves them.

All standards used must be the most recent version at the time of Contracting.

3.1. GENERAL PROVISIONS

3.1.1. Justifications of Supply Sources

Prior to the initiation of the works or part of the works, the Contractor must submit to the Supervising Engineer complete certificates demonstrating the supply sources and the quality of all the materials to be used in accordance with article 2.10.3 "Method Statements".

3.1.2. Approval and Acceptance of the Materials

Based on preliminary, parallel and control tests, the Contractor shall prepare reports on the quality of the built-in material and the completed works.

The quality of materials is evaluated on the basis of results from testing control samples that have been prepared during the production and the criteria for quality for particular properties according to the designs and these Technical Specifications.

On the basis of any suspicious indications regarding the achieved materials quality, the results of testing should necessarily be supplemented with results of investigations on other samples.

Technical acceptance of the materials is carried out on the basis of the test-proven qualities as required by the Design and according to these Technical Specifications.

3.2. STRUCTURAL CONCRETE

3.2.1. Codes Standards

- EN 206-1:2000: Concrete - Part 1: Specification, performance, production and conformity
- EN 12350: Testing fresh concrete
- EN 12390: Testing hardened concrete
- EN 12504: Testing concrete in structures
- EN 1992-1-1: Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings. • EN 1992-1-2: Eurocode 2: Design of concrete structures - Part 1-2: General rules – Structural fire designs. The following Eurocode is already published: •
- EN 1990: 2002 Eurocode – Basis of structural design

3.2.2. Reinforcement

Supply and installation of the reinforcement shall comply with the requirements laid down in EuroCodes of Reinforcement bars. Their quality shall correspond to code EN 10080 and Eurocode 2

clause 3.2.1(5). All kinds of reinforcement fulfilling the characteristics according to EN 10080 and Euro code 2 clause 3.2.1(5) are allowed. Reinforcement steel shall have a yield strength of $f_{yd} = 400$ MPa and a characteristic tensile strength of $f_{tk} = 500$ MPa. Only ribbed bars shall be used for structural elements. Smooth bars may be used for stirrups and secondary elements. All anchoring of the reinforcement shall be according to Euro code 2.

All reinforcement is to be certified as free from radioactivity

All reinforcement for use in the Permanent Works shall be certified and accompanied with relevant mill reports. The Contractor shall carry out additional tests if instructed by the Supervising Engineer.

Any reinforcement which does not comply with the Specification shall be removed from Site.

3.2.3. Concrete

Structural concrete is any class of concrete which is used in reinforced, pre-stressed or plain (unreinforced) concrete construction, which is subject to stress and which is required to comply with Clause 3.2.1. Non-structural concrete is composed of materials complying with the Specification but for which no strength requirements are specified and which is used only for filling voids and similar purposes where it is not subjected to significant stress. A pour refers to the operation of placing concrete into any mould, bay or formwork, etc., and also to the volume which has to be filled. Pours in vertical succession are also referred to as lifts. Water/cement ratio is the ratio by weight of the free water in the mix divided by the weight of cement in the mix. Free water is the water in the mix excluding water absorbed by the aggregate.

3.2.3.1. Materials

(a) Cement

Cement shall comply with the current European Standards. Alternatively the following Standards can be used as reference:

Euro Code E2 for ordinary Portland cement (OPC)

Euro Code E2 for rapid hardening Portland cement (RHC)

Euro Code E2 for, sulphate resisting Portland cement (SRC)

Euro Code E2 for white or cultured Portland cement (WPC) or (CPC)

Euro Code E2 for low heat Portland cement (LHPC)

Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it. The Contractor shall provide sufficient storage capacity on Site to ensure that his anticipated program of work is not interrupted due to lack of cement having due regard to factors outside the Contractors control such as transport, weather conditions, holiday and breakdowns. Cement which has become hardened or lumpy or fails to comply with the Specification in any way shall be removed from the Site. All cement used in the Permanent Works shall be accompanied by a certificate of conformity. The Contractor shall carry out additional tests if instructed by the Supervising Engineer. Cement which does not comply with the Specification shall not be used in the Permanent Works.

The contractor shall keep full records of all data relevant to the manufacture, delivery testing use of all cement used in the Permanent Works and shall provide the Supervisor with two copies thereof.

(b) Aggregates for concrete

Aggregates for concrete shall conform to the requirements for fine and coarse aggregates to Euro Code.

Crushed stone for preparation of concrete must be clean of any organic and non – organic ingredients.

The Contractor is obliged to obtain approval from the Supervisor for use of sampled crushed stone, For preparation of concrete the following fractions must be present:

- for all, grade 0 – 4 mm; 4 – 8mm;
- for larger sizes 8 – 20mm; 20 – 40 mm.

During construction the Contractor shall provide regular control, and sampling of the aggregate regarding: moisture, content of organic ingredients, mud.

(b1) Aggregates for mortar

Aggregates for mortar shall conform to Euro Code

(b2) Delivery and Storage of Aggregates

Aggregates shall be delivered to Site in clean arid suitable vehicles. Different types or sizes of aggregate shall not be delivered in one vehicle. Each type or size of aggregate shall be stored in a separate bin or compartment having a base such that contamination of the aggregate is prevented. Dividing walls between bins shall be substantial and continuous so that no mixing of types or sizes occurs. The storage of aggregates shall be arranged so that as far as possible rapid drying out in hot weather is presented, in order to avoid sudden fluctuations in water content. The storage of fine aggregates shall be arranged so that they can drain sufficiently before use in order to prevent fluctuations in water content of the concrete. If the Contractor intends to place concrete during cold weather, storage of aggregates shall be arranged so that ice or snow does not become mixed with them. If the Contractor proposes to heat aggregates in cold weather the arrangements shall ensure substantially uniform heating and shall not cause the introduction of additional works.

(b3) Testing aggregates**Acceptance testing**

The Contractor shall deliver to the Supervisor samples containing not less than 50 kg of any aggregate which he proposes to use in the Permanent Works and shall supply such further samples as the may require. Each sample shall be clearly labelled to show its origin.

The acceptance tests carried out by the Contractor shall generally be on three representative samples of fine and coarse aggregates taken in the presence of the Supervisor. The total numbers of tests required for acceptance are to be decided by the Supervising Engineer.

If at any time a significant physical or chemical change in the nature of the coarse or fine aggregate occurs, or a new source of aggregate is used, the Supervisor may direct that some or all of the acceptance testing is repeated.

Routine testing

The Contractor shall carry out routine testing of aggregates for compliance with the Specification 'during the period in which concrete is being produced for the Permanent Works. The tests set out below shall be performed on aggregates from each separate source on the basis of one set of tests for each day on which aggregates are delivered to Site provided that no set of tests shall represent more than 250 tones of fine aggregate nor more than 500 tones of coarse aggregate, and provided also that the aggregates are of uniform quality. If the aggregate from any source is variable, the frequency of testing shall be as instructed by the Supervisor.

Grading

Silt and clay content

Moisture content

Test	Fine Aggregate	Coarse Aggregate
Water Absorption	-	3*
Flakiness Index		3*
Shell Content Determination	-	3*
Test for Shell Content	-	1*
10% Fines Test or Aggregate Impact	-	3*
Value	3*	3 on each nominal size
Grading	3*	3*
Chloride Content	3*	3*
Sulphate Content	-	3*
Soundness	As required,	As required,
Petrography Examination	Minimum 3	Minimum 3
Clay, silt and dust determination	3	3
Organic impurities	3	

One test on each sample.

In addition to the above routine tests, the Contractor shall carry out the following tests at the frequencies stated:

Moisture content: As frequently as may be required in order to control the water content of the concrete as required by the Specification.

Chloride content: As frequently as may be required to ensure that the proportion of chlorides in the aggregates does not exceed the limit stated in the Specification.

(c) Water for Concrete and Mortar

Water for mixing or curing concrete or mortar shall not contain more than the following concentrations of impurities in accordance to the adopted code:

Max. mg/litre

- The sum of sulphate, alkali carbonates and bicarbonates 1000
- Chlorides 500
- Suspended solids 2000 other dissolved solids 2000 at the commencement of the Works the Contractor shall send a sample of the water proposed for concrete and mortar to an accredited laboratory capable of carrying out the full analysis of potable water. The results of the analysis shall be submitted to the Supervisor. The sample of water sent for analysis shall be taken in the presence of the Supervisor. If the water selected comes from reliable potable water source the Contractor shall obtain a copy of a recent analysis from the chemist of a relevant Water Authority. If the Supervisor considers this satisfactory the tests required above need not be carried out.
- Water to be used for mixing concrete or mortar shall be tested in accordance with the adopted code and shall comply with the recommendations for the Initial Setting Time test and the Compressive Strength test.
- If the source of water is changed it shall be tested as above. If water contains 80 percent of the maximum concentration of impurities properties given above it shall be retested at two monthly intervals.

(d) Admixtures**(1) General**

The use of admixtures in concrete may be required under the Contract to promote special properties to the concrete or may be proposed by the Contractor to assist compliance with the Specification. In all cases the Contractor shall submit to the Supervisor full details of the admixture he proposes to use and the manner in which he proposes to add it to the mix. The information provided shall include: Whether or not the admixture contains chlorides, and if so the chloride ion The typical dosage and the detrimental effects of an excess or deficiency in the dosage. The chemical names of the main active ingredients in the admixture expressed as a percentage by weight of admixture.

- Whether the admixture leads to the entrainment of air when used at the manufacturers recommended dosage and if so, the extent to which it does so.
- Long and short term effects of the admixture on concrete including the effects on different types of cement and aggregates.
- Storage life.
- Safety precautions required in handling.
- Compatibility with other additives.
- Compliance with Standards.
- The chloride ion content of any admixture shall not exceed 2 per cent by weight of the admixture nor 0.03 per cent by weight of the cement in the mix.

Admixtures shall not be mixed together without the consent of the Supervisor.

(2) Super Plasticizing Admixtures

Super plasticizing admixtures shall comply with the adopted code.

In addition to the normal trial mix cubes required an additional set of cubes shall be made with 1.5 times the intended super plasticizing admixture addition to assess the effect of overdose on the concrete.

If the super plasticizing additive is not specified but the Contractor requests permission to use it the Supervisor shall not approve its use unless full particulars including chemical constituents of the admixture are submitted and the additional trial mixes mentioned above have been carried out and all are considered satisfactory.

The Supervisor reserves the right to refuse the use of super plasticizing admixture for concrete required for particular structures.

(3) Air-entraining agents

In addition to the general requirements, air entraining agents shall be capable of producing an air content in concrete mixes within the limits stated on the Drawings and without any tendency to produce excessive air content in the event of prolonged mixing times.

The effect of a proposed air entraining agent shall be tested by the Contractor in trial mixes produced in the plant which he proposes to use for the Permanent Works.

Air entraining agents shall comply with the adopted code.

(4) Workability Agents

Subject to the agreement of the Supervisor, admixtures may be used by the Contractor to assist in meeting the requirements of the Specification or to aid the placing of concrete.

Workability agents shall comply with the adopted code and shall not have any adverse effect on the properties of the concrete. If a reduction in strength of the concrete is caused, the Contractor shall counteract this by a reduction in water cement ratio or by an increase in cement content.

3.2.3.2. Design of Concrete Mixes for Structural Concrete

(a) Classes of Concrete

The classes of structural concrete to be used in the Permanent Works shall be those indicated in the BoQs or elsewhere and as per the definition in EN 206-1:2000. Indicatively please see table below:

Grade of concrete	Minimum Cement Content kg/m ³	Maximum Water/Cement ratios		150 mm cubes required minimum average 28 day strength (MAS)
		A	B	N/mm ²
C 25/30	320	0.51	0.48	30
C 30/37	320	0.55		37

Note: MAS Required Minimum Average 28 day strength

Concrete class C 30/37 has characteristic compressive cylinder and cube strength of concrete after 28 days, $f_{ck} = 30 \text{ N/mm}^2$ and 37 N/mm^2 corresponding to Eurocode 2 clause 3.1.2

(b) Design of proposed mixes

The Contractor shall design the mixes which he proposes to use in the Permanent Works to achieve acceptable workability and resistance to segregation during handling and placing. The design mixes shall be submitted to the Supervising Engineer for approval.

(c) Trial Mixes with 150 mm test cubes

For each mix of concrete the Contractor shall in the presence of a representative of the Supervisor prepare three separate batches of concrete using the materials which have been approved for use in the Permanent Works and the mixing plant which he proposed to use for the Permanent Works.

The marking, curing and testing of all test cubes shall comply with the requirements of the adopted

code. The slump of the concrete carried out in accordance with the adopted code and shall be recorded.

Three cubes from each batch shall be tested for compressive strength at seven days and the remaining three at 28 days.

The density of all the cubes shall be determined before the cubes are crushed. The average value of the crushing strength of the nine cubes tested at 28 days less 2 N/mm shall be greater than the Minimum Average Strength given in Table under 3.3.3.2 for the grade of concrete tested.

(d) Quality Control of concrete production

For each grade of concrete in production at each plant for use in the Permanent Works, samples of concrete shall be taken at the point of mixing or of deposition as instructed by the Supervisor and in the presence of a representative of the Supervisor, all in accordance with the sampling procedures described in the adopted code.

The slump of each sample carried out in accordance with the adopted code and shall be determined at the time of sampling.

Samples shall be taken on the basis of one for each 20m of concrete placed but in any case not less than one sample per day or one sample for each pour of concrete placed, whichever is the more frequent.

Three 150 mm test cubes shall be cast from each sample, cured and tested as set out in the adopted code.

One cube shall be tested at seven days and two at 28 days.

The average strength of the two cubes crushed at 28 days shall be referred to as one test result. Concrete shall be deemed to comply with the strength specified if the average strength of any four consecutive test results (8 cubes) exceeds the final average trial mix strength minus 2N/mm for the grade of concrete with no single test result (2 cubes) being less than 2 the final average trial mix strength minus 6 N/mm.

(e) Failure to comply with requirements

The Contractor shall take any action instructed by the Supervisor to remedy concrete which fails to comply with the Specification. Such action may include but is not necessarily confined to the following:

- Adjusting the mix proportions until the concrete again complies with the Specification.
- Cutting test cores from the failed concrete and testing
- Carrying out additional works to overcome the effect of the failed concrete.
- Removing the failed concrete. Increasing the frequency of sampling until control is again established.

3.2.4. Formwork

Formwork shall be so constructed that they will support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic, so that after the concrete has hardened the formed faces shall be in the positions shown on the Drawings within the tolerances set out in the corresponding Euro Code

All joints in formwork shall be tight against the escape of cement and fines and shall be securely supported.

Formwork shall be so designed that it may be easily removed from the work without damage to the faces of the concrete. It shall also incorporate provisions for making minor adjustments in position, if required, to ensure the correct location of concrete faces. Due allowance shall be made in the position of all formwork for movement and settlement under the weight of fresh concrete.

The formwork, shall be thoroughly cleaned and then dressed with a re agent prior to concreting or/and placing of rebars. The agent shall be either suitable oil incorporating a wetting agent, an emulsion of water suspended in oil or low viscosity oil containing chemical agents.

3.3. EXPANSION JOINTS

In case of New Expansion Joints (BOQ-Option II)

Expansion joints are to be produced and installed according to design requirements specified in the Drawings and BoQs (Option II) of this contract.

In case of Old Expansion Joints (BOQ-Option I)

This intervention aims at providing comfort conditions to the vehicular and pedestrian traffic and no other aspects have been considered. Therefore, the existing expansion joints shall not be replaced with new ones but shall be removed carefully with appropriate equipment as per the BoQs (option II), treated, coated as per Article 3.9 and reinstalled.

NOTE: UNDP reserves the right to award contract for either option of the BoQs, based on funds availability and management's decision.

3.4. DRAINS

Aim of the drains is to ensure the evacuation of the surface water from the carriageway surface and the water passing through the asphalt concrete layers and collected on the waterproofing. Further, drains have to be protected against corrosion.

EN 10088	Stainless steels -1:1997 Part 1: List of stainless steels -2:1995 Part 2: Technical delivery conditions for sheet/plate and strip for general purpose -3:1997 Part 3. Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes
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3.5. RAILINGS

The existing railings shall be cleaned from rust and dirt, coated with anti-corrosion paint and reused as per the relevant BoQs. The Contractor shall ensure that the railings are securely fastened with bolts and proceed with any repairs if necessary by welding or/and bolting. The new bolts shall have factory applied corrosion resistant compatible with the associated structural steel corrosion protection.

The Contractor shall strengthen the anchoring of the railing where needed (according to the preliminary assessment approx. 5% of railing is loose) with appropriate material (i.e. epoxy) subject to approval by the Supervising Engineer as a temporary measure against loads. This measure should not be seen as a permanent measure against crash loads. The Contractor in cooperation with UNDP and local authorities shall install warning sign for the pedestrians in the local language regarding the condition of the railing and the sidewalk.

The railings at the modular part of the bridge (Span 20) shall be fabricated, supplied and installed as per the description in the BoQs work item 3.6. These railings is a temporary measure until a more permanent solution to the entire span is implemented.

Preparation of steel-surface before application of paints and related products shall be in accordance with: EN ISO 8503

If any welding is need it shall conform to the following specifications:

EN 25817:1993	Arc-welded joints in steel — Guidance on quality levels for imperfections
EN 287-1	Qualification test of welders. Fusion welding. Steels
EN 288-2	Specification and approval of welding procedures for metallic materials. Welding procedures specification for arc welding
EN 12944	Paints and varnishes — Corrosion protection of steel structures by protective paint systems

ISO 4016
ISO 4033

Bolts with hexagonal heads partially threaded type
Hexagonal nuts type A and B.

The welders shall all possess relevant certificates as per EN287-1

3.6. SURFACING

It is proposed, in this technical specification to replace the existing pavement with new asphalt pavement based on a bearing course and a wearing course layer.

Technical requirements shall be based on the following preliminary standard.

EN13108-1:2001	Bituminous mixtures - Material specifications – Part 1: Asphalt concrete
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- American Society for Testing and Material (ASTM)
- American Association of State highways Officials (AASHTO)

3.7. WATERPROOFING

Technical requirements for waterproofing materials, production and quality control should meet the requirements one of the following preliminary standards.

3.7.1. Flexible sheets

EN(00254087):2001-02	Flexible sheets for water proofing - Reinforced bitumen sheets for concrete bridge decks and other concrete surfaces trafficable by vehicles -Definitions and characteristics
EOTA:2000-11-14	Liquid applied bridge deck waterproofing products and kits

3.7.2. Water proof micro-surfacing with asphalt mixes, produced by hot process

3.7.2.1. Composition of the waterproofing

The waterproofing comprises:

- a priming coat on cement concrete,
- partial bond layer,
- a first coat of mastic asphalt forming the waterproofing,
- a second coat of mastic asphalt with a coat of chippings forming a second impermeable layer and mechanical protection of the waterproofing.

3.7.2.2. Priming coat

The priming coat consists is cold-applied at two hundred (200) to two hundred and fifty (250) grams per square meter.

Light solvents with boiling points much lower than the asphalt application temperature will be used.

3.7.2.3. Partial bond layer

This consists of one of the following, as the Contractor wishes:

- either 7x5 mm fiberglass mesh, 70 g per m². The strength of a strip five (5) cm wide will be zero point nine (0.9) kN (warp) and zero point three seven (0.37) kN (weft). This mesh will not be sprayed;
- or a sheet of perforated brown paper in which the perforations total fifteen percent (15 %) of the area.

3.7.2.4. Waterproofing complexes

The Contractor may choose between the two following types:

Complex A

- a first layer of waterproofing in mastic asphalt consisting of powdered natural rock asphalt (86 %) and 40/50 (14 %) bitumen mixed in such a way that after the addition of natural Latex LXM (0.6 %) indentation according to French standard NF T 66.002 or equivalent is between thirty-three (33) and forty-five (45) tenths of a millimeter in the type A test.
- a second layer of waterproofing and protection in asphalt bitumen-aggregate mixture. This will consist of mastic asphalt and aggregate (sand and crushed hard gravel). There must be total bitumen content of seven (7) percent. Indentation tested in accordance with French standard NF T 66.002 or equivalent must be between fifteen (15) and forty (40) tenths of millimeters in the type B test.

Complex B

- a first layer of waterproofing in mastic asphalt consisting of one of the following materials (chosen by the Contractor):
 - a mixture of powdered natural rock asphalt and natural bitumen and/or distilled bitumen (type 40/50),
 - or a hot mixture of distilled bitumen (type 40/50) or natural bitumen and filler.
 - In both cases, the total bitumen content must be at least sixteen (16) percent. Indentation of this layer according to French standard NF T 66.002 or equivalent must be between twenty (20) and eighty (80) tenths of a millimeter in a Type W test.
- a second layer of waterproofing and protection in asphalt bitumen-aggregate mixture consisting of asphalt mastic and aggregate (sand and crushed hard gravel). The total bitumen content must be at least seven (7) percent. Indentation tested in accordance with French standard NF T 66.002 or equivalent must be between fifteen (15) and forty (40) tenths of millimeters in the type B test.

3.7.2.5. Description of the materials

The Contractor must submit for acceptance by the Supervising Engineer the precise complex that he proposes to use. In particular, he must specify the following characteristics:

- the precise composition of each of the two layers of complex proposed,
- the nature of the basic components: asphalt (powder or blocks of mastic asphalt), the origin and bitumen content of the rock asphalt or synthetic asphalt and the type and origin of the filler and the hardness of the bitumen used,
- the nature and origin of the binder and the aggregate,
- the manufacturing equipment and control procedures,
- the expected results of indentation tests on the first and second courses performed in compliance with French standard NF T 66.002 or equivalent.

3.8. TRAFFIC SIGNALIZATION

Preparation of materials shall confirm to ENV 3.

The panels shall be hot dip galvanized according to EN 1459 and 1461.

3.9. ANTI-CORROSION PROTECTION

Preparation of steel-surface before application of paints and related products shall be in correspondence to:

EN ISO 8503	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates -1:1995 Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces -2:1988 Part 2: Method for grading of surface profile of abrasive blast-cleaned steel; comparator procedure -3:-Part 3: Method for calibration of ISO surface profile comparators and for determination of surface profile; focusing microscope procedure -4:2001 Part 4: Method for calibration of ISO surface profile comparators and for determination of surface profile; stylus instrument procedure -5:2001 Part 5: Replica tape method for the determination of the surface profile
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4. EXECUTION OF WORKS

4.1. SITE INSTALLATION

The contract includes site installation and removal of site installation.

The Contractor shall mobilize and bring to the site all installations necessary for the execution and completion of the works. Not later than two weeks after signing of contract, a plan for mobilization, installation, running and removal of the site installation shall be submitted for the approval of the Supervising Engineer.

4.2. PREPARATION OF WORKING AREAS

The Contractor shall prepare the site area for the anticipated work on the bridge construction prior to site installation.

4.2.1. Power Supply

The Contractor shall make his own arrangements at his own cost for the supply of electricity to the Site for the purposes of the construction of the Works.

4.2.2. Drinking Water - Water for the Purposes of the Contract

The Contractor shall be responsible for the supply of all water required for the purposes of the Contract.

The Contractor shall be responsible for the provision of all water and for the payment of all costs connected therewith.

Where water cannot be made available directly to the site through the mains, the Contractor shall arrange for the conveyance of bulk supplies of water to the site and he shall ensure that sufficient supplies of water are at all times available.

4.2.3. Demolition

This clause concerns the work on the demolition of any bridge element as proposed by the Contractor and approved by the Supervising Engineer. The Contractor shall submit to the Supervising Engineer, for his approval, a plan for demolition works, detailing:

- Methods of demolition to be utilized,
- The amounts and limits of the demolition works
- Equipment to be used
- Labor to be employed
- Methods for debris removal, storage and transport,
- Safety precautions.

These details shall be forwarded to the Supervising Engineer before the demolition work is to be undertaken in a date upon agreement between the two parties.

All debris from the demolition work shall be segregated and properly disposed of to an approved landfills / dumpsites or for recycling if possible. The site shall be cleared of all the debris arising from the demolition.

4.3. TOPOGRAPHICAL CONTROL

The Contractor shall organize and conduct the topographical surveys at the site.

During the execution of the Works continual dimensional and geometric control of the execution shall be applied and all the data shall be entered into geodetic reports providing an on-going record of

changes in the bridge geometry as it is being resurfaced.

The Contractor shall survey the longitudinal section at points that are sufficiently close (approximately every 5 meters). He shall submit written records (or digital data on CD ROM) of these longitudinal sections to the Supervising Engineer, followed by the necessary notes, observations and the measures to be taken regarding the adjustment of the curbs (or cornices) etc.

4.4. CONCRETE WORKS

All concrete works shall be implemented in accordance with the requirements specified in this section.

These requirements shall be considered minimum requirements and shall not in any way reduce the contract parties' responsibility to perform safe and durable structures.

The concrete works shall comply with the following EN standards:

- EN 206-1:2000: Concrete - Performance, production and conformity;
- ENV 13670-1:2000: Execution of Concrete Structures.

Prior to concreting the Contractor shall furnish the concrete mix design for approval by the Supervising Engineer as per Article 3.2.3.2 (b)

4.4.1. Concrete - Performance, Production and Conformity

4.4.1.1. Scope

This section specifies requirements for the concrete works for all cast in situ concrete and should be read in conjunction with article 3.2. Further reference is made to EN 206-1:2000.

4.4.1.2. Normative references

The concrete works shall be implemented in every respect according to the guidelines outlined by the following EN standards:

- EN 206-1:2000: Concrete - Performance, production and conformity. In the following, references are made to EN 206 with corresponding titles.
- Any supplementary information or requirements, additions and/or in prEN 206 is presented under the relevant heading

Unless otherwise stated under the headings, the EN 206 text is valid.

4.4.1.3. Definitions, symbols and abbreviations

See EN 206.

4.4.1.4. Classification

Classification is defined in EN 206 and in article 3.2.3.2 (Please see also Article 3.2.3.2 (a))

4.4.1.5. Requirements for concrete and methods of verification

i. Basic requirements for constituent materials

General

Materials for use in concrete production shall be stored and handled in a way that does not change their properties or expose them to contamination, cross-mixing, or harmful influence from the environment. No materials shall be brought to the concrete plant, unless they have been tested and accepted in accordance with the requirements to the constituent materials.

All reference to %-values in this Section shall mean mass percentage (percentage by weight) unless otherwise stated.

Pre-testing

It shall be documented that all the constituent materials satisfy the stated requirements. The Contractor shall submit the documentation to the Supervising Engineer for approval before the initial tests can commence.

Cement

Cement for reinforced concrete shall be Portland cement type 1 in accordance with EN 197-1 and the following table or similar.

In addition to the requirements in EN 197-1 the cement shall fulfill the following changes and additions:

Portland Cement		
All types		
Properties	Requirements Minimum 3 %	Test methods
C3A content		EN 196-2

The content of chromate (water-soluble) shall be minimized.

Aggregates

The requirements shall conform to prEN 12620.

The alkali-reactivity shall fulfill the requirements stated in relevant standard.

The test method for fine aggregates is ASTM C 227.

Coarse aggregates shall be tested according to one of the following two test methods: CSA23.2-14 (52 weeks expansion) or ASTM C 1260 (14 days expansion).

CSA 23-2-14A has been approved as ASTM C 1293.

Mixing Water

The requirements shall be fully documented.

Admixtures

The admixtures shall also fulfill the requirements in prEN 934-6.

Additions (including mineral fillers and pigments)

Only addition Type II may be used.

The fly ash shall fulfill the requirements in EN 450.

The micro silica shall fulfill the requirements in CEN/TC 104/WG 9 N49.

ii. Basic Requirements for Composition of Concrete

General

The concrete composition and the constituent materials for designed or prescribed concrete shall be chosen to satisfy the requirements specified for fresh and hardened concrete, including consistence, density, strength, durability, protection of embedded steel against corrosion, taking into account the production process and the intended method of execution of concrete works.

The concrete shall be designed so as to minimize segregation and bleeding of the fresh concrete.

- Selection of Cement
- Use of Aggregates

The equivalent alkali content shall be calculated based on the actual quantity and the alkali content of

the constituent materials, excluding fly ash and micro silica, which shall not exceed that stated in the relevant standard. The requirement corresponds to 60 % mortar (40 % coarse aggregates) in mix, adjustment to be made for other compositions.

- Use of Recycled Water
- Use of Additions
- Use of Additions

Plasticizers shall be used for all concrete.

Air entraining agent shall be used for structures exposed to frost.

- Chloride Content

The chloride ion content shall not exceed the values stated in the relevant standard.

- Concrete Temperature

iii. Requirements Related to Exposure Classes

General

The requirements related to the exposure classes are stated in the relevant standard.

Concrete structures exposed to frost action - above ground level - will be required to contain freeze/thaw resisting aggregates and an air-entraining agent in accordance with the recommendations in prEN 12620.

- Limiting Values for Concrete Composition
- Performance-related Design Methods

iv. Requirements for Fresh concrete

Consistence

The best suitable test method for consistence shall be determined by the Contractor. The suitability of the test method and the consistence specified by the Contractor shall be demonstrated and documented in connection with the trial casting.

For pumped concrete the testing of consistence shall be performed after pumping unless a relationship between the workability of the concrete before and after pumping has been established.

- Cement content and water/cement ratio
- Air content

The air content in fresh concrete measured at the place of casting by the pressure method shall be as stated in the relevant standard. However, it is not allowed to exceed 10.0 % by volume of the fresh concrete.

Maximum Aggregate Size

The maximum size shall be as stated in the relevant standard.

v. Requirements for Hardened Concrete

Strength

Ref. relevant standard

Density

Ref. relevant standard

Resistance to Water Penetration

Reaction to Fire

Air content

This requirement is additional to EN 206.

The requirements for the air content in hardened concrete measured in volume percentage of binder in accordance with ASTM C457 are stated in the relevant standard as minimum value and maximum value. (Binder is defined as paste content + air content, i.e. the concrete volume less the volume of aggregates).

Air voids shall occur in the hardened concrete as a finely distributed system with a minimum specific surface, in accordance with ASTM C 457, as specified in the relevant standard.

The air content in the fresh concrete shall be high enough to fulfill the above mentioned requirements. The Contractor shall determine the actual minimum air content in the fresh concrete based on a relation between the air content in the fresh concrete and the air content in the hardened concrete. The relation shall be established by testing in connection with the trial casting.

The air content in the hardened shall be documented during the trial casting.

4.4.1.6. Specification of Concrete

i. General

The Specification refers to concrete as stated in the relevant standard with the additional requirements to the concrete compositions.

ii. Delivery of Fresh Concrete

- Information from the User of the Concrete to the Producer
- Information from the Producer of the Concrete to the User
- Delivery Ticket for Ready-Mixed Concrete
- Delivery Information for Site Mixed Concrete
- Consistence at Delivery

It is not allowed to add water to the truck mixer on site.

iii. Conformity Control and Conformity Criteria

General

The testing shall be performed on individual concrete composition.

The sampling and testing plan and conformity criteria shall comply with the procedures given in 8.2 in prEN 206.

The following shall be added:

Assessing the strength in the structure

If the documented test results do not comply with the required compressive strength, the actual Inspection Section shall be rejected, unless the Contractor by testing the compressive strength of cores drilled out of the concrete structure can document a characteristic strength of at least 80% of the required characteristic strength tested on cast cylinders.

The testing programme shall be accepted by the Supervising Engineer in advance.

Conformity Control for Designed Concrete

Conformity Control for Compressive Strength

General

Before start of production the producer shall define Inspection Sections (volume of concrete) for the concrete production. The Inspection Sections may not be changed provided that the conditions are the

same. The purchaser shall be informed in advance.

Sampling and Testing Plan

Minimum rate of sampling for concrete with product certification or production control certification for initial production shall be replaced by 1/100 m³ or 2/production week and for continuous production by 1/200 or 1/production week.

Minimum rate of sampling for concrete without product certification or production control certification for initial and continuous production shall be replaced by 1/50 or 1/production day.

Conformity Criteria for Compressive Strength

- Conformity Control for Tensile Splitting Strength
- Conformity Control for Properties other than Strength

Regarding air content of air-entrained fresh concrete the upper limit (+ 1 %) may be limited based on the contractor's requirements established in connection with the trial casting. The conformity criteria for chloride content shall also include alkali content.

- Conformity Control for Prescribed Concrete Including Standardized Prescribed Concrete
- Actions in the Case of Non-Conformity of the Product

iv. Production Control

General

All constituent materials of the concrete shall, when delivered to the concrete production site, be clearly marked and the delivery notes shall contain the following information:

- Name of supplier
- Type of material, for aggregates also source and nominal size
- Consignee
- Date of delivery
- Quantity

Containers and stockpiles shall be marked with the name and type of the constituent material so that they can easily be identified.

Powder materials (cement, fly ash and dry micro silica) shall be stored dry in closed containers and in a manner, which allow them to be used in the same sequence in which they are delivered.

Micro silica slurry shall be stored in closed containers and shall frequently be stirred to prevent separation. The containers may not be exposed to frost.

With regard to storage of aggregates, the bottom of the containers and the base of the stockpiles shall be of either steel or abrasion resistant concrete and shall be drained.

Admixtures in a water solution shall be stored in closed containers and may not be exposed to frost.

Admixtures in form of powder shall be stored dry in closed containers.

Production Control System

Recorded Data and other Documents

Testing

Concrete Composition and Initial Testing

Personnel, Equipment and Installation

Batching equipment the text after the 1st paragraph is replaced by the following:

The inaccuracy of reading of digital batching equipment shall be less than the following values, stated in relation to the added quantity when mixing one batch:

Admixtures	+/-1.0 %
Other constituent materials	+/- 0.5 %

If digital batching equipment is not being used an acceptable accuracy shall be agreed with the

Supervising Engineer.

Batching of Constituent Materials

All batching data shall be recorded along with the time of the mixing process by describing the intended and the achieved quantity and the percentage of deviation. This also applies to the water content in aggregate and supplementary water.

The recordings shall be carried out immediately before the constituent materials are to be introduced in the mixer or into a silo before the mixer. The records shall be numbered consecutively and shall be kept in a log book.

Mixing of Concrete

The effective mixing time measured from the last batching of constituent materials and supplementary water (if any) shall be recorded automatically for each batch.

The batches shall be numbered consecutively.

Addition of plasticizer on site is allowed if:

- It is being added to a rotating drum mixer. The adding and mixing of plasticizers in the truck shall be done only by personnel duly instructed and formally authorized to do so. The correct dosage shall be measured at the plant and kept in the truck in an approved labeled container, which is to be used for this purpose only.
- The influence of the supplementary addition including the time of adding and the mixing time has been documented.
- The effect including the time of adding and the mixing time shall be demonstrated in the fresh concrete by examining the uniformity of the workability of the concrete from at least five samples selected from different places of the load.
- The mixing time after adding admixture should not be less than 1 min/m³ concrete and not less than 5 minutes.
- If the Contractor wishes to apply additional plasticizer on site then it shall be tested in connection with the trial casting.

Production Control Procedures

Water/cement ratio

The water/cement ratio shall be calculated from the recorded weighed quantities. The quantity of water used for calculations shall be the effective quantity of water.

Cement content

The cement content per m³ concrete shall be calculated from the recorded weighed quantity and measured air content.

Fly ash

The fly ash content per m³ concrete shall be calculated from the recorded weighed quantities and measured air content.

Microsilica

The microsilica content per m³ concrete shall be calculated from the recorded weighed quantities and measured air content.

Microsilica and Fly ash content

The combined content of microsilica and fly ash per m³ concrete shall be calculated from the recorded weighed quantities and measured air content,

Air content in hardened concrete

The air content in the hardened concrete shall be determined during the trial casting. Chloride content

The content of available chloride in the concrete constituent materials shall be sufficiently low to ensure that the calculated maximum content of chloride in the final mix does not exceed that stated in the relevant standard. The chloride content shall be determined as Cl⁻ as a % of the total quantity of cement, fly ash and microsilica.

Alkali content

The equivalent alkali content shall be calculated based on the actual quantity and the alkali content of the constituent materials, excluding fly ash and microsilica, which shall not exceed that stated in the relevant standard. The requirement corresponds to 60 % mortar (40 % coarse aggregates) in mix, adjustment to be made for other compositions.

The type of test shall include alkali content.

Density of fresh concrete should also be tested for normal-weight concrete.

Evaluation of Conformity

General

- The Contractor shall define the volume of concrete (Inspection Sections) for the acceptance testing, which shall be approved by the Supervising Engineer before start of the production.
- Assessment, Surveillance and Certification of Production Control

4.4.2. Execution of Concrete Structures

4.4.2.1. Transport of Concrete

The concrete shall be discharged from the mixer and transported to the Works by means which shall prevent adulteration, segregation or loss of ingredients, and which shall ensure that the concrete is of the required workability. The time elapsing between mixing and placing a batch of concrete shall be as short as possible, and in any case no longer than will permit completion of placing and compaction before the onset of initial set. If the placing of any batch of concrete is delayed beyond this period, the concrete shall not be placed in the Permanent Works.

4.4.2.2. Placing of Concrete

Concrete shall not be placed in any part of the Permanent Works until the Supervisor's consent has been given in writing, and the Contractor shall give the Supervisor at least 18 hours' notice of his intention to place concrete. If concrete placing is not commenced within 24 hours of the Supervisor's consent, the Contractor shall again request written consent as specified above.

(a) Preparation of surfaces to receive concrete

Existing concrete surfaces shall be prepared as per Article 4.4.2.6 so that before deposition of further concrete they shall be clean, hard and sound and if required by the Supervisor shall be wet but without any freestanding water.

Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other suitable methods which will avoid washing away the freshly deposited concrete any of its constituents.

Any under drains constructed for this purpose shall be completely grouted up when they are no longer required by a method agreed by the Supervisor. If so instructed by the Supervisor rock surfaces against which concrete is to be placed shall receive a prior coating of mortar mixed in the proportions similar to those of the fines portion in the concrete to be placed.

The mortar shall be kept ahead of the concrete. The mortar shall be well worked into all parts of the excavated surfaces and shall be not less than 5mm thick.

The amount of mortar placed at any one time shall be limited so that it does not dry out or set before being covered with concrete.

(b) Placing procedures

The concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork.

It shall be brought up in layers approximately parallel to the construction joint planes and not exceeding 500mm in compacted thickness unless otherwise permitted or directed by the Supervisor, but the layers shall not be less than four times the maximum nominal size of aggregate in thickness.

Layers shall not be placed so that they form feather edges nor shall they be placed on a previous layer which has taken its initial set.

In order to comply with this requirement, a layer may be started before completion of the preceding layer.

All the concrete in a single bay or pour shall be placed as a continuous operation. It shall be carefully worked round all obstructions, irregularities in the foundations and the like so that all parts are completely full of compacted concrete with no segregation or honeycombing. It shall also be carefully worked round and between water stops, reinforcement, embedded steelwork and similar items which protrude above the surface of the completed pour.

All work shall be completed on each batch of concrete before its initial set commences and thereafter the concrete shall not be disturbed before it has set hard. No concrete that has partially hardened during transit shall be used in the Permanent Works and the transport of concrete from the mixer to the point of placing shall be such that this requirement can be complied with.

Concrete shall not be placed during rain which is sufficiently heavy or prolonged to wash mortar from coarse aggregate on the exposed faces of fresh concrete. Means shall be provided to remove any water accumulating on the surface of the placed concrete. Concrete shall not be deposited into such accumulations of water.

In drying weather, covers shall be provided for all fresh concrete surfaces which are not being worked on. Water shall not be added to concrete for any reason.

When concrete is discharged above its place of final deposition, segregation shall be prevented by the use of chutes, down pipes, trunks, baffles or other appropriate devices.

Forms for walls, columns and other thin sections of significant height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on the formwork or reinforcement above the level of the placed concrete.

(c) Interruptions to placing

If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the Contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already in place in accordance with Article 4.4.2.6. All works on the concrete shall be completed while it is still plastic and it shall not thereafter be disturbed until it is hard enough to resist damage. Plant and materials to comply with this requirement shall be readily available at all times during concrete placing.

Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or un-compacted concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.

The Contractor shall plan the dimensions of pours in such a way that thermal or shrinkage stresses are minimized.

(d) Placing sequence

The Contractor shall arrange that as far as possible the intervals between placing successive lifts of concrete in one section of the Permanent Works are of equal duration. This duration shall normally be not less than three and more than seven days under temperate weather conditions unless otherwise agreed or instructed by the Supervisor.

Where required by the Supervisor to limit the opening of construction joints due to shrinkage, concrete shall not be placed against adjacent concrete which is less than 21 days old.

When the Drawings call for contraction gaps in concrete, these shall be of the widths and in the locations shown on the Drawings and they shall not be filled until the full time interval shown on the Drawings has elapsed.

4.4.2.3. Compaction of Concrete

The concrete shall be fully compacted throughout the full extent of the placed layer. It shall be thoroughly worked against the formwork and around any reinforcement and other embedded items, without displacing them. Particular care shall be taken at arises and other confined spaces. Successive layers of the same pour shall be thoroughly worked together.

Concrete shall be compacted with the assistance of mechanical immersion vibrators, unless the Supervisor agrees with another method.

Immersion vibrators shall operate at a frequency of between 7000 and 10000 cycles per minute.

The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacturer in order that the effort to compact is not reduced.

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete 1/2 being placed to be vibrated for the necessary period and, in addition, stand-by vibrators shall be available for instant use at each place where concrete is being placed.

Where the concrete contains aggregate with a nominal size of 75mm or more, vibrators with a diameter of 150 mm or more shall be used.

Vibration shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. Vibrators shall not be used to move concrete laterally and shall be withdrawn slowly to prevent the formation of voids. Vibration shall not be applied by way of reinforcement nor shall vibrators be allowed to touch reinforcement or other embedded items. The vibrators shall be inserted vertically into the concrete to penetrate the layer underneath at regular spacing which shall not exceed the distance from the vibrator over which vibration is visibly effective.

4.4.2.4. Curing of Concrete

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperature differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete.

Curing shall be continued for as long as may be necessary to achieve the above objectives, but in any case for at least fourteen days or until the concrete is covered by later construction whichever is the shorter period.

The curing process shall commence as soon as the concrete is hard enough to resist damage from the process, and in the case of large areas or continuous pours shall commence on the completed section of the pour before the rest of the pour is finished.

Details of the Contractor's proposals for curing concrete shall be submitted to the Supervisor before the placing of concrete commences in the Permanent Works.

All exposed horizontal concrete surfaces shall be closely covered with polythene sheeting immediately after the concrete has been finished. Joints in the polythene sheeting shall be lapped by at least 300 mm and sealed with tape. This sheeting shall be properly secured to prevent its removal by wind and the development of air spaces beneath it. This shall be carried out, wherever possible by placing a layer of dry sand 80 mm thick on the polythene.

Care shall be taken at all stages to prevent damage to the polythene sheeting which shall be left in position for at least 7 days.

4.4.2.5. Protection of Fresh Concrete

Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from this cause.

No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

Concrete placed in the Permanent Works shall not be subjected to any structural loading until it has attained at least its minimum average strength.

4.4.2.6. Construction Joints

Whenever concrete is to be bonded to other concrete which has hardened, the surface of contact between sections shall be deemed a Construction joint.

Where construction joints are shown on the Drawings, the Contractor shall form such joints in those positions. The location of joints which the Contractor requires to make for the purpose of construction shall be subject to the agreement of the Supervisor.

Construction joints shall be in vertical or horizontal planes except in sloping slabs where they shall be normal to the exposed surface or elsewhere where the Drawings require a different arrangement. Construction joints shall be so arranged as to reduce to a minimum the effects of shrinkage in the concrete after placing, and shall be placed in the most advantageous positions with regard to stresses in the structures and the desirability of staggering joints.

Feather edges of concrete at joints shall be avoided and any feather edges which may have formed where reinforcing bars project through a joint shall be cut back until sound concrete has been reached.

The intersections of horizontal or near horizontal joints and exposed faces of concrete shall 1/2 appear as straight lines produced by use of a guide strip fixed to the formwork at the top of the concrete lift, or by other means acceptable to the Supervisor.

The surface of the fresh concrete in horizontal or near horizontal joints shall be thoroughly cleaned and roughened by means of high pressure water and air jets when the concrete is hard enough to withstand the treatment without the leaching of cement. The surface of vertical or near vertical joints shall be similarly treated if circumstances permit the removal of formwork at a suitable time.

Where concrete has become too hard for the above treatment to be successful, the surface whether formed or free is to be thoroughly scrubbed by mechanical means or wet sand blasted and then washed with clean water. The indentations produced by scrubbing shall be not less than 40 mm deep and shall not extend closer than 40mm to a finished face.

If instructed by the Supervisor the surface of the concrete shall be thoroughly brushed with a thin layer of mortar, immediately prior to the deposition of fresh concrete. The mortar shall be kept just ahead of the fresh concrete being placed and the fresh layer of concrete shall be thoroughly and systematically vibrated to full depth to ensure complete bond with the adjacent layer.

No mortar or concrete may be placed in position on or against a construction joint until the joint has been inspected and passed by the Supervisor.

4.4.2.7. Expansion and Contraction Joints in Concrete

Expansion and contraction joints are discontinuities in concrete designed to allow for thermal or other movements in the concrete.

Expansion joints are formed with a gap between the concrete faces to permit subsequent expansion of the concrete. Contraction joints are formed to permit initial contraction of the concrete and may include provision for subsequent filling.

Expansion and contraction joints shall be formed in the positions and in accordance with the details shown on the Drawings or elsewhere in the Specification.

Also in this project there are going to be used hydration joints which will allow the concrete to expand by the rising temperatures as a result of hydration process, these joints will be left open until the complete hardening of the concrete. The joint will be reinforced with additional reinforcement as described in the drawings. After the hardening process and after the finish of the hydration process the joint will be filled with class concrete C30/37.

EX joints shall be fixed in all cases where the existing building is connected with the new construction inner and outer, floors and ceilings.

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4.4.2.8. Water stops

All references to water stops include grout stops.

No water stop material shall be brought onto site until the Contractor has submitted full details of the materials he proposes to use, including samples, and these have been approved by the Supervisor. All samples shall be of adequate length for testing.

Water stops shall be made of materials which are resistant to chlorides or other deleterious substances which may be present in the environment of the Permanent Works. Rubber water stops may be of natural or synthetic rubber and shall have an elongation at breaking stress of at least 500 per cent at 25°C and shall be capable of accommodating a transverse movement of at least 50mm.

4.4.2.9. Mortar

This clause covers mortar for use ahead of concrete placing, and other uses not covered elsewhere in this Specification. Mortar shall be composed of fine aggregate and specified type of cement. The mix proportions shall be as stated on the BoQs (Sand-cement mortar 1.5cm. Two layers of 650 Kgr of cement Portland per 1 m³ of dry sand and one final layer 900 Kgr cement Portland per 1m³ of dry sand to a smooth finish). If not stated shall be one part of cement to two parts of fine aggregate by weight.

Small quantities of mortar may be hand mixed but for amounts over 0.5 m³ a mechanical mixer shall be used. The water content of the mortar shall be as low as possible consistent with the use for which it is required but in any case the water/cement ratio shall not be more than 0.5.

4.4.2.10. Grouting of pockets and holes

Pockets and holding-down bolts holes shall be thoroughly cleaned out using compressed air and water jet. Holes drilled by a diamond bit shall be roughened. The pockets and holes shall be filled with grout consisting of cement and clean fresh water mixed in proportion of two parts by weight of cement to one part by weight of water.

The space between the top surface of foundation concrete and the underside of base plates shall be filled with a special mortar made up in the following proportions:

Portland cement 50 kg

Fine aggregate 50 kg

An additive acceptable to the Supervisor to counteract shrinkage in proportions recommended by the manufacturer.

The special mortar shall be mixed with the lowest water-cement ratio which will result in a consistency of mix of sufficient workability to enable maximum compaction to be achieved.

The special mortar shall then be well rammed in horizontally below the base plate and from one edge only until it is extruded from the other three sides. The mortar which has extruded shall then be rammed back to ensure complete support without voids.

4.5. REINFORCEMENT

4.5.1. Materials

The required reinforcement type is specified in Section 3.

4.5.2. Bending, Cutting, Transport and Storage of the Reinforcement

The reinforcement shall be bend in accordance standards for reinforcement.

The Contractor shall prepare detailed reinforcement plans and bar bending schedules in accordance with approved construction drawings. All bars shall be unambiguously identified by numbers on the plans and schedules.

Copy of all reinforcement plans and bar-bending schedules shall be submitted to the Supervising Engineer for information and approval before commencing cutting and bending.

The reinforcing steel shall be transported and stored such as to prevent any mechanical damage, accumulation of dirt and corrosion.

4.5.3. Welding

The Contractor shall prepare a Method Statement which shall define the welding procedure, the welder's qualifications and testing, the materials to be used, pre-trials and welding quality control tests all in accordance with international standards.

4.5.4. Assembly and Placing of the Reinforcement

Reinforcement shall be accurately placed and shall be firmly secured and held in position to ensure that it does not move during steel fixing and concreting works.

Bars shall be laid together at all intersections. The ends of the tying wire shall be bent away from the cover layer.

The spacing of supports shall always be close enough to maintain the specified cover layer within the specified tolerances. The spacing of supports under reinforcement shall provide a rigid system without deflection and without crushing of spacers.

Reinforcement shall be supported by spacers against all form sides. Steel chairs shall support reinforcement layers against each other. In no event shall steel chairs or steel supports extend into the cover zone.

Reinforcement shall not be left exposed for an extended period before being cast in, and it shall be kept covered by tarpaulins, whenever it is not worked on.

Bars, which are found to have reduced sections, visible transverse cracks at bends, or other damage, shall be rejected.

Spacers shall be designed and fabricated with sufficient strength and rigidity and be arranged so as to ensure that the spacer will be properly embedded in the concrete. The spacers shall be made of concrete or cement mortar with a water/cement ratio not exceeding that of the surrounding concrete and with the same type and constituents. The contractor's proposal for spacers shall be submitted to the Supervising Engineer for his acceptance.

4.5.5. Control

Each delivery of reinforcement bars shall be accompanied by a test certificate from the manufacturer, according to the requirements in ENV 10080 section 8 Testing and 9 Product identification.

A check of conformity between order, certificate and tagging shall always be carried out, and documented. Check of required cover on the reinforcement shall be carried out for 3% of the concrete surfaces as specified by the Supervising Engineer.

4.6. DECK AND FOOTPATH EXPANSION JOINTS

In case of old expansion joints (BOQ-Option I)

The existing suspension joints shall be reused. The Contractor shall carefully dismantle them and place them 5 m from the joint for cleaning, treating and coating. Following this procedure the steel expansion joints shall be re-installed in the previous position with the use of proper lifting equipment.

In case of new expansion joints are installed (BOQ-Option II)

The Contractor prior to initiating the works shall verify/calculate the fitting parameters according to the temperature and age of the deck and shall submit to the Supervising Engineer the relevant report. Thereafter the installation procedures shall be submitted specifying the works stages as per the manufacturer's instructions.

Water from the deck running through the expansion joints will be collected in a gutter below the expansion joints. It will be discharged to the low point in the PVC discharge pipes (diameter 110 mm) and connected to an outfall constructed for the purpose.

4.7. DRAINAGE OUTLETS AND FALLPIPES

When gullies will be installed attention should be paid to the good waterproofing of connection to the intake gutter and it will be checked that there is no counter-slope or obstacle to water flow in this connection. The gullies will be prolonged by visible down pipes 120 mm in diameter and they will continue in a way to protect the structure below.

4.8. CONTROLS DURING CONSTRUCTION

(Please see also Articles 2.7 and 4.2)

The Contractor will supply to the Supervising Engineer before the beginning of the concreting of the deck a report explaining the method used to obtain geometry of the structure. This report will contain all the corrective measures that the Contractor intends to use to remove or alleviate irregularities in the profile along the deck. The corrective measures that can be used consist in particular of the re-profiling and extra carriageway thickness within the limits of the design assumptions in the deck calculation reports. The Contractor can also propose other correction principles that would remove or reduce possible irregularities in the longitudinal profile of the completed deck.

The Contractor must survey the longitudinal section of the deck with points that are sufficiently close. He must provide these longitudinal sections in writing for the Supervising Engineer, accompanied by the necessary observations and the measures to be decided. Leveling measurements must be accurate to two (2) millimeters.

4.9. DECK WATERPROOFING AND SURFACING

This section describes the works to be performed for the pavement on the carriageway on the bridge superstructure. The area to be paved is only the carriageway

4.9.1. Waterproofing with Prefabricated Bituminous Membrane

4.9.1.1. Materials

A new contemporary waterproofing membrane composed of polymer bitumen sheeting shall be placed over the whole surface of the concrete deck of the bridge.

The thickness of the polymer bitumen sheeting shall be at least 5 mm thickness placed over previously applied cold bitumen basic coating (quantity 0.3 kg/m² to 0.5 kg/m²) powdered with quartz sand 0.7-1.2 mm and sprayed over with hot gluing bitumen for adhesiveness (quantity 2-2.5 kg/m²), all in accordance with the waterproofing membrane supplier's instructions.

Requirements for the material listed for waterproofing shall comply with the European Standard PrEN (00254087) 2001-02, chapter 3 or equivalent. Each delivery of waterproofing products shall be followed by analyze data sheets for the delivered material.

The choice of waterproofing materials and supplier shall be subject to the approval of the Supervising Engineer.

4.9.1.2. Execution of the works

Before laying the waterproofing membrane the concrete layer C25/30 shall be laid creating a cambered surface of 2% outwards and shall be inspected by the Supervising Engineer. The minimum thickness will be 3cm and the maximum 10cm. The Contractor shall treat the transverse construction joints over each pier with concrete and shall place light reinforcing mesh $\Phi 8/200\mu\mu$ or rebars $\Phi 8/200$ perpendicular to the joint to a distance 50cm from either side of the joint (2x50cm). The concrete surface shall have the following characteristic:

Levelling: Depressions or lumps should not be more than 1cm on a 4 m length.

The coarseness shall be controlled according to BS EN 1504-2:2004 "Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Surface protection systems for concrete"

Then the surface shall be cleaned by light sand-blasting or shot-blasting.

Just before application of the basic coating, sand and dust shall be removed by vacuum cleaning or by compressed air. The concrete surface shall be dry and the temperature above 5 °C or as specified by the supplier.

Overlap in the longitudinal direction of the sheeting shall be minimum 15 cm and in the transverse direction of the sheeting the overlap shall be minimum 10 cm.

The fully adhesion shall be verified by tear-off tests with 2.5 cm wide strip cut in the membrane performed in the presence of the Supervising Engineer.

Traffic on the membrane before covered by the pavement shall be avoided.

4.9.2. Waterproofing with Asphalt Mixes, Produced by Hot Process

4.9.2.1. Preparation of the base

The base on which the waterproofing membrane is laid will be considered to comply with the fabric construction technical clauses concerning the geometrical tolerances of execution and the quality of the extrados concrete (cf. article on controls during construction). Recesses for flashing will be at least (10) cm high.

When the surface has been accepted in conformity with the procedure laid down, the following minimum normal treatment will be executed:

- removal of non-cohesive substances: clay, soil, dust, laitance, etc. and any curing product that may have been applied;
- final cleaning of the surface by brushing and/or vacuum treatment followed if necessary by washing with clean water at very high pressure ($> 200 \text{ MN/m}^2$).

These two operations shall be carried out simultaneously and repeated as many times as necessary.

The procedures, equipment and programmes required for this preparation shall be submitted for the Supervising Engineer's approval. Asphalt will only be laid when he has given his permission after he has examined the preparation of the base.

4.9.2.2. Transport and surfacing plant

The transport and surfacing plant used must ensure:

- that the material is kept within the temperature range laid down,
- that the material is perfectly mixed.

The site must not be soiled.

4.9.2.3. Priming coat

This will be applied to a clean surface from which non-cohesive materials have been removed (soil, clay, dust, etc.).

Application will be carried out using a soft brush or by spraying; the use of rubber scrapers is forbidden. 'Sponge scrapers' are tolerated if the work is completed by use of a soft brush.

The surface to be coated will be dry (naturally, or dried artificially). Application to a moist surface or during rainfall is forbidden.

The product must coat the entire surface and gaps will be touched up. Accumulations of material will be removed.

4.9.2.4. Partial bond layer

This will be applied immediately before the first waterproofing layer is applied.

4.9.2.5. First waterproofing layer

The work must not be undertaken or continued:

- unless the support is dry and the priming coat solvents have evaporated,
- during rain.

The thickness of the first layer of asphalt mastic will be:

- four (4) millimeters plus or minus (1) millimeter, if complex A is chosen;
- eight (8) millimeters plus or minus two (2) millimeters if complex B is chosen.

Re-use of laid material is forbidden.

When it is laid, the material must be at between two hundred degrees (200°C) and two hundred and twenty degrees (220°C). The temperature must never exceed two hundred and fifty degrees (250°C) during manufacture. Renewed laying on cooled zones must cover to a depth of at least five (5) centimeters.

The first layer of mastic asphalt must be continuous, especially at overlaps of the lengths of paper or mesh of the partial bond layer.

The flashing in the grooves will be constructed in pressed trowelled layers giving a thickness of three (3) millimeters for the entire height of the groove or a sheet of prefabricated reinforced bitumen.

At any extremity or break in the deck, the layer of mastic asphalt will be left as it is or, if there is no joint, extended downwards to the line defined in the contract drawings.

4.9.2.6. Openings for water, drains

The metal plates or elastomer sheets forming part of these structures will be fixed between two layers of mastic asphalt.

4.9.2.7. Second waterproofing layer

The thickness of the second layer of gritted mastic will be such that the total thickness of the waterproofing complex is generally thirty (30) millimeters. This is an average thickness.

The thickness of the layer is shown by the placing of metal rules previously set at the level. The reuse of laid material is forbidden.

When it is laid, the material must be at between two hundred and thirty-five degrees (235°C) and two hundred and fifty-five degrees (255 °C). The temperature must never exceed two hundred and sixty degrees (260°C) during manufacture.

Renewed laying on cooled zones will be by a beveled joint with a coverage depth of at least five (5) centimeters.

At the extremities of the deck and at breaks, the second waterproofing layer will be left as it is to enable the placing of the system to provide continuity of waterproofing beneath the joint or, if there is no joint, extended down to the line shown in the contract drawings.

The second layer may under no circumstance display intermediate low points except in places identified during the preparation of the base.

4.9.2.8. Control and tests

i. Control of the temperature

Asphalt temperature will be counter-checked by the Contractor at the arrival of each transit-mixer truck and then in the buckets throughout laying operations.

ii. Taking of samples

The Contractor will enable the Supervising Engineer to take at least two samples for every two mixer trucks for the performance of indentation tests and possibly checking of the bitumen content and particle-size distribution.

The asphalt will be collected in a sample mould directly under the delivery chute after some material has been poured. The mould will be leveled immediately.

Sampling will be performed towards the end of the first third of unloading and at the beginning of the last third.

iii. Holes for water discharge and drains

The surfacing of the second layer must not display any counter-slope that would hinder the flow of water to these points.

iv. Bubbles, blisters and swellings

The external surface must not display any bubbles, blisters or swellings. All defects must be repaired as necessary.

v. Protection against heat

The Contractor will install protection to decrease the effects of the sun. It will be proposed to the Supervising Engineer for approval and will consist of:

- either a layer of gravel ten (10) cm thick,
- or a coat of white 'Emulak' paint or similar.

4.10. SURFACING OF DECK BRIDGE

4.10.1. Introduction

This section refers to the surfacing of the bridge deck with hot mix asphalt concrete and related works. The Contractor will submit the composition of the paving material to the Supervising Engineer for approval. Laboratory results (compactness, strength) will be provided to support the proposal.

4.10.2. Layer's Thickness

The thickness of different layers to be provided on deck bridges are summarized as follows:

- Binder course placed directly on the deck waterproofing : 4.0cm
- Wearing course placed on the binder course: 3.0cm.

The thickness of the layers of the adjacent part of the road (East side of the Bridge) shall be the same.

4.10.3. Removal or Breaking Up of Existing Bridge Pavement Surface

Prior to the commencement of bridge surfacing the Contractor is required to remove or break up the existing pavement surface and be controlled by the Supervising Engineer. The existing bituminous

surface layers shall be broken up and scarified, and concrete bridge kerbs shall be removed and disposed of, all in a manner to be approved by the Supervising Engineer. Care shall be taken to ensure that the breaking up is confined to the bituminous layers and concrete edging and that the underlying layers are not damaged. Any voids caused by the removal of the concrete edging shall be filled with the foreseen concrete layer. The resulting surface shall then be cleaned with high pressure air to ensure that no lumps or large particles of pavement remain.

As it is mentioned already under section 1 of the current technical specifications since there has been no detailed structural assessment carried out on the bridge at the time of writing this TS the Contractor shall exercise extreme caution during the demolition and construction works and be responsible for choosing the optimum methods, tools and equipment (i.e. demolition hammers/pneumatic drills or mechanical means) to minimize the disturbance of the substructure. The method to be followed and tools and equipment to be used shall be subject to approval by the Supervising Engineer. Particular attention shall be given when working on the cantilever slabs where the Contractor shall strictly ensure the safety requirements of the personnel involved in the work.

4.10.4. General Requirements for Bituminous and Asphalt Concrete Surfacing

This Section covers the materials, methods of construction and requirements common to the construction of all bituminous surface treatments specified in this Specification.

4.10.4.1. Materials

Bituminous binders

Bitumen and bituminous emulsions shall comply with the requirements of this chapter.

Aggregates

Aggregates shall comply with the requirements of this chapter.

Stockpiling of aggregate

Sites for the stockpiling of aggregate shall be prepared in such a manner that no grass, mud, dirt or other unsuitable material will be included when the aggregates are loaded for use.

Access to stockpile sites shall be prepared and maintained in such a way that no dirt is conveyed by vehicle wheels on to the area to be surfaced while aggregate is being transported to or from the stockpiles. Each stockpile shall be approved at least 18 days prior to use of material in construction.

Stockpiles shall be so sited that they will not be exposed to excessive contamination with dust arising from construction traffic on the road or access roads. Aggregates contaminated to such an extent that it contains more than the allowable percentage of material passing the 0.075 mm sieve shall not be used for surfacing.

4.10.4.2. Plant and equipment

General

All plant and equipment used on the works shall be suitable for the purpose intended, of adequate rated capacity, maintained in good working condition, and shall be operated by experienced operators.

All plant and equipment that will be operated on the road during construction of the surface treatment shall be free of any binder, fuel or oil leaks and no re fuelling or servicing of any equipment will be allowed to take place while such equipment is on the road.

Bitumen distributor

A pressure sprayer shall be used for the distribution of bituminous materials on the road surface. Distributors operating on a constant pressure or constant volume system shall be fitted with a low speed speedometer, which shall be kept in efficient working order at all times.

The distributor shall be so designed as to be capable of re-heating bitumen to the correct temperature, to show the temperature accurately at any times by a fixed thermometer, and to maintain the temperature within the limits for spraying during a period covering a spraying operation.

The distributor shall be fitted with a dial gauge contents indicator, and also with a calibrated dipstick.

The distributor shall be provided with adequate means for protection against whirling spray.

Rollers

Sufficient rollers of each type shall be available on the works to maintain progress. The specific equipment to be used shall be agreed upon with the Supervising Engineer.

Miscellaneous equipment

Sufficient equipment for handling and hauling aggregate and binder shall be provided to ensure prompt and continuous covering of bituminous material as specified.

The Contractor shall have available all the necessary ancillary equipment and hand tools to carry out the work efficiently.

Considerations

For spans 1-16 the Contractor shall not use equipment, machinery of combined weight more than 50 tones whereas for the spans 17, 18 and 19 the Contractor shall use light machinery not exceeding 35.0 tones. Heavy machinery is not allowed to be used on the sidewalk.

4.10.4.3. Heating bituminous binders

Bituminous binder shall be heated to a temperature between the following limits:

			Recommended Spray Temperature	
Type of Binder	Lower Limit	Upper Limit	Fan	Swirling Spray
Bitumen 80/110	165 °C	190 °C	175 °C	185 °C
Bitumen 150/200	150 °C	175 °C	165 °C	175 °C
60% bitumen emulsion	37 °C	50 °C	45 °C	50 °C
MC 30 cutback	40 °C	60 °C	50 °C	55 °C
MC 70 cutback	65 °C	90 °C	80 °C	90 °C

Binders which have been heated to temperatures higher than the upper limits given in the above table shall not be used and shall be removed from the site. The recommended spraying temperature is also indicated and every Endeavour shall be made to maintain the spray temperature to within a range 5°C above or below the recommended temperature.

Rates of application and tolerance

All bituminous binders and aggregate used in the bituminous surface treatment shall be applied at the rates of application as determined by the Supervising Engineer after tests on the materials proposed for use, within a tolerance of plus or minus 5% of the specified rate.

The nominal rates of application of bituminous binders given surface treatment shall be applied at the rates of application as determined by the Supervising Engineer after tests on the materials proposed for use, within a tolerance of plus or minus 5% of the specified rate.

The nominal rates of application of bituminous binders given in further sections shall, unless otherwise specified, be measured at spraying temperatures. The nominal rates of application to be used on site shall in all cases be as directed by the Supervising Engineer.

Where the expressions "net bitumen" or "net bitumen quantity" are used elsewhere in these Specifications for specifying application rates for binder, they shall be taken to mean penetration grade bitumen plus the volatile normally present therein, but excluding any water, emulsifier or volatile oils added to manufacture bitumen emulsions or cutback bitumen.

Dust control

Any deviations and construction roads shall be kept watered and clamp during all surfacing operations

and all dust removed from surface before any material is applied.

4.10.5. Bituminous Prime Coat

This Section covers the supply and application of bituminous priming material to a prepared base course, in accordance with this Specification.

4.10.5.1. Materials

Bituminous material

The priming material shall be proposed by the Contractor and be submitted to the Supervising Engineer for approval at least one month before the asphalt work commences

The priming material shall be directed by the Supervising Engineer according to the texture of the surface to be treated. If it is open textured, MC 70 cutback bitumen shall be used.

Mineral aggregate

Mineral aggregate used for blinding the primed surface shall consist of crushed rock or river sand, with 100% passing the 6.7 mm sieve and not more than 2% passing the 0.075 mm sieve. The aggregate shall be clean, hard dry, and free from excessive dust. It shall contain no clay, loam, and organic or other deleterious matter.

4.10.5.2. Weather limitations

The decision on whether or not to apply the prime coat under specific weather conditions shall rest with the Supervising Engineer.

Spraying of prime coat may not be undertaken when the ambient road temperature is expected to fall below 15°C immediately prior to commencing the application of prime nor if the ambient road temperature is expected to fall below 5°C during the breaking period of the binder.

Priming of lime/cement stabilized base may not be undertaken during winter season when frost occurs during the breaking period of the prime and when temperature falls below or is likely to fall below 15°C and 5°C mentioned above.

Prime may not be used as a curing membrane over stabilized base under same seasonal and temperature conditions.

4.10.5.3. Preparation of the base course

No longer than 24 hours before spraying, the base shall be broom and cleaned of any loose or hard surface crust layer created during shushing compaction work by means of a rotary broom and hand brooms. A light spray of water shall be uniformly applied to the base immediately before the application of the prime if so ordered by the Supervising Engineer. If the water is over applied, the base shall be allowed to dry until a uniform damp surface is obtained.

No prime shall be sprayed on a base saturated with water.

4.10.5.4. Application of bituminous priming material

Bituminous material shall be applied by means of a distributor at the rate of 1.00 liter per square meter or as directed by the Supervising Engineer, and at the recommended temperature for the product.

When necessary to provide for traffic, the prime coat shall be applied in lanes of approximately one-half the width of the completed surface. A lane of prime coat shall be applied, allowed to penetrate for not less than 4 hours, then covered with blinding material if required and opened to traffic before the bituminous material is applied to the adjacent lane. In covering the first treated lane a strip at least 300 mm wide shall be left uncovered where the two lanes join, to permit a slight overlap of the bituminous material.

Where traffic can use deviations the prime coat shall be sprayed evenly over the full width of the base course in one or more lanes and shall be left undisturbed for a period of not less than 2 days.

The total width of primed surface shall be 300 mm wider than the specified width of the final surfacing and the edges of the prime shall be parallel to the center line of the road.

4.10.5.5. Maintenance and opening to traffic

The Contractor shall be fully responsible for any damage to the base course for opening to traffic. He shall repair all defects, at his cost, as directed by the Supervising Engineer.

Traffic shall not be permitted on the surface until the bituminous material has penetrated to a minimum of 5 mm, and dried, and in the opinion of the Supervising Engineer will not pick up under traffic. Where the completion of the final surface is delayed and the over long periods, the Contractor shall spread the minimum quantity of coarse sand or crusher fines over the primed areas at least 2 days after the prime coat has been applied to avoid picking up, and traffic shall be allowed to use areas so treated.

Potholes, which may develop, shall be carefully backfilled with premixed material and compacted to the satisfaction of the Supervising Engineer. Any areas containing an excess or deficiency of priming material shall be corrected by the addition of sand or bitumen as directed by the Supervising Engineer. All the repair work in such case will be deemed to be included in the Contrast rates by the Contractor.

4.10.6. Bituminous Tack Coat

A tack coat to assist in bonding between layers shall only be applied as and where directed by the Supervising Engineer. It shall consist of a light application of diluted bitumen emulsion spread evenly over either the surface of bridge deck to give not more than 0.5-0.8 kg per square meter of residual bitumen (With reference to the system of waterproofing adopted) or over the surface of the binder course and before the application of the wearing course layer, at the rate of 0.4 - 0.6 kg/m².

4.10.7. Premixed Asphaltic Concrete Surfacing

This Section covers procuring, furnishing and placing all materials, correcting any irregularities in the surface of the base with premixed material and constructing a hot premix surface in accordance with these specifications and in conformity with the lines, grades and dimensions shown on the drawings or as directed by the Supervising Engineer. Where reference is made to asphalt concrete this shall be considered as a premix surfacing.

The bituminous surfacing to be used are mixtures of dried, hot aggregate and hot straight run bitumen. The mixture shall be designed in accordance with this Specification, which makes provision for the use of aggregate of pre-determined grading, together with adequate bitumen to meet the specified strength and stability criteria.

The term Premix shall apply for both the mix and the compacted layer.

The nominal size of the mix shall be the nominal maximum size of the aggregate used. Mixes will be identified by their nominal size in mm.

4.10.7.1. Materials

Aggregates

Mix type selection shall be based upon availability of suitable aggregates. The mix of aggregate forming the final grading shall be carefully checked in the laboratory prior to its adoption and shall be composed with heavy and tenacious elements, cleaned and exempted of heterogeneous and extraneous materials.

The mix bands for the mixes exposed in the following table are purposely wider or inside the mix bands. The contractor shall submit to the Supervising Engineer approval the final smooth curve of mix aggregates.

The component of the grading mix shall respond in particular to following prescription

Coarse and fine aggregates shall be 100% composed of crushed material, of granite or basaltic origin, with a:

- > Los Angeles abrasion < 18% on total weight;
- > Frost sensibility < 12% on total weight;
- > Absorption of water < 1.60%
- > Imbibitions coefficient < 0,015 on total weight.

- **Sand**, shall be characterized by an "Sand Equivalent" > 80%, in which the 85% of component is obtain from crushed treatment.

- **Mineral filler**, shall be obtained from crushed rocks and constituted by cement Portland, Hydrated lime and calcium carbonate, with the following composition:

- Passing to 300 ,um 100%
- Passing to 150 ,um 90%
- Passing to 75 ,um 80%

Regarding the grading bands, the aggregates shall comply with the requirements of the following table:

Sieve size	Mix design and Nominated Maximum Size of Aggregate	
	Binder course	Wearing Course
	25.0 mm (1.0 in.)	19.0 mm (3/8 in.)
	Total percent passing (by weight)	
25.0 mm (1 in) 19.0 mm (3/4 in.) 12.5 mm (1/2 in.) 9.5 mm (3/8 in.) 4.75mm (No4) 2.36 mm (No 8) 1.18 mm (No16) 300 ,um (No 50) 75 ,um (no 200)	100 60 to 100 45 to 80 40 to 70 25 to 52 18 to 40 10 to 30 1 to 7	100 60 to 100 50 to 85 30 to 58 20 to 43 12 to 36 3 to 18 2 to 8
Asphalt Cement (weight percent of Total Mixture)	3.5 to 5.0	4.0 to 6.5
Bitumen Grade	80/110	80/110
Layer Thickness (mm)	40	40

Notes to above Table

- The maximum aggregate size shall not exceed half of the compacted layer thickness.
- If so directed by the Supervising Engineer, 1 to 1.5 percent of cement, lime, or other approved mineral filler in weight of the total mix will be added.

Asphalt Concrete - Bitumen

The type of bituminous binder shall normally be 80/110 penetration straight run bitumen unless otherwise directed by the Supervising Engineer

4.10.7.2. Plants and equipment

All plant and equipment used shall be suitable for the purpose intended, of adequate rated capacity, maintained in good working condition, and shall be subject to the approval of the Supervising Engineer. Obsolete or worn out plant will not be allowed on the work. Plant to be used on the work

shall include the following:

Mixing plant

The mixer or mixers may be of the standard twin pug mill type or similar but in any case shall be of sufficient capacity to maintain thorough uniform mixing at the full rated capacity of the mechanical pavers. The mixer shall be equipped with a sufficient number of paddles set in the proper order and position to produce a mixture conforming to the specified requirements. Worn paddles and liners shall be regularly replaced to ensure proper mixing at the rated capacity. The mixer, or mixers, may be of either the batch mixing type or the continuous mixing type, provided the equipment has demonstrated that it is suitable for producing the required grading and uniformity of mix within the tolerance specified.

The aggregate drier shall be of the revolving drum type and capable of heating and drying the aggregate to specified requirements at the full rated capacity of the mixers. The drier shall be provided with a thermometric instrument capable of continuously indicating the temperature of the aggregate at the discharge end. Where the drier is of the forced draught type, the plant shall be provided with dust collector units which will trap and feed fines lost in the drying process, back into the mix.

Where the mixer is of the continuous type, the plant shall be provided with storage bins, with at least three separate compartments for handling the different grades of aggregate used in the mix. Each compartment shall be fitted with an adjustable gate, which can be accurately set for controlling the flow of aggregate, so as to ensure correct proportioning of the mix.

The bitumen boilers shall be capable of heating the binder to specified temperature at the full rated capacity of the mixers and shall be so designed and maintained as to prevent a direct flame coming into contact with the tanks. These boilers shall be fitted with thermometers indicating temperature of binder at the discharge end.

Bitumen storage and supply lines shall be insulated or steam-jacketed in such a manner that there will be no appreciable drop in temperature of the bitumen between the heating unit and the mixing unit.

Thermometric instruments, for indicating the temperatures of aggregate and binder entering the mixer, shall be conveniently located so as to be clearly visible to the mixer operator from a position on the mixer platform.

4.10.7.3. General requirements

In addition to the above requirements, mixing plants, whether of the batch type or continuous mixing type, shall be so equipped as to ensure that:

- Temperatures of aggregates leaving the drier and of bituminous binder entering the mixer, and of the mixture leaving the mixer can be readily determined and positively controlled within specified limits at all times.
- Weights or volumes of different sized of aggregate and of bituminous binder as set by the Supervising Engineer can be consistently introduced into the mixer.
- The bituminous binder can be uniformly distributed throughout the mixer with the aggregate completely coated.
- Mixing time can be positively controlled to the minimum specified, and
- Bin samples of aggregate shall be readily obtainable. Should the Supervising Engineer determine that the equipment furnished does not meet all of these requirements, the deficiencies shall be corrected by the Contractor before further use, or the deficient equipment shall be replaced with satisfactory equipment

Hauling trucks

Sufficient hauling capacity should be available to ensure uniform capacity operation of the asphalt plant and pavers. Some of the more important considerations in determining the number of trucks to use are: capacity of the trucks, loading time, length and time of haul, discharge time at the spreader, number of spreader and characteristic of plant production.

The loader must not bear any of its weight on the pavers' hopper and must operate so that practically all the mix is picked up and deposited in the hopper.

Trucks used to haul the asphalt paving mixture should be in good mechanical condition at all times. All surfaces that come into contact with the asphalt mixture should be clean and smooth and free from

cracks, holes, or dents. Milk lime water or a soap or detergent solution may be used for coating the truck bodies.

In cold weather, or for long hauls, a canvas or similar covering should be placed over the hot-mix after loading into the truck.

In any case, all the detail and procedure of asphalt mixture transport shall be submitted by the Contractor to the Supervising Engineer's approval.

Spreading equipment

Mechanical pavers shall be used for spreading premixed bituminous material and shall be of an approved type. The pavers shall be self-propelled and capable of spreading the premixed material in an even layer to the required thickness and over widths of not less than one traffic lane. The pavers shall be fitted with a screed-heater, if so required, to ensure uniform spread at low temperatures. The machine shall be readily and accurately adjustable for changes in pavement crown. The pavers shall be fitted with an electronic sensing system for controlling the line and level of the surface of the layer.

The method of lying, the type and the number of pavers must be submitted to the Supervising Engineer's approval by the Contractor.

Rollers

The Contractor may furnish and use one self-propelled flat steel wheeled roller (static) of 10 - 12 tone weight, to compact the premix wearing course

One small static steel wheel roller (1.32 tones, 86 cm wide drum) or similar and walk-behind rollers static shall also be used,

Considering that the structural condition of the bridge is not known the type and the number of rollers must be submitted to the Supervising Engineer's approval.

Asphalt Distributor

An asphalt distributor is needed on every plant-mix for applying asphalt tack coat. In case of spaying modified bitumen, the asphalt distributor may have a particular high heating central and a central high-pressure.

Hand Tools

The contractor shall use the all kind of hand tools such as rakes, shovels, lutes, etc. necessary for the ancillary works.

4.10.7.4. Composition of bituminous mixes

The Contractor will be responsible for designing the mixes for the various layers of construction, and submitting the results to the Supervising Engineer for approval.

Nonetheless, the mix design method and the applicable design criteria shall be obtained by the Marshall Method. The needed characteristics are summarized as follow:

Asphalt layer	Binder Course	Wearing Course
Test's description and value	25.0 mm. (1.0 in.)	19.0 mm. (3/8 in.)
Density by volume g/cm ³	2.300	2.350
Voids % by volume	4-7	3-5
Stability kN	> 80	> 110
Flow value 1/10 mm.	2-4	3-4
Rigidity value N/mm.	200-320	250-370

When the composition of the design mix has been established by the Contractor and approved by the Supervising Engineer, the Contractor shall maintain the composition of the working mix within the following tolerances from the design mix:

Binder:	established from one test	design percentage : ± 0.4
	established from series of 5 or more tests.	design percentage ± 0.2
Aggregate:	passing 4.75 mm sieve	design percentage : ± 6
	passing 0.30 mm sieve	design percentage : ± 5

The above table describes the requirements for each type and size of aggregate specified for wearing course and binder.

4.10.7.5. Weather limitations

The decision on whether or not to apply the hot premix surfacing work under specific weather conditions shall rest with the Supervising Engineer.

4.10.7.6. Construction

Quality of the base course

After the prime coat or tack coat, as the case may be, has been applied, the surface of the base course shall be checked for smoothness and accuracy of grade, elevation and cross-section and any portion which fail to pass specified requirement shall be suitably corrected with premixed bituminous material, properly spread and compacted, until specified requirements are met, all at the Contractor's expense.

The premixed bituminous material used for correcting the surface of the base shall be either the same mixture as specified above for the construction of a hot premix wearing course or shall consist of a mixture of nominal 6 mm maximum size coarse aggregate and 5% - 6% by weight of bituminous road binder.

Mixing Time

With regard to the batch plants, the total mixing time begins with the opening of the weight hopper gate and ends with the opening of the mixer discharge gate. Dry mixing time begins with the start of the asphalt application and ends with the opening of the mixer discharge gate. With the modern plants, it is sufficient to mix for about 35/45 seconds in order to obtain a uniform coating. The mixing time should be the shortest time required to obtain a uniform distribution of aggregate size and thorough coating of aggregate particle with bitumen. The mixing time may be adjusted on the basis of the particles coating test procedure.

Transporting the mixture

The premix shall be transported from the mixing plant to the point of use in pneumatic-tired vehicles having tight bodies previously cleaned of all foreign material. When so directed by the Supervising Engineer, each load shall be covered with canvas sufficient in size and weight to protect it from the weather and from dust. The mixtures shall be placed at a temperature between 120°C and 150°C. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight.

Spreading

Immediately before placing the mixture, the existing surface shall be cleaned of all loose or deleterious materials. No premix shall be placed until the surface has been approved by the Supervising Engineer.

The speed of the approved mechanical pavers shall be regulated to eliminate dragging or tearing of the mixture during placing.

The mixture shall be placed in lanes of one-half width of bridge deck at a time whenever possible. The 150-mm width of strip along the edge adjacent to the area on which the succeeding lane will be placed shall be left unrolled until the adjacent lane is placed. After the preceding lane has been compacted, the adjacent lane shall be placed, finished and compacted as provided for the preceding lane, except that the rolling shall be extended to include the 150 mm width of strip not previously compacted. The

Contractor shall so arrange his work that all adjacent lanes over any section of the bridge being surfaced are placed, compacted and finished off the same day.

At joints with existing compacted bituminous surfacing, whether it be new or old work, the edge of the existing surfacing along the joint shall be neatly cut away in straight lines over a sufficient width to ensure full specified thickness of new surfacing being placed and the exposed edge in the existing work shall be painted with hot bitumen immediately in advance of placing the new work.

If, for any reason, the pavers should drift away from adjacent lane during construction, the unfilled, space so made shall be carefully filled with fresh hot mixture obtained from the hopper of the pavers or from the truck. Stealing mixture from that already spread to fill up those areas will not be permitted.

In limited areas, where the use of mechanical spreading and finishing equipment is impractical, the mixture may be spread by hand. When hand spreading is permitted, the mixture shall be dumped on metal sheets outside the area and spread by means of hot rakes, using the back of the rake for distributing the material and reducing the amount of raking to a minimum in order to avoid segregation of the various sizes of aggregate in the mixture.

Any fresh mixture spread accidentally on the existing work at a joint shall be carefully removed by brooming it back with a stiff broom on to non-compacted work, so as to avoid formation of irregularities at the joint. The finish at joints shall comply with the surface requirements and shall present the same uniformity of finish, texture and density as other sections of the work.

While the surface is being compacted and finished, the Contractor shall carefully trim the outside edge of the pavement to proper alignment. The edge so formed shall be leveled while still hot with the back of a rake or by other suitable equipment.

Any defects in the surfacing work, caused by faulty workmanship, shall be corrected and made good by the Contractor at his own expense and to the satisfaction of the Supervising Engineer. Care shall be exercised at starting and stopping of the pavers to prevent the formation of humps and depressions. The finished surface shall conform to surface requirements hereinafter specified.

Compaction

In conjunction with this article please see comments regarding the weight of the equipment on Article 1.2-Considerations

Immediately after the spreading by a mechanical spreader, the mixture shall be rolled with smooth steel-wheeled roller, and/or a tandem vibrating roller. Final rolling shall be carried out by pneumatic tired roller. All rolling shall be longitudinal and shall commence at the outer edges of the road, overlapping the shoulders, and progress towards the center of the road except that on super-elevated curves, rolling may progress from the lower to the higher edge.

The roller shall be driven so that the driven wheels are closest to the spreader and all steering shall be carried out when on compacted materials. Rolling shall continue until the surface is of uniform texture and density, free from roller wheel marks, and true to grade and cross-section. Rolling speed should be about 3 km per hour. The roller wheels shall be clean and smooth and to prevent adhesion of the mix the wheels shall be kept moistened with water, but an excess of water will not be permitted.

At all places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers. Hand tampers shall weigh not less than 12 kg and shall have a tamping face of not more than 0,003 m².

Any mixture, which does not comply with this Specification, or is in any way defective, shall be removed and replaced with fresh hot mix which shall be immediately compacted to conform to the surrounding area, all at the Contractor's expense. Skin patching on a rolled area will not be allowed.

The degree of compaction of the compacted layer shall be minimum 97% for binder course layer and 98% for wearing course layer of the maximum laboratory density as determined during the Marshall test.

Dimensional tolerances

The finished surface of the premix wearing course shall be true to line, grade and cross-section and when tested with a 3 m long straight edge applied parallel to the center line of the road and with a crown template or camber board conforming to specified cross-section and applied at right-angles to the center line of the road, the variation of the surface from each testing edge, between any two contacts with the surface shall at no point exceed 4 mm. Any irregularities exceeding such specified tolerance shall be suitable corrected by the Contractor at his own expense until these requirements are met. Corrective work shall be carried out in such a manner as to blend in color, texture and finish

with adjacent work and the minimum compacted thickness shall always be that specified.

The thickness of a course shall nowhere be less than specified. Any additional material used in regulating the previous layer will not be measured or paid for, notwithstanding the tolerances allowed in this Specification.

The completed surfacing shall nowhere deviate from the specified edge by more than 10 mm.

4.11. PAINT AND COATINGS

The purpose of coating is to protect, preserve, or visually enhance the surface to which it shall be applied. All material to receive paint or other coating shall be properly prepared and primed to ensure adhesion of the coating to their surfaces and maximize the life of the coating. In general, surfaces shall be dry and free of contaminants, such as dirt, grease, moisture, and mildew. Ferrous metal surfaces shall be free of rust, metal burrs, and foreign matter. The surfaces shall be cleaned with appropriate solvents or by wire brushing, sandblasting, flame cleaning, or pickling with acids. Priming shall be with rust-inhibitive primer.

Water emulsion lime-based paint shall be used for the painting of the concrete parapet walls – white colour. The concrete kerbs shall be painted with highly durable water borne acrylic kerb paint. Black and white stripes

4.12. ANNEX - STRUCTURAL METAL WORKS

If structural metal works are requested within this Contract, they have to follow the technical specification below.

The works include fabrication, supply and delivery of steel structures as over-all structure incl. platforms, walkways/galleries, stairs, landings and support for components or mechanical equipment with bolted connections incl. all fabrication and erection materials.

4.12.1. Reference standards

EN 10021	Steel and iron products, General technical conditions for supply
EN 10025:2004	Structural steel standard
EN 10219	Cold formed welded structural hollow sections
EN 25817:1993	Arc-welded joints in steel — Guidance on quality levels for imperfections
EN 287-1	Qualification test of welders. Fusion welding. Steels
EN 288-2	Specification and approval of welding procedures for metallic materials. Welding procedures specification for arc welding
EN 12062	Non-destructive examinations of welds - General rules for metallic materials
EN 970	Non-destructive examination of fusion welds - Visual examination
EN 12944	Paints and varnishes — Corrosion protection of steel structures by protective paint systems
ISO 4016	Bolts with hexagonal heads partially threaded type
ISO 4033	Hexagonal nuts type A and B.

4.12.2. Materials

Structural design has to be performed according to Eurocode 3 standards for steel structures. The steel classification shall be structural steel S235 or Fe360, according to Eurocode 3. Materials shall conform to EN 10219 and all materials used shall have a quality certificate issued by the Manufacturer regarding chemical content, characteristics and mechanical tests according to the standards in force. The Contractor shall produce all necessary shop drawings showing all construction details and produce method statement of the steel structure for the approval of the Supervisor.

4.12.3. Welding

The Contractor shall produce shop drawings showing in detail the elements of trusses which shall be welded. The shop drawings shall be drawn in due consideration of designers instructions and details shown on the drawings. The Contractor shall provide guidelines for welding complying with the specifications EN 288-2 for all trusses elements.

Technical Documentation by the Manufacturer

Such guidelines shall be submitted to the Supervisor for his approval prior to start the assembling of the truss. The Contractor shall be required to provide the Supervisor the following documents in addition to welding guidelines:

- material certificates: conformity of material with the mill documents, marking,
- identification (e.g. heat number, grade)
- material preparation and processing;
- welding technology including remediation of defects;
- welders list and their qualification certificates
- assembling technology of the elements: preparation, tracing, assembling order, equipment and working devices;
- programme for quality control;

- indications regarding pre-assembling in the factory, storage, marking and assembling for transport, as well as loading schemes in transport devices.

Consumables

Welding consumables shall comply with the applicable EN standards and the Contractor shall provide quality certificates from the Manufacturer. The type of consumables shall be determined by the Manufacturer of the steel structure, depending on the selected method of welding. The Contractor shall store the welding materials in a secure and dry place, as recommended by the manufacturer. The welding defects beyond admissible tolerances shall not be accepted and re-welding shall not be permissible.

Welder's Qualification

Only experienced and qualified welders with valid test certificated according To EN 287 -1 can be engaged on the job

Welding Edges

The welding edges can be prepared by milling or by flame-cutting and subsequent manual grinding. In all cases, welding edges shall be free of contamination, such as rust, paint, grease, moisture, etc.

Arc strikes, weld spatters, notches

Ignition of the electrodes shall only take place in the welding grooves. Arc strikes occurring outside of the weld seam shall be carefully grounded. Welding beads on and beside the weld seam are not permitted. Spatters have to be removed properly. This requirement shall also be observed with regard to the surface preparation for a proper anti-corrosive treatment. Notches according to the definition of EN 25817 – C shall be removed – as far as necessary – in a workmanlike manner, preferably by grinding, in special cases by re-welding.

Welded Joints Quality Requirements

Irrespective of the type and form of the welded seams, their quality will be 100% checked dimensionally, visually according to EN 970. Non-destructive test on the welded joints shall be performed according EN 12062. The weld quality shall be evaluated according to EN 25817 criteria, quality group C for all welds. Unaccepted welding seams shall be repaired. The repaired area shall be 100% tested according to the original test method. The welding on site shall be done and supervised permanently by a qualified welding engineer and foreman supervising the assembly line. The Contractor shall engage experienced and qualified welders. The Contractor shall be required to demonstrate that the welders engaged have sufficient working experience for the construction of trusses of rather significant height, requiring special expertise.

4.12.4. Site erection

Before site erection, quality of all components to be assembled shall be checked. The erection shall be executed according to the execution drawings, prepared by the Contractor. The Contractor shall submit the method statement in which he shall provide the following information:

- Measures regarding storage and transport to the site of the construction elements;
- Organization of the pre-assembling platforms on site, specification of the transport and lifting devices being used;
- Size checking used to obtain the enforceable (applicable) fixing tolerances;
- Preparation and execution of the welded (site welding) and bolted joints;
- Checking of the elevations and levels specified in the design for the assembled structure;
- Sequence of components erection;
- Support methods ensuring the stability of the elements during intermediate erection stages;

- Welding technology based on welding procedures;
- Schedule for quality control and taking-over of the supplies, erection and anticorrosive protection
- Health and safety methodology
- Measures to be adopted to safeguard the workers and the property at site during the erection works.

The Contractor shall take all precautionary measures not to damage any component of superstructure during loading, transport, unloading, storage and erection. The damaged or deformed parts shall not be incorporated into permanent works. The Contractor shall use appropriate and safe technology for handling and lifting during erection of the components of the trusses and roofing elements. The Contractor shall, at his own expense, hire a specialist consultant who shall guide its workmen during the assembling and installation of trusses, wall and roof panels at site.

4.12.5. Anchoring and bolting

The anchors shall be made of steel S235. The anchor threads shall be acc. to DIN 931 for regular bolts or DIN 6914 for High Strength bolts.

The following standards shall apply as far as fasteners are concerned:

DIN 934 for hexagonal nuts, and washers

DIN 125 for regular bolts

DIN 6915 and DIN 6916 for High Strength structural bolting

The size and type of the anchors, nuts and washers shall be shown on the shop drawings.

All the drilling works for bolts shall be done once welding works are completed.

4.12.6. Corrosion protection

The corrosion protection works shall be carried only by qualified specialized companies equipped with appropriate equipment in order to ensure the acceptable workmanship of high quality. The primary steel structure shall be treated with corrosion protection according EN1294.

Prior to corrosion protection application all surfaces shall be sandblasted and adequately prepared, degree of preparation SA 21/2 acc. to EN12944-3, before application of the first paint layer. The steel structure shall be painted with an anti-corrosion primer layer and with two finishing layers. Primer and finishing layers of paint shall be in two different colors for better distinction. Nontoxic paints shall be used throughout the construction works.

The protective paints shall not contain any lead and must be approved by the Supervising Engineer. The protective paints shall uniformly and continuously be applied on all surfaces. The technology to apply the primer and the paint or the fire protection paint shall be according to the Manufacturer's instructions. Any deterioration of the protective primer during transport or storage shall be remedied at the storage location. For this, an additional quantity of protective primer shall be supplied together with the sub-assemblies (accessories).

The corrosion protection shall provide a time to first maintenance of 20 years in normal conditions.