# VOLUME 3

# TECHNICAL SPECIFICATIONS

**I. Subject of the Public Procurement**

The subject of the Public Procurement of Works is – **Project for Improving (heavy maintenance) state road I B category, No. 12 Matije Gupca Street in Sombor performance section: City of Sombor from km 54+963.24 to km 56+622.87 , L=1,66 km,** according to work items cited in enclosed technical description, technical conditions and Bill of Quantities.

II TYPE AND DESCRIPTION OF WORKS, TIME FOR COMPLETION AND TECHNICAL CONDITIONS

The Contractor shall be obliged to execute works on improving **(**heavy maintenancewith putting up temporary and permanent traffic signalization) of **Improving (heavy maintenance) state road I B category, No. 12 Matije Gupca Street in Sombor performance section: City of Sombor from km 54+963.24 to km 56+622.87 , L=1,66 km** in line with technical documentation, technical conditions and Specifications which are an integral part of this Terms of Reference and chapter the Tender Documents. Offered deadline for completion of works must not exceed 6 months from the signing the contract by both parties. The Contractor enters Deadline for execution of works in the Bid Form. The Contractor who submits the Bid shall be deemed to have visited the site and got acquainted with all conditions necessary for preparation of acceptable Bid.

**II.1 SPECIFICATIONS, TYPE AND DESCRIPTION OF WORKS**

1. GENERAL PROVISIONS

Introduction

Sombor is an urban settlement in the County of Western Bačka. The inner town has 51,471 inhabitants according to the 2002 census, and the whole town has 97,263 inhabitants.

Sombor is the administrative center of the Western Bačka County, which includes the municipalities of Apatin, Odžaci and Kula, with a total of 215,916 inhabitants.

The Municipality of Sombor is well connected by the roads of the first and second classes that go from the direction of Bački Breg - M18, Subotica - M17.1, Novi Sad - M18.

Sombor is 175 km away from Belgrade, and 220 km away from Budapest.

Within Sombor Municipality, there are 15 villages: Bezdan, Bački Breg, Bački Monoštor, Aleksa Šantić, Čonoplja, Dorosovo, Gakovo, Kljajićevo, Kolut, Rastina, Riđica, Stanišić, Svetozar Miletić, Stapar and Telečka.

Cross-border connections

Within the EU Project No.EuropeAid/131050/D/SER/RS (Building and Planning Cross border road between Num.51 road Baja part1.- Zombor ), the City of Sombor has, based on the consent given by the PE Roads of Serbia, begun preparation of the project documentation for heavy maintenance. With regard to border crossing SRB/HU in Bački Breg, traffic should be taken into account in relation to development of settlements in the neighbouring country, Hungary (Szantoi, Davod, Nagybaracska, Batmonostor, Baja, Szekszárd and Budapest).

Legal basis for preparation of the Project on Heavy Road Maintenance is the Law on Public Roads, Article 59, Periodical MaintenanceWorks (Official gazette RS No. 101/2005)

Short description of the Project

By this Project the works on improving **(heavy** maintenance) of **state road I B category, No. 12 Matije Gupca Street in Sombor performance section: City of Sombor from km 54+963.24 to km 56+622.87 , L=1,66 km** The works shall include improvement of the existing carriageway and construction of new carriageway based on relevant traffic load so that this carriageway may bear forecasted axle load of at least 11.5 t per axle.

For Matije Gupca Street in Sombor, the designed roadway width should be 7.20 m and the designed speed of the road 50 km/h. Shoulders of 1.20 m in width should be included on the given sections.

The design solution has to be produced within the existing road beltway.

CONSTRUCTION SITE LOCATION

This section of state road I B category, No. 12 Matije Gupca Street state road is located in the City of Sombor.

Existing condition on the site

Based on the terms of reference, performed surveying of morphological characteristics and insight into the situation on the field, the final design for enhanced road maintenance in Matije Gupca Street in Sombor was developed.

The given section is a continuation of the first-class state road Bezdan - Sombor at km 54+963.24 in the construction area (town area) of the town of Sombor. The width of the existing road is 6.00 m to 7.20.

The route is characterised by a large number of road connectors and crossroads of primary and secondary city networks.

* At km 0 + 108.00 on the right in the direction of the widening of the portion of the road, Tome Roksandića Street is connected
* At km 0 + 160.00 on the left in the direction of the widening of the portion of the road, Solunskih Boraca Street is connected, which is a town road with a width of 6.50 m with a closed system for collecting surface water,
* At km 0 + 410.00 on the right in the direction of the widening of the portion of the road, Dušan Mudraka Street is connected,
* At km 0 + 625.00 on the left in the direction of the widening of the portion of the road Janka Veselinovića Street is connected,
* At km 0 + 610.00 on the right in the direction of the widening of the portion of the road, Sime Šolaje Street is connected,
* At km 0 + 835.00 on the right in the direction of the widening of the portion of the road, Isidora Sekulić Street is connected
* At km 0 + 885.00 on the left in the direction of the widening of the portion of the road, Nike Maksimovića Street is connected,
* At km 0 + 990.00 on the left in the direction of the widening of the portion of the road, 8.Marta Street is connected and on the right Josićki put (road),
* At km 1 + 108.00 on the right in the direction of the widening of the portion of the road, Naserova Street is connected,
* At km 1 + 306.00 on the left in the direction of the widening of the portion of the road, Toze Markovića Street is connected, from which the road Matija Gupca gets a closed storm sewage system,
* At km 1 + 517.00 on the right in the direction of the widening of the portion of the road, Uroša Predića Street is connected,
* At km 1 + 536.00 on the left in the direction of the widening of the portion of the road, Rade Končara Street is connected,
* The end of the section is a semaphored intersection on the Apatin road.

**DESIGNING**

**Components of the Situation Plan**

The designed roadway is positioned and levelled in line with the existing roadway. On both sides of the road there are stabilised shoulders 1.2m wide with a 7% inclination.

The existing road is about 6.0 meters wide and its tread surface is in a rather poor condition. Therefore, it is planned to "cover" the existing road with a layer of asphalt concrete 4.0 cm thick, and its extension to 7.20 m.

It is anticipated to have it coated with a new layer of asphalt with pre-scraping at the places where it is necessary, as well as with the production of suitable brick layers in order to obtain the appropriate levelling ratios of the final layer of the road.

The existing roadway shall be extended symmetrically on both sides for about 60cm. At the extension points, the road structure with corresponding layers of crushed stone and two asphalt layers is applied.

Approximately, on the last 350m of the route, the installation of the new pavement on the right side of the roadway (instead of the existing one) is planned, since the roadway extension is also carried out on that section. In this part, it is also planned to move the existing drains to the edge of the new pavement.

SCOPE OF WORKS

Works include items of works specified in enclosed Bill of Quantities. The works shall be executed under traffic. The Contractor shall pay special attention to maintenance of adequate level of safety for all traffic participants.

REQUIRED MATERIAL QUALITY

The quality of material used by the Contractor for fulfillment of contracted works has to be compliant with the requirements provided for in these Specifications. The Contractor is free to use also other materials with the characteristics meeting the prescribed requirements regarding the quality, provided that these actions do not increase the contracted value of works. Characteristics of these materials need to be verified by an accredited laboratory, and their application approved by the Supervisory Authority. Under no circumstances shall the Contractor issue a request for compensation due to the unsatisfactory quality of incorporated materials, even if this incorporated material has been approved by the Supervisory Authority. The Contractor performs, at their own expense, necessary field, laboratory and other tests in order to confirm that the incorporated material meets the Technical Conditions and Specifications, and keeps the evidence of these tests. The Contractor shall deliver one copy of report on laboratory and other tests to the Supervisory Authority. The Contractor shall obtain adequate attestations on quality not older than six months from the date of incorporation for all the materials purchased and incorporated according to the requirements prescribed under the work items.

MEASUREMENT OF QAULITY OF WORKS COMPLETED

Works with the measurement unit m1 (payment per meter): Measurement shall be exercised in the field by means of tape, cyclometer or metal ruler with centimeter division, depending on measured length. Also, for measurement of grater lengths geodetic instruments may be used. The measurement shall be exercised in a presence of the Supervisory Authority. The Record on performed measuring shall be prepared, containing also adequate sketch, and shall be verified by the Supervisory Authority.

Works with the measurement unit m2 (payment per square meter): Measurement shall be exercised in the field by means of geodetic instrument, tape or metal ruler with centimeter division marked on its edges and diameters of surface in question, the sketch in adequate scale shall be formed and surface calculation shall be performed. The measurement shall be exercised in the presence of the Supervisory Authority. The Record on performed measuring shall be prepared, containing also adequate sketch (if applicable), and shall be verified by the Supervisory Authority. Works with the measurement unit m3 (payment per cubic meter): For work items where this is feasible, the measurement of volume shall be exercised by the geodetic instrument. In case of regular or nearly regular geometric shapes, three dimensions shall be measured in a manner prescribed within „The works with measurement unit m1 (payment per meter)“, and based on these measures the volume shall be calculated. Measuring and preparation of the Record shall be exercised in the presence of the Supervisory Authority. The Record shall be verified by the Supervisory Authority.

Works with the measurement unit of piece (payment per piece): For works paid per piece, the joint review of works executed shall be performed and quantity defined through counting which shall be noted in the Record. The Record shall be signed by the Contractor and Supervisory Authority.

Works with the measurement unit of ton (payment per ton): For these works, first of all the volume which should be fulfilled by the material in one of the ways described under „ Works with the measurement unit m³ (payment per cubic meter)“ shall be defined. The quantity of incorporated material expressed in tons shall be calculated as a sum (by multiplication) of the measured volume and volume density of incorporated material. Unless otherwise determined by the Supervisory Authority, the volume density of the incorporated material shall be defined in a laboratory based on the sample taken from the section under works for which the calculation is performed. The Record (with copy of laboratory report, if necessary) shall be prepared and verified by the Supervisory Authority.

TRAFFIC SAFETY

The Contractor is obliged to proceed in accordance with applicable laws and regulations in the field of road traffic safety during the execution of works.

Prior to possession of site, the Contracting Authority provides the following permits and approvals:

−Decision on temporary traffic regulation on section under construction provided by the competent ministry.

The works on the section shall not commence before the competent authorities and Supervisory Authority make sure that the applicable regulations are complied with. The Contractor shall, in accordance with the Project on temporary traffic regulation which constitutes an integral part of design document, perform setting of required road markings and traffic signs and signalization for adequate direction of traffic during the execution of works which are the subject of this Public Procurement. The Contractor shall take all necessary measures for directing day and night.

In addition, the Contractor shall:

−take care of safety of every person, whether they are entitled to be on the site or not, and maintain the construction site in such a state so that any kind of possible danger is evaded;

− maintain and/or replace, at their own expense, lighting, barriers and warning signs (limits, announcements) in order to protect the Works or safety of traffic and people wherever and whenever necessary or required by the Supervisory body.

The Contractor shall keep the traffic signs, road markings, lighting, barriers and signalization for traffic control clean and readable at all times, and shall perform their installation, relocation and removal depending on the progress of works.

Upon completion of works, the Contractor shall move from the construction site all temporary traffic signage and equipment in order to enable safe and unhindered traffic flow.

* 1. ENVIRONMENTAL PROTECTION

In course of execution of works the Contractor shall protect the environment and respect the existing applicable laws and regulations in a part regarding the environmental protection, as well as the following laws:

−Occupational Safety and Health Law ("Off. Gazette of RS", No. 101/2005); page 7 of 76 FM 740.07.1 Tender Documents in an Open Procedure - Public Procurement No. 48/2017

−Law on Environmental Protection ("Off. Gazette of RS", Nos. 135/2004, 36/2009, 36/2009 – st. law, 72/2009 - st. law and 43/2011 - decision of CC), provisions regulating protection of air, natural resources and noise;

− Law on Integrated Prevention and Control of Environmental Pollution, " Off. Gazette of RS", No. 135/04;

−Law on Environmental Protection, ("Off. Gazette of RS", Nos. 135/04., 36/2009, 36/2009 – st. law, 72/2009 - st. law and 43/2011 - decision of CC)

The Contractor shall obtain every environmental approval for temporary works in accordance with the applicable laws of the Republic of Serbia. Such permits and approvals relate, but not merely, to:

−locations of borrow pits,

−locations of plants for material processing,

−method of collection and disposal of wastewater, oil and other liquids,

−fuel supply, its storage and type of fuel used.

The Contractor shall take all necessary measures in order to mitigate emission and spreading of dust, gasses, noise and the like, by spraying water on access roads without hard road surface, on dusty roads with hard road surface, places with accumulated aggregate and the like, by adjusting and usage of filters and other devices, as well as by carrying out general care and control.

The Contractor shall be responsible for locating and organization of their borrow pits, and they shall at their own expense bring every borrow pit from which earth, sand, gravel and stone material are taken to its original state, as well as avoid leaving an open face side of side cut impossible to get subsequently greened. All side waste shall be removed and put away, whilst every stone mound shall be cleaned, consolidated, leveled-off and covered by earth, followed by planting the grass. Waste shall be removed to locations proposed by the Contractor and approved by the Supervisory Authority. Final bringing into original state, top soiling and grassing of damaged surfaces shall be performed by the Contractor upon approval of the Supervisory Authority.

Permits and approvals for the disposal of waste material to public landfills shall be obtained by the Contractor at their own expense. Proposed unit and total prices for all work items shall be based on costs of executed works of required quality, and they shall include compensation for carrying out all safety measures and required measures for environmental protection.

OCCUPATIONAL HEALTH ANDSAFETY PROTECTION

The Contractor shall appoint a person for prevention of accidents and take all necessary measures for health and safety protection of all the employees executing the works, as well as all the other persons on the construction site or otherwise affected by the works, including:

− Provision of mechanization and its maintenance in order to keep it safe and not hazardous to human health, to the necessary extent;

− Procedures which shall ensure, to the necessary extent, safety of human health when using, handling and storing, or transporting, products and materials;

− Procurement of such protective clothing and equipment (such as helmets, clothing with reflective marks, boots), first aid, medical and health services, information, manuals, training and supervision as needed and to the extent necessary for insurance of healthy and safe conditions for workers;

−Maintenance of all locations on the construction site in a safe condition, without any risk to health, as well as maintenance of safe and risk-free accesses to and exits from these locations.

The Contractor shall provide premises for maintenance of personal hygiene, intended for all the employees, in such a way, number and locations adjusted to legislation and other regulations which shall be entirely approved by the supervision body.

The Contractor shall maintain all such premises in hygienically satisfying condition, and upon completion of works these premises shall be removed, and construction site shall be brought to its original state. The Contractor shall immediately send out from the construction site every employee found to create disturbance on the site or surrounding terrain without employing him/her again without prior approval of the supervisory body.

RESPONSIBILITY FOR ROUTINE ROAD MAINTENANCE

The Contractor shall be deemed responsible for routine maintenance of road which constitutes a part of the construction site. In case of traffic accident on this road part, the Contractor shall be obliged to repair all defects as instructed by the supervisory body.

Winter maintenance of the existing road sections occupied for the purpose of construction shall remain an obligation of the local road maintenance division of the PE „Roads of Serbia“, and the Contractor shall enable and approve performance of these works.

At the beginning of winter, the Contractor shall bring the works to such a state which ensures safe traffic flow during the winter period. In case they do not act accordingly, the Contractor shall be deemed obliged upon request to promptly repair all the damages without any right to compensation. Roads, access and priority roads used for site traffic shall be maintained and clean, free from dirt, mud and material residues fallen out of the vehicle or off the vehicle tires. The Contractor shall be deemed responsible for preservation of road equipment or signs, or for their replacement. The Contractor shall not be entitled to compensation for performance of obligations specified under this point of General Conditions.

DISLOCATION AND PROTECTION OF INSTALLATIONS

Works on construction, dislocation and protection of installation are not the subject of this Public Procurement. On the basis of obtained pre-project conditions of the holder of the public authorizations, the Synchron plan has been prepared as an integral part of this technical documentation. The Contractor shall be deemed obliged to establish the existence and accurate position of all installation types prior to commencement of works, and to inform the competent institutions thereof. Works on dislocation and/or protection of installations of various infrastructural systems shall be executed by the specialized companies, and in accordance with the specific design documentation and technical conditions and standards applicable to this type of works. This specific documentation needs to be prepared before commencement of works on heavy maintenance of carriageway of the road section in question. Whenever the Contractor encounters, during the execution of works, installations which are not shown in plans provided by the company that owns them, and which need to be relocated or protected, they shall immediately inform the supervisory body thereof. In case of existence of installations that do not need to be relocated, the Contractor shall protect these installations while carrying out the works in their vicinity with approval of owner of installations and supervisory body. The Contractor shall, in case they damage pipeline, cables and other installations on the site, inform the owners and promptly organize execution of all necessary repairs at their own expense.

APPOINTED MANUFACTURERS

When Specifications mention name of a manufacturer regarding certain product or material, it is for the purposes of providing a prominent example from the aspect of required standard for that product or material. The manufacturer mentioned in Specification in this manner shall not be deemed appointed manufacturer. The Contractor may suggest and base their prices on procurement from other manufacturer, provided that they are able to prove that item subjected to procurement assumes the equivalent product or material.

RELATION TO REGULATIONS AND STANDARDS

Whenever the Contract specifies certain standards and regulations which need to be met when procuring goods or material for the purpose of execution of works and incorporation in works, as well as when performing and testing the quality of works executed, the provisions of the last edition or the latest revision of these standards and regulations are applicable, unless otherwise explicitly provided for in the Contract.

* **Axis**

The axis in the Situational Plan represents the rectified existing axis of the road which is shown in the following numerical appendix:









* **Side roads and road connectors**

All road connectors have been reconstructed and connected to the given road in the existing recorded widths. The existing canal network cannot be established continuously due to pedestrian paths, high vegetation, lighting poles, low voltage and high voltage networks as well as pillars of Telecom, so it is foreseen that their cleaning and profiling should be carried out wherever possible.

Connection roads have been processed in the zone of turning radii.

* **Marking**

All axle components in the situational plan are defined in the table and on the axis itself.

The widths of the functional elements in the situational plan are dimensioned as well as the turning radii. Each intersection and road connector are marked with a set of points with the description of ER (edge of the roadway), the list of which is given in the numerical annexes of this technical report.

* 1. **Elements of longitudinal profiles**
* **Reference level in the longitudinal profile**

Reference level in the longitudinal profile has been designed in the function of fitting into existing and planned levelling ratios.

The minimum longitudinal slope of the level was reached from minIn = 0.00%, and max maxln = 0.53%.

The radii of the vertical curvature of the reference level have been used in the range of Rv = 1000m to Rv = 10000m.

Reference level in the longitudinal profile is in the function of defined measures of rehabilitation with minimal values of levelling and scraping.

At the sites of the facilities, the reference level of the road meets the conditions for rehabilitation of the roadway in line with homogeneous moves. The attachment of the longitudinal profile is enclosed with the Situational Plan. Within the longitudinal profile, a warping diagram is also shown along with the data on the reference level, terrain, intersection and facility locations.

* 1. **Regular cross-sectional profiles and details**

Regular cross-sectional profiles are a standard solution that explicitly displays all functional and constructive elements of the road.

Regular cross-sectional profiles show the situation according to:

• Homogeneous rehabilitation measures according to the road structure design,

• Geometry of the road, that is, according to the cross-sectional slope of the roadway in the direction or curve

All cross-sectional profiles explicitly show rehabilitation measures in the case of a levelling layer or scraping as well as their thickness, manner of making edge strips and shoulders, absorbing ditches of road connectors and piping under the road connectors.

The cross-sectional profile of the existing roadway is roof-like. The solution for the rehabilitation of the roadway in the cross-sectional profile involves retention of the roof-like tilt of the roadway of a minimum value in the direction of 2.00% and a symmetrical extension for the value of edge strip of 30.00cm. The warping of the roof-like roadway is shown in the warping diagram within the longitudinal profile.

* 1. **Typical and critical cross-sectional profiles**

The typical and critical cross-sectional profiles are set at a minimum distance of 25.00 m, and the characteristic points of the horizontal geometry of the road, the beginning and the end of the midpoint of the circular curve, as well as the characteristic points on the route, in the zones of larger intersections, at the beginning, in the middle and the end of the road facility.

The points of the roadway extension in the curves are marked as well as the points of intersection and matching them to the existing situation, the places of facilities and other infrastructural systems, such as the railways, road connectors and the piping according to the details from the regular cross-sectional profiles.

In addition to typical and critical cross-sectional profiles, the following tabular work bill of quantities for items that can be calculated through cross-sectional profiles are also defined:

* Levelling layer,
* Scraping,
* Excavation,
* Embankment,
* Excavation of absorbing ditches.
  1. **Drainage**

**DRAINAGE**

Transversal inclination of the roadway meets the conditions for drainage, Iproadway = 2.0%.

Solving the problem of collecting surface water from the roadway and other road elements is a very complex process in urban areas that requires a special design solution beyond the boundaries of the road belt, looking at the wider system area of, which, I hereby emphasise, cannot be the subject of enhanced road maintenance.

The designer kept the existing drainage system, i.e., they envisaged possible adjustment of the position of the drains to the new widths of the roadway in the sections of a closed system, and in the places of open trenches, the purification and profiling were planned.

* 1. **Road structure**

The road structure is a special book of technical documentation for enhanced maintenance, where all three designed sections are integrated into the framework of a single contract.

**ROAD STRUCTURE**

According to the terms and conditions from the terms of reference for "overhauling" the existing roadway, the following road structure was adopted:

• existing roadway (with scraping and overlaying with BNS layer if necessary - in order to obtain appropriate levelling ratios)

• Asphalt layer of AB 11s 4.0cm

The roadway extension structure consists of the following layers:

• 30.0 cm of crushed stone 0-63 mm

• 20.0 cm of crushed stone 0-31.5 mm

• 6.0 cm upper bituminous support layer BNS 22A

• 4.0 cm wearing layer of asphalt concrete AB 11s

The conditions on the extensions as well as the conditions for making the levelling layer depending on the thickness have been defined.

* 1. **Bill of quantities and work pro forma invoice**

**BILL OF QUANTITIES AND WORK PRO FORMA INVOICE**

All the necessary works on the implementation of the complete road design are covered by the bill of quantities and the work pro forma invoice. The cost of carrying out works was from the market, calculated roughly at the time of the design development.

The amount of works on the given section and the individual and total price of construction works carried out have been defined by the bill of quantities and the work pro forma invoice.

The quantities presented in the bill of quantities have been obtained on the basis of the areas and length calculated by AutoCAD from the Situational Plan, by collecting data based on the geodetic situation as well as from the table work bill of quantities.

The designer emphasises that the prices used in the preparation of the bill of quantities do not have to match the prices of the potential contractor.

During the development of the design, the designer complied with the existing regulations and standards, as well as all geodetic substrates and design data which are listed as follows:

* Terms of reference of the Investor,
* Geodetic substrates,
* Agreements with Investor and Road Manager,
* Applicable technical regulations and standards for designing this kind of documentation that are maintained in the company through ISO 9001 - 2008 documentation.

**2. PREPARATORY WORKS**

**2.01 STAKING OUT AND MARKING OF THE ROAD ROUTE, STRUCTURE AND FACILITY**

***Work description***

The road axis marking should include all measurements with the aim of transferring data from the design to the field, as well as ensuring, restoring and maintaining points established on site during the whole construction period, or until submission of the works to the Investor.

***Handover of the road axis and acceptance***

The investor will hand over to the Contractor the main traverse and benchmarks (landmarks) with all necessary data in the form of drawings, sketches, tables etc. The handover and acceptance of data on the main traverse and benchmarks should be in writing, signed by the representatives of the Investor and the Contractor. During the road axis handover, the Investor shall submit to the Contractor the following drawings:

• Situation plan, the scale 1: 1000 (1: 2000 or similar), with the indicated axis of the road. The links of all major axis marks with the main traverse should be drawn up, including all the necessary data for the staking out;

• Calculation of basic labels, or in the case of an electronic calculations, the coordinates of the basic labels and insurance points, including chainage and the curve coordinates;

• List of traverse points and vertex coordinates, including topographic points;

• List of height marks, slopes, including inclination of the terrain;

• Drawings of traverse and trigonometric points.

***Control during performance***

The contractor will regularly control the surveyed axis of the road, road profiles, benchmarks (landmarks) and traverse points. The Contractor will restore any destroyed or damaged mark at his own expense. The supervisory authority will control the accuracy of the renewed labels.

***Handover and acceptance upon the completed work***

The Contractor will restore the axis of the road, the chainages, the traverse points and the benchmarks at the request of the Investor, after completing all the works on the road and hand it over to the Investor before the technical acceptance. The prescribed acceptance / handover record should exist. The investor is authorised to request a level book on the new road route during the technical acceptance.

***Measurement and payment***

The quantity, according to the above description, will be paid at the aggregate price per length meter, including axis insurance, maintenance and renewal of the axis and other markings required for quality works, as well as all material and transport. The total price for marking includes all necessary measurements for all access roads, axes crossing with the main direction, all elements defined in the marking plan, during works and technical acceptance.

**2.02 MAINTENANCE OF TRAFFIC DURING THE EXECUTION OF WORKS**

If it is necessary to regulate public transport during the execution of works, it is necessary to draw up a work signalling plan, for which the approval of the competent authorities should be obtained. The signalling system should be installed according to the plan.

Calculation of works is done on the basis of all costs of installation, assembly and disassembly of signs and maintenance during the execution of works. The price includes 20% of the value of the purchase of signs.

**2.03 DEMOLITION OF THE ASPHALT ROADWAY**

Existing roadways of all kinds, which according to the project should be removed, shall be demolished with the machine along with the substrate of average thickness d = 25-40 cm and of various composition. The material obtained by demolition of the existing roadway, should be loaded into the means of transport, transported to the landfill designated by the inspection body, unloaded and chopped, or preferably use for the construction of the embankments.

Calculation of completed works is done per square meter of ruined demolished roadway for all work, material and transport, and according to the above description.

**2.04 DEMOLITION OF EXISTING PAVEMENTS**

Existing pavements, regardless of the type, which according to the design should be removed, shall be demolished manually together with a concrete base under the pavement. The demolished pavements should be cleaned from the concrete and mortar, loaded into the vehicle, transported to the landfills, arranged to form proper shapes and figures. The debris produced during the demolition of the pavement should also be loaded into the vehicle and transported to a landfill whose location will be determined by the supervisory authority, disposed of and deposited throughout the landfill.

If the ruined pavements can be reused, they should be deposited in the place of new installation.

The calculation of the performed works is done per length meter of the removed pavement, for all work, material and transport, and according to the above description.

**2.05 PREPARATION OF WORKING CONNECTORS FOR CONTINUING WITH THE ASPHALT WORKS**

In the areas where the existing asphalt roadway, according to the design, is expanded or continued, a stepwise asphalt pavement indentation (d = 6-10cm) should be made with an air pressure hammer with a digging blade or a circular cutter. The cutting line on the surface of the pavement should be right. The indentation degrees by height are at the level of height of the laid-out layers, with a horizontal stroke of about 10 cm for asphalt layers. The material obtained by demolition is to be loaded into a vehicle, transported to a landfill, or used on the construction site.

The calculation for the performed works is done per length meter of the prepared roadway for continuation, and according to the above description.

**2.06 SCRAPING OF THE EXISTING ASPHALT ROADWAY OF 3CM AVERAGE THICKNESS**

On the section of fitting of the roadway and on the section where the level is raised in relation to the existing roadway or at the places of the rutting distress, scraping of asphalt in layers of 3 cm thick should be performed. The scraped material should be taken to the place specified by the design or by the order of the supervisory authority. The calculation of the performed works is carried out per square meter of scraped surface, and the cost includes the removal of scraped material.

**2.07 ELEVATION REGULATION OF MANHOLE COVERS**

Existing sewage manholes not corresponding to the newly designed elevation with their height position, shall be fitted together with the appropriate elevation-lowering (10-20 cm) of the steel frame, with demolition and placement of the concrete pad under the frame. All material generated by this work is loaded into a vehicle, transported to a landfill according to the instructions of the supervisory authority, unloaded and deposited.

The calculation of performed works is done by piece of regulated manhole and drain, for all work and material, and according to the above description.

**2.08 SUMMER RECORDING**

Upon completion of construction works, the investor and the contractor are obliged to take a snapshot of the derived condition if there were significant changes in relation to the design solution. The calculation for the performed works is done per meter of the required route for which the project of the derived state was made.

**2.09 DEVELOPMENT OF THE SURVEY OF AS-BUILT SITUATION**

Upon completion of construction works, the Investor and the Contractor are obliged to conduct a survey of as-built situation if there were significant changes to the design solution. The calculation for the performed works is done per length meter of the required route for which the design of as-built situation was made.

**2.10 FELLING OF TREES**

On the stretch of land, which is included in the construction of the roadway, trees should be cut. Trees should be cut mechanically to a height of up to 80 cm. The cut tree should be carefully landed. Then branches should be trimmed, the timber classified and prepared for transport. The location of the deposit shall be determined in agreement with the supervisory authority. During works, measures of protection in order to avoid possible damage to adjacent facilities and property in general should be taken. The calculation of works is done by a piece of felled tree for all work, material and transport, and according to the above description and diameter of the trees.

***Removal of stumps and roots***

On this stretch of land included in the construction of the roadway, the removal of the stumps of the felled trees and those already there should be conducted. Removal of stumps is done mechanically. The obtained wood mass should be classified, loaded into the transport vehicle, transported to the landfill, the place of which will be determined by the supervisory authority. The calculation of the performed works is done according to the piece of removed stump for all work, material and transport, depending on the diameter of the stump, as described above.

**2.11 SEALING OF THE EXISTENT OF DRAINS**

Existing drains which, according to the design, will no longer be used shall be closed. The closure of the drains consists of the removal of the grid, the demolition of the concrete part to the required level, the concreting of the drainage and the filling of the cavity with sand. The drain grids should be transported by a vehicle to a place designated by the Supervisory Authority. The calculation of the performed works is done according to the number of sealed drains for all work and material, and according to the above description.

**3.01 HUMUS EXCAVATION**

***Description of works***

The work includes surface excavation of humus made at excavation site in bulk excavation on the route and in the gravel pit, as well as below the embankment, in the thickness planned by the design, the transport or pushing it mechanically into the landfill on the side in the belt of the road land and keeping of the humus. The average thickness of the removed humus is 20 cm. All work must be carried out in accordance with the design and these technical terms and conditions.

***Performance***

All excavated material should be deposited along the route beyond the surface of the subsoil, so that subsequent use and access to it is unhindered. Transporting or pushing the material into the landfill must be done carefully in order to preserve the quality of the excavated humus for later needs in the arrangement of the slopes and green surfaces, so that the material is not mixed with other non-humus material.

***Measurement and payment***

By signing the records on the handover of the route and forming the calculated cross-section profiles, as well as subsequent changes in them, the bill of quantities is considered definite. The thickness of the layer is not measured separately, but it is only controlled whether the work was done in the thickness anticipated by the design, or the change duly ordered by the Supervisory Authority. Payment is made per cubic meter (m³) of autochthon humus measured in accounting profiles. When the digging of humus beneath the embankment is greater or less than the projected depth, the excess or shortage of the excavated humus is calculated on the basis of the level record.

*3.02 EXCAVATION IN BULK EXCAVATION SITES*

***Description of works***

The work includes all bulk excavations, all types of soil materials provided by the design, together with the removal, i.e. pushing of the excavated material into the embankments, landfills for various needs according to purpose, the manner of usage of the material in the execution of works. These works include all excavations of side cuts, cut, roadway extensions, gravel pits, adjustment of watercourse, deviations of roads, and bulk excavations during the execution of the building.

***Performance***

All excavations should be performed according to the profiles, registered levels, slopes prescribed by the design, taking into account the required characteristics for the intended use of the excavated material, and according to these technical terms and conditions. The stopping outside the design (to smaller or larger extent) can be done only at the request of the Supervisory Authority. The costs for removing damages caused by the rock fell or digging outside the design, or the due order of the Supervisory Authority, shall be borne by the Contractor. Excavation should be carried out using appropriate machinery and other means depending on the type of soil. Mechanical pushing, i.e. loading of materials, and transportation to the place of use, or to the landfill with the unloading, should also be considered. All excavation material must be adapted to the requirements of the intended use according to the design and these technical terms and conditions. When performing the excavation, the necessary protective measures for complete safety at work and all necessary insurance of the existing facilities and communications should be implemented. Effective drainage must be enabled at every stage of work. Difficult performance of work due to the occurrence of water while digging will not be paid in particular. The slope inclinations in excavations should be calculated according to the design, or at the request of the Supervisory Authority. This work also requires the cleansing of all inappropriate places in earthworks, which require special protective security solutions, as a result of which the Contractor is not entitled to change the agreed unit prices. When carrying out the works, a special care should be taken not to cause undermining, disturbance of balance or damage to the excavation slopes foreseen by the design. In any such case, the Contractor is obliged to remediate after the instructions of the Supervisory Authority, but cannot demand any compensation or recognition of payment for additional or unforeseen work. In the case of the substructure over dig, any repair by returning and compacting the layer shall be prohibited. The road bed must be formed at the level of the over dig, drainage should be deepened if necessary, and the bottom surface should have increased thickness, while the surplus work caused by the over dig shall be borne by the Contractor. Before and during work, all changes in excavation or material quality should be sampled for testing the usability of the material for the purpose for which it will be used.

***Gravel pits and landfills***

According to the general conditions, the contractor provides the location for a gravel pit and landfill with all accompanying documents and consents. Prior to the start of the exploitation of the gravel pit, the Contractor is obliged to submit to the Supervisory Authority a proposal for exploitation of the gravel pit with all the necessary evidence of the quality of the material. Material proven to be unsuitable for the roadway construction must be removed. The contractor is obliged to form a landfill at his own expense. The landfills should be formed so that the terrain is not slipping, and upon completion of the works, they should be planned and arranged according to the request of the Supervisory Authority. For gravel pits and landfills put forward on the Contractor's proposal, all costs for repurchasing, damages, etc. and any related costs due to possible site modification shall be borne by the Contractor. The place for disposal of humus and other inappropriate material should be indicated in the Situational Plan.

***Measurement and payment***

There is no special measurement in the road bed, since only the control of the finished work is carried out, where the accuracy of the level of excavation on the route and in the gravel pits is ± 5 cm and at the level of the subsoil ± 3 cm. The payment is made per cubic meter (m³) of autochthon soil calculated in the measure of the building book and with the areas established in the calculation profiles for the road bed. The amount to be determined in the manner described above is paid at the unit price of the contract per unit of measure and this amount represents a full compensation for all work, equipment, tools and other means necessary for the quality performance of the previously described works.

**3.03 SUBSOIL COMPACTION**

After digging out the humus, under the embankment and side cut excavation, the subsoil should be compacted. Subsoil compaction should be carried out mechanically. Subsoil compactness is required using the standard processing procedure 100% of the maximum laboratory compactness, and in depth up to d = 50cm.

In the event that the required compaction cannot be achieved in certain places, the compaction will continue with the addition of sandy and gravel material until the required size is achieved. Calculation of the performed works is done per square meter of the compacted subsoil for all work, material and control tests.

**3.04 CONSTRUCTION OF EMBANKMENTS FROM EARTH MATERIALS**

***Description of works***

This work includes backfilling, spreading, rough or fine planning, drying or wetting and compaction of materials in an embankment according to the dimensions defined in the design. All work must be carried out in accordance with the Design and Standard SRPS U.E1.010 - Earth works during the construction of the road.

***Material***

The inorganic material (sand) of the prescribed quality will be used for the construction of the embankments. Organic waste, roots, turfs, or material that can change their physical and mechanical properties due to biochemical action cannot be installed in the embankment. The embankment material can be obtained from the gravel pit.

***Quality control of materials***

Regulations for Quality Control (SRPS):

- U.B1 010-sampling

- U.B1 012-determination of soil moisture

- U.B1 014-determination of specific weight

- U.B1 016-determination of volume weight

- U.B1 018-determination of the granulometric composition

- U.B1 020-determination of consistency limits

- U.B1.024-content of combustible and organic matter

- U.B1 038-determination of optimal water content

Determination of the content of organic and combustible materials, as well as the change in the volume of soil, should be carried out only for specific cases (suspicious materials).

***Classification of materials***

A unique terminology according to USCS and AASHO classification and Casagrande`s plasticity diagram will be used to classify embankment materials.

Previous tests of materials for the embankment

When examining the suitability of earthen materials for the construction of the embankments, it is necessary to carry out tests of all materials from the passages and gravel pits with coherent soil, including coherent components in mixed materials. The following tests should be carried out:

1. Examine the dry bulk density, optimum humidity and actual humidity by means of Proctor`s procedure.

2. Examine the granulometric composition and degree of unevenness.

3. Examine the Aterberg's consistency limits, the flow limits, the plasticity limits, the plasticity index, and check the sensitivity to the effect of frost (Casagrande's criterion)

4. Establish group index (Ig).

5. Determine the California load bearing capacity of the soil index (CBR) according to SRPS U.B1 042.

***Criteria for assessing material quality prior to installation***

• The humidity of the material should be such that, when compacted, the prescribed quality can be achieved (close to the optimum);

• Minimum bulk density in the laboratory with energy E = 60 MPm / m³ should be:

- For subgrade 16.5 KN / m³. For non-coherent materials whose bulk density is less than 16.5 KN / m³, additional tests must be carried out,

- for embankments up to 3 meters measured from the level of the roadway surface 15,5 KN / m³,

- for subsoil and embankments over 3 m measured from the level of the roadway surface 15,0 KN / m³.

Optimal humidity is less than 25%;

• Flow limit less than 65%;

• Plasticity index is less than 30%;

• Unevenness degree "U" not less than 9;

• Organic matter content is less than 10%;

• If the embankment is made of incoherent grain material, the grain size must not be greater than 30 cm, and not more than 10% of size up to 40 cm;

• For the embankments, materials that have been shown to be stable for the road bed can be used.

When testing the appropriateness of earth materials for the construction of embankments, the testing of materials from each passage and gravel pit should be carried out, as well as with any material change. Tests should be conducted on at least two samples for each type of material.

These tests must be carried out if there are geomechanical tests provided in the Design.

The material for the construction of embankments of categories V and VI should satisfy the following requirements:

• the granulometric composition of the material should meet the condition that the degree of unevenness "U" is not less than 4;

The maximum grain size must be less than half the thickness of the layer, but less than 40cm (where 15% of the grain size up to 50 cm can be tolerated).

***Transporting and backfilling***

Transporting and backfilling materials on the prepared ground or on the already built embankment layer can begin only after the takeover of the lower layers by the Supervisory Authority.

Each individual layer must be scattered in the longitudinal direction horizontally or at most in the slope with the same projected longitudinal inclination. In cross-sectional sense, each individual layer must have a two-sided or one-sided slope of 2-5% for the discharge of storm water.

Each individual layer must be spread according to the projected cross-section. When bringing the material by means of transport, driving through of vehicles must evenly distributed throughout the entire width of the substructure.

The height of a single spread layer must be in accordance with the effect of compacting with the depth of the compacted agent, the type of bulk material and segregation phenomena, but not more than 30 cm in a bulk. If there are requirements and possibilities for embedding embankments in layers thicker than 30 cm, then the Supervisory Authority may approve this request if the Contractor fulfils the following conditions: on the test section of 30 - 50 m, the thickness of the layer, types mechanical means, number of passages, properties of materials with humidity and density of the layer in five places, of which minimum two in the lower half of the layer are identified with the use of mechanical means used for embankment compression.

The entire process of adopting thickness through the test section is done by a joint commission which comprises a representative of the Supervisory Authority and a representative of the Contractor. On the basis of the results, the Supervisory Authority enters the necessary findings and gives the order through the construction log. Extraordinary costs of work on the test section shall be borne by the Contractor, as well as the as-built layer, with the constructed embankment payer being considered an as-built embankment layer if it is on the route and if the compaction is satisfactory.

Stone embankments are made in layers of the usual thickness of 30-50cm, but the actual thickness of the spread layer of the embankment is confirmed in the test section.

These materials are compressed with vibrating rollers (self-propelled or trailed), with vibrating plates and compactors, depending on the applied materials.

For each type of material that is embedded in the embankment, it is necessary to carry out a test on the test section and to adopt the machinery according to the aforementioned procedure.

***Compaction***

Each layer of embankment must be filled in full width with appropriate mechanical means, whereby compaction should in principle be conducted from the edge to the middle.

For any inaccessible places for machinery or places where the use of heavy compacting tools for other reasons would be inappropriate (filling behind a facility, supporting walls, etc.) other suitable means or compaction methods should be used, the use of which will be approved by the Supervisory Authority.

Prior to compaction, the material of each layer must be crushed, mixed, moistened or dried to a humidity which is in accordance with the preliminary test and with which the used material can be compacted successfully. If after compaction and quality control it is not immediately preceded with the pouring of the next layer, but after some long period of time, before filling, the quality of the compaction of the already made layer should be controlled again. In this case, only after the test confirms the quality of the compactness, may the compression commence.

In the case where a coherent material would mostly be used for the embankment and weather conditions would prevent its use, it is allowed to use other procedures in the construction of embankments such as, for example, stabilisation, processing or replacement of materials that will be required or approved by the Supervisory Authority, but these costs are borne by the Contractor.

When there is a risk of rain during the day, the Authority will, if necessary, determine the suspension of further work on the embankments without reimbursement of costs. On the embankment of coherent material, it is necessary to plan and roll the upper surface of the layer with a light smooth roller (3 - 5 tons) so that the surface is inclined from 2 to 5% to the edges, to be smooth and without indentations in which the storm water could be collected. Prior to filling the new layer, this smoothed surface should be roughened to achieve the best possible connection between the layers. This also applies to other major interruptions in the construction of embankments (due to the termination of the construction season, etc.).

Work on the filling will be interrupted at any time when it is not possible to achieve satisfactory results, especially due to rain, high groundwater or other elements. On this basis, the Contractor is not entitled to any compensation. The embankment material must not be installed on frozen surfaces or on snow or ice.

When the inclination of the terrain is from 20 to 30%, the terraced side cutting in the construction of the embankments in the width of 1 - 1.5 m must be carried out. The sides of the terraced side-cuts should be with the 2: 1 slope.

When the terrain inclination is greater than 30%, the terraced side-cuts should be performed continuously, and when the inclination of the terrain is between 20% and 30%, 1m of the intermediate space should be provided. The transversal slope of terraced side-cuts should be 3% down the slope side.

The final layer of the earth embankment in the thickness of 30 - 50 cm should preferably be made of stone or gravel materials from the gravel pit, and according to the instructions of the Supervisory Authority. In case the road structure is not dimensioned with a finishing layer of stones, and there is a possibility of economical dimensioning, the Investor has the right to make the necessary changes, and the Contractor is obliged to act according to the modified solution (mass and level layout).

Embedding quality control

Regulations under which control is implemented (SRPS):

- U.B1 010-sampling

- U.B1 012-determination of soil moisture

- U.B1 016-determination of soil bulk density

- U.B1 046-determination of the modulus of compressibility with a circular plate.

***Criteria for assessing the density of coherent materials with an addition of up to 20% of stone aggregate***

|  |  |
| --- | --- |
| Description | Required compactness by Proctor`s standard  E = 60 MPm /m3 |
| a) Embankment layers up to 3m measured from the roadway surface level | 100 % |
| b) Embankment layers under 3m measured from the roadway surface level | 95 % |

Criteria for assessing the density of coherent materials with the addition of more than 20% of the stone aggregate

The minimum required value of the stiffness module (Ms) for non-coherent materials and the different participation of stone materials are determined by a ∅30cm plate with optimum humidity according to the following criteria:

• mixed material, 20-35% of the stone aggregate Ms = 25-30 MPa

• mixed material, 30-50% stone aggregate Ms = 30-35 MPa

• mixed material, more than 50% of stone aggregate at optimum humidity or humidity close to optimal Ms = 40 MPa.

For rough grain crushed stone materials and mixed materials, bulk density control can be carried out, as required, by volume methods - the frequency of regular control testing. Compactness of the layers of the embankments is examined for every 50-100 m with two experiments in the immediate vicinity which give one result. For embankments of less than 50 m in length, the same applies. The humidity of the material is examined on a daily basis. The filling of the next layer cannot be performed until the required quality of the previous layer is confirmed. In the event that in the course of the control examinations the Supervisory Authority determines greater deviations from the prescribed results, the scope of the tests may subsequently be changed. The quality of the embedded layers can be determined in accordance with the Supervisory Authority and by other recognised methods. In this case, in accordance with the Supervisory Authority, the installation quality criteria of the as well as the method and scope of the test must be indicated. The acceptance of embedded material, the acceptance of each layer of embankments will be carried out by the Supervisory Authority according to the prescribed criteria.

***Measurement and payment***

Measurement and calculation is per cubic meter (m³) of the embankment measured on site within the quantities from the Design, without humus and including the shoulder core. The quantities described above are paid at the unit price of the contract per unit of measurements of embedded embankment material.

The unit price is full compensation for all work including spreading, wetting and drying, compacting, terraced side-cutting, planning slopes and shoulders (with an accuracy of ± 5cm in relation to the projected slopes of the embankment) and all other work from this description, labour force, material and the transfer from the gravel pit to the place of installation, and the Contractor has no right to request any supplements for the construction the embankment.

3.05 i 3.07 APPLICATION OF HUMUS ON FLAT AND SLANTING SURFACES AND DEVELOPMENT OF SHOULDERS

***Description of works***

On the slopes of cavities and embankments, the preparation for application of the humus layer should be implemented and the layer underneath the shoulder should be levelled up to the projected level, after which a layer of humus of the projected thickness should be applied, planned and later conduct the compaction on the shoulder.

***Performance***

Humus application should be done immediately after the completion of the embankment or cavity. Prior to the application of humus, it is necessary to meet the following basic conditions in order to achieve stability:

• The surface water of the background basin must be collected in a controlled manner and taken away.

• The slopes of the embankment, and in particular of the cavities, should be roughly planned in order to achieve appropriate roughness, which ensures connection with vegetative protection.

• After the final application and processing of the humus material has been completed, grass sowing should be performed.

The deviation of the as-built levels of the final surface of the shoulder is ± 1 cm in relation to the projected surfaces shown in the drafts of the Design. The material obtained from the gravel pit is used for filling by humus material. Active humus material should be used, which guarantees the sustainability of the plants. The type of seed, the mixture of grass and clover which meet ecological conditions and ensures the sustainability of growth should be chosen. Grassing by sowing, on humus surfaces, should be conducted with high quality. Seeding is commenced at a favourable time, after rain, in the following manner:

Spread artificial fertiliser on the slopes, Thomas's phosphor flour in the amount of 400 kg / ha and potassium salt in the amount of 200 kg / ha. After fertilisation, processing and preparation of soil for sowing is completed. Sowing is conducted manually, and the surface is then rolled with a wooden hand roller, so that the seed is firmly fixed in the ground. After sowing and rolling, 100 kg / ha of Nitromoncal should be dispersed, and after grassing another 100 kg / ha of this substance. In the event of a dry weather, the Contractor is obliged to sprinkle the sown area with water, since only the grassed areas are taken into account and paid for. The choice of seed type, according to the characteristics of the land, should be performed by the Contractor based on the advice of the appropriate expert.

***Measurement and payment***

Measurement and payment is done per cubic meter (m3) of humus surface, including all work and material needed for humus application and planning, or per square meter of humus applied shoulder (m2).

**3.06 PLANNING AND ROLLING OF THE FINAL GRADE**

Treatment of the final grade consists of the design of the final grade at projected levels and complementary compaction across the entire width of the substructure to the required compaction. Final rolling is carried out with a smooth roller in order to obtain a flat surface of the final grade, allowing for deviations from (+, -) 2 cm in relation to the projected levels. To test the compression of the final grade, load-bearing test plate of 30 cm in diameter should be used. The minimum value of the compressibility module ms min = 25 mn / m2 is required.

Calculation of performed works is done per square meter for humus application of sloping surfaces and per cubic meter for development of shoulders, all work and material, with control tests.

**3.08 SPREADING OF EARTH MATERIAL IN THE LANDFILL**

Excess humus and excavated earthen material up to the III category that is brought to the landfill will be spread along the landfill in layers and roughly planned according to the instructions of the Supervisory authority.

Calculation of performed works is done per cubic meter (m³) of autochthon material, for all work and material.

**3.09 TRANSPORT OF EARTH MATERIAL**

Excess excavation of humus and earth material, as well as the transport of material from the gravel pit for embankment construction or humus up to category III application, should be loaded and transported to the landfill or to the place of installation, at the distances from the work pro forma invoice. This item includes vehicle loading, transport, unloading and rough spreading.

Calculation of performed works is done per cubic meter of the loaded, transported, unloaded and roughly spread material in autochthon state.

**4. ROAD STRUCTURE CONSTRUCTION**

**3.01 GENERATION OF A LOAD BEARING CAPACITY LAYER FROM MECHANICALLY COMPRESSED GRAIN MATERIAL 0/63 MM 30 CM THICK DESCRIPTIONS**

This item includes procurement, delivery, installation, rough and fine spreading, possibly wetting, and compression of the bearing layer of unbound stone material, according to the dimensions and special requirements given in the design.

***Performance***

The lower carrier layer is installed on the previously embedded layer which must be accepted by the Supervisory Authority and only then can the loading of the material for the lower bearing layer begin. Vehicles with muddy wheels must not be driven on loose or compressed material. After the driving in, the material is scattered and finely deposited, in the thickness necessary to obtain a layer of projected thickness after compacting. Workers should make sure that no material segregation occurs. Compression is carried out with appropriate means. The compacted layer must have projected levels, width, and fall, as it is given in the design.

***Quality of basic materials***

The quality control in previous examinations is carried out according to the following regulations (SRPS):

|  |  |
| --- | --- |
| Natural aggregate and stone; taking samples | SRPS B.B0.001 |
| Testing the stability of stone in the frost | SRPS B.B8.002 |
| The bulk aggregate mass with pores and cavities | SRPS B.B8.030 |
| Water absorption of the aggregate | SRPS U.B8.031 |
| Bulk stone mass density, stone porosity and stone density | SRPS B.B8.032 |
| Identifying particles in an aggregate passing through a 0.02 mm sieve | SRPS B.B8.036 |
| Identifying dilapidated grains in a large aggregate | SRPS B.B8.037 |
| Content of clay and sludge ingredients | SRPS B.B8.038 |
| Testing the resistance of stone and aggregate to wear (Los Angeles) | SRPS B.B8.045 |
| Definition of the shape and appearance of the grain surface of the stone aggregate | SRPS B.B8.047 |
| Stone aggregate grain shape testing | SRPS B.B8.048 |
| Identifying humidity | SRPS U.B1.012 |
| Identifying soil bulk mass | SRPS U.B1.016 |
| Identifying the granulometric composition and particles of less than 0.08 mm aerometry (or according to SRPS B.B7.036) | SRPS U.B1.018 |
| Identifying the optimum water content | SRPS U.B1.038 |
| Identifying the California load index | SRPS U.B1.042 |

Tests are performed for each material change.

CRITERION FOR ASSESSING THE QUALITY OF MATERIAL

The unbound stone aggregate to be used for the production of these layers must meet the requirements in terms of:

• Physical-mechanical and mineralogical-petrographic properties of the rock and aggregates themselves

• Granulometric composition

• Bearing capacity

• Contents of organic matter and light particles

Physical and mechanical properties of the stone from which the crushed aggregate is produced:

|  |  |
| --- | --- |
| Medium compressive strength in dry state of matter | min 120 (MPa) |
| Water absorption (% of the mass) | 1.0 % |
| Resistance to freezing  (25 freezing cycles) | The stone is freeze-resistant if the drop is of the medium compressive strength after freezing up to 20% in relation to the medium compressive strength in dry state |
| Mineral and petrographic composition | The stone can be of eruptive, sedimentary, metamorphic origin. The presence of marl, clay slates, soft and clay sandstones, conglomerates, decayed granite and gneisses is not allowed. |

Physical and mechanical properties of stone aggregate grains:

• Share of unfavourable grain shape (3: 1) max. 40%

• Water absorption (SRPS B.B8: 031) max. 1.6%

• Dilapidated grains max. 7%

• Resistance to wear (Los Angeles) max. 40%

The granulometric composition of the unbound stone aggregate should be within the following limits:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Square sieve opening  (mm) | 0.09 | 0.25 | 0.50 | 1.0 | 2.0 | 4.0 | 8.0 | 16.0 | 31.5 | 45.0 | 63.0 |
| Pass through the sieve  by weight% | 2-11 | 8-17 | 11-24 | 15-33 | 20-44 | 27-56 | 38-69 | 56-85 | 85-100 | 100 | 100 |

In addition to the above criterion, the material must also meet the following requirements:

• it should be resistant to atmospheric conditions

• it should not be prone to degradation due to construction site traffic at different meteorological conditions

• the share of fine fractions (<80 μm) should be <6%

• plasticity index of fine particles Ip <12

• degree of unevenness U = 15-30

• bearing capacity at compression level Sz = 95% in relation to the modified Proctor`s material test 0/63 CBRlab> 30%

• the content of organic matter and light particles must not exceed 5% by weight for material 0/63 mm

CONTROL OF PROCESSED AND COMPRESSED LOWER BEARING LAYER

Quality control is performed on every 1000m2 (if there is a need for a larger number of tests, the Supervisory Authority may request an additional number of tests) of the material used or for each change of material in accordance with the following standards:

• Optimum humidity and maximum bulk mass (SRPS U.B1.038)

• granulometric composition (SRPS U.B1.018)

• Content of clay and sludge particles (SRPS B.B8.036)

• the degree of compressibility, i.e. the bearing capacity of the as-built layer, as well as the humidity at the moment of testing carried out at every 50 m 'of the as-built layer

CRITERIA FOR ASSESSMENT OF QUALITY OF EMBEDDING

Determination of the compression modules by the method of the circular plate according to the standard SRPS U.B1.046. This test is carried out at least once every 30 m. On the substructure of the bearing layer with humidity close to optimum, the module of compressibility should be Ms> 60MPa.

The flatness test is carried out with a batten of 4 m in length, on each transversal profile. The deviation must not exceed ±15 mm

The height of the built-in bearing layer at any point can deviate from the projected one from 0 to -15 mm, which is checked by level surveying

MEASUREMENT AND PAYMENT

Calculation and payment is done per m3 by the Supervisory Authority of the accepted layer of projected thickness.

3.01 GENERATION OF A LOAD BEARING CAPACITY LAYER FROM MECHANICALLY COMPRESSED GRAIN MATERIAL 0/31.5 MM 20 CM THICK

DESCRIPTION

This item includes procurement, delivery, installation, rough and fine spreading, possibly wetting, and compression of the bearing layer of unbound stone material, according to the dimensions and special requirements given in the design.

PERFORMANCE

The lower carrier layer is installed on the previously embedded layer which must be accepted by the Supervisory Authority and only then can the loading of the material for the lower bearing layer begin. Vehicles with muddy wheels must not be driven on loose or compressed material. After the driving in, the material is scattered and finely deposited, in the thickness necessary to obtain a layer of projected thickness after compacting. Workers should make sure that no material segregation occurs. Compression is carried out with appropriate means. The compacted layer must have projected levels, width, and fall, as it is given in the design.

THE QUALITY OF BASIC MATERIALS

The control in previous examinations is carried out according to the following regulations

|  |  |
| --- | --- |
| Natural aggregate and stone; taking samples | SRPS B.B0.001 |

|  |  |
| --- | --- |
| Testing the stability of stone in the frost | SRPS B.B8.002 |
| The bulk aggregate mass with pores and cavities | SRPS B.B8.030 |
| Water absorption of the aggregate | SRPS U.B8.031 |
| Bulk stone mass density, stone porosity and stone density | SRPS B.B8.032 |
| Identifying particles in an aggregate passing through a 0.02 mm sieve | SRPS B.B8.036 |
| Identifying dilapidated grains in a large aggregate | SRPS B.B8.037 |
| Content of clay and sludge ingredients | SRPS B.B8.038 |
| Testing the resistance of stone and aggregate to wear (Los Angeles) | SRPS B.B8.045 |
| Definition of the shape and appearance of the grain surface of the stone aggregate | SRPS B.B8.047 |
| Stone aggregate grain shape testing | SRPS B.B8.048 |
| Identifying humidity | SRPS U.B1.012 |
| Identifying soil bulk mass | SRPS U.B1.016 |
| Identifying the granulometric composition and particles of less than 0.08 mm aerometry (or according to SRPS B.B7.036) | SRPS U.B1.018 |
| Identifying the optimum water content | SRPS U.B1.038 |
| Identifying the California load index | SRPS U.B1.042 |
| Natural aggregate and stone; taking samples | SRPS B.B0.001 |

Tests are performed for each material change.

CRITERION FOR ASSESSING THE QUALITY OF MATERIAL

The unbound stone aggregate to be used for the production of these layers must meet the requirements in terms of:

• Physical-mechanical and mineralogical-petrographic properties of the rock and aggregates themselves

• Granulometric composition

• Bearing capacity

• Contents of organic matter and light particles

Physical and mechanical properties of the stone from which the crushed aggregate is produced:

|  |  |
| --- | --- |
| Medium compressive strength in dry state of matter | min 120 (MPa) |
| Water absorption (% of the mass) | 1.0 % |
| Resistance to freezing  (25 freezing cycles) | The stone is freeze-resistant if the drop is of the medium compressive strength after freezing up to 20% in relation to the medium compressive strength in dry state |
| Mineral and petrographic composition | The stone can be of eruptive, sedimentary, metamorphic origin. The presence of marl, clay slates, soft and clay sandstones, conglomerates, decayed granite and gneisses is not allowed. |

Physical and mechanical properties of stone aggregate grains:

• Share of unfavourable grain shape (3: 1) max. 40%

• Water absorption (SRPS B.B8: 031) max. 1.6%

• Dilapidated grains max. 7%

• Resistance to wear (Los Angeles) max. 40%

The granulometric composition of the unbound stone aggregate should be within the following limits:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Square sieve opening  (mm) | 0.09 | 0.25 | 0.50 | 1.0 | 2.0 | 4.0 | 8.0 | 16.0 | 31.5 | 45.0 |
| Pass through the sieve  by weight% | 2-9 | 5-15 | 8-21 | 11-30 | 15-40 | 20-50 | 28-62 | 46-75 | 95-100 | 100 |

In addition to the above criterion, the material must also meet the following requirements:

• It should be resistant to atmospheric conditions

• it should not be prone to degradation due to construction site traffic at different meteorological conditions

• the share of fine fractions (<80 μm) should be <6%

• plasticity index of fine particles Ip <12

• degree of unevenness U = 15-30

• bearing capacity at compression level Sz = 95% in relation to the modified Proctor`s material test 0/31 CBRlab> 80%

• the content of organic matter and light particles must not exceed 3% by weight for material 0/31 mm

CONTROL OF PROCESSED AND COMPRESSED LOWER BEARING LAYER

Quality control is performed on every 2000 m3 of the material used or for each change of material in accordance with the following standards:

• Optimum humidity and maximum bulk mass (SRPS U.B1.038)

• granulometric composition (SRPS U.B1.018)

• content of clay and sludge particles (SRPS B.B8.036)

• the degree of compressibility, i.e. the bearing capacity of the as-built layer, as well as the humidity at the moment of testing carried out at every 50 m 'of the as-built layer

CRITERIA FOR ASSESSMENT OF QUALITY OF EMBEDDING

Determination of the compression modules by the method of the circular plate according to the standard SRPS U.B1.046. This test is carried out at least once every 30 m. On the substructure of the bearing layer with humidity close to optimum, the module of compressibility should be Ms> 80MPa.

The flatness test is carried out with a batten of 4 m in length, on each transversal profile. The deviation must not exceed ±10 mm

The height of the built-in bearing layer at any point can deviate from the projected one from 0 to -10 mm, which is checked by level surveying

MEASUREMENT AND PAYMENT

Calculation and payment is done per m3 by the Supervisory Authority of the accepted layer of projected thickness.

3.03 PREPARATION OF THE FLATTENING LAYER BNS 22 D = 6.0-10.0 CM THICK

ITEM DESCRIPTION

This item includes procurement of materials, preparation, spreading, installation and compacting of asphalt mixture in hot process from mineral material and bitumen in one layer of thickness d = 6.0-10.0 cm, that is, according to the levels and dimensions given in the construction project.

MATERIALS

Composite materials for making a levelling layer from bituminous materials:

share of organic impurities% (m / m) max. 0.5 SRPS U.B1.024

sand equivalent,% min. 60 SRPS U.B1.040

fineness modulus 1.70 - 2.55 SRPS U.E4.014

density (kg / m3) - SRPS B.B8.031

\* The value in brackets refers to the crushed sand of the silicate composition

Stone chippings

Stone chippings fractions should meet the following quality requirements:

Resistance to crushing and wear acc. to Los Angeles

(% m / m) max. 28% w / w SRPS B.B8.045

frost resistance Na2SO4, loss

after 5 cycles max. 5% m / m SRPS B.B8.044

percentage of unwrappness of total

area of all grains (%) max. 20% SRPS U.M8.096

water absorption at fraction 4/8 mm max. 1.2% w / w SRPS B.B8.031

Grain content in fractions above 4 mm

where the ratio of the highest to the

smallest dimension is > 3: 1 max. 20% m / m SRPS B.B8.048

fraction of clay balls in a single

fraction max. 0.25% w / w SRPS B.B8.038

density - SRPS B.B8.031

For each fraction of stone chippings the granulometric composition of the fraction is tested in all aspects according to SRPS B.B8.029, and the content of particles is smaller than 0.09 mm according to SRPS B.B8.036 standard.

Bitumen

Bitumen BIT 60 is used and in all cases it must meet the criteria given in SRPS U.M3.010. for BIT 60.

PREVIOUS EXAMINATION OF ASPHALT MIXTURES

Prior to the commencement of works, the Contractor is obliged to create in the authorised laboratory the project of the previous asphalt mixture compliant with the requirements of these technical conditions in all respect.

The production of the asphalt mixture must not begin until the Contractor submits the previous mixture to the approval of the Supervisory Authority. Attestation of basic materials and the previous mixture must not be older than 6 months. If changes in basic materials occur or the choice of material changes, the Contractor is obliged to submit to the Supervisory Authority a written proposal for the change of the adopted asphalt mixture, or to propose a new prior blend to the consent before the beginning of the use of these materials.

The basic requirements that must be respected in the preparation of the previous mixture are:

• to be as similar as the projected granulometric composition of the mineral mixture set by the design requirements (target line of the granulometric composition) and the requirements of the relevant SRPS standards for the quality of mineral stone material,

• the corresponding values of the volume characteristics of the mixture with the project requirements of this design,

• requirements of relevant SRPS standards for the quality of individual projected bitumen types.

Granulometric composition of the mineral mixture

The granulometric curve of the projected mineral mixtures must satisfy the boundary conditions given in SRPS U.E9.021 / 86 for road bases of bituminous materials BNS 22s listed in the following table:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sieve openings (mm) | 0.09 | 0.25 | 0.71 | 2.00 | 4.00 | 8.00 | 11.2 | 16.0 | 22.4 | 31.5 |
| passages (%) | 5-11 | 8-17 | 13-27 | 24-40 | 34-53 | 50-70 | 61-81 | 75-94 | 97-100 | 100 |

Testing of constituent materials and quality of the previous composition of the asphalt mixture is done according to SRPS U.E9.021 / 86 and should satisfy the quality requirements for BNS 22s.

The designer's consent to the previous composition of the asphalt mixture is mandatory.

TECHNOLOGY OF EXECUTION

PREPARATION AND TRANSPORT OF ASPHALT MIXTURES

Production of asphalt mixture is conducted by machine in the plant for the production of asphalt mixture. A continuous plant for the production of asphalt mixtures can be used if the quality of asphalt mixture produced through this process proves to be satisfactory.

The temperature of bitumen in tanks on an asphalt base is optimum 150° C, no more than 165° C. The temperature of the aggregate must not be higher than the bitumen temperature by more than 15° C, while the temperature of the output asphalt mixture is optimum 160 ± 10° C and at most 175° C.

Immediately after production, the asphalt mass is directly shipped to the place of installation.

PREPARATION OF THE ROAD FOUNDATION/SUBSTRATE

Before the construction of the asphalt layer, the Contractor shall record the level and the flatness of the road foundation and submit it to the Supervising Authority for inspection. In areas where the surface of the substrate layer is higher than the designed levels, it is necessary for the Contractor to repair the road foundation according to the requirements of the design solution.

The laying of the asphalt mixture on a road foundation made of mechanically stabilised granular material can begin when it is tested and accepted by the Supervisory Authority. The time interval between the substrate test and the installation of the asphalt mass may be up to 24 hours and during that time the transport on the tested substrate should be prohibited.

Before laying BNS, the substrate must be clean and free from frost.

INSTALLATION OF ASPHALT MIXTURE

The installation of the asphalt mixture is done only in favourable weather conditions, when the surface and air temperature are higher than + 5° C. In specific weather conditions, such as strong winds, the Supervisory Authority may suspend work at temperatures higher than mentioned, if there is a suspicion that under these conditions the works will not be performed well. The temperature of the asphalt mixture at the site of installation should not be lower than 140°C and higher than 175° C.

Spreading of the asphalt mixture is done by machine and immediately after that, a suitable rolling mode must be provided to ensure the required compaction of the asphalt layer.

Other details of the performance technology of this item are given in the applicable standard SRPS U.E9.021 / 86 and other valid SRPS standards.

PERIOD OF EXECUTION OF WORKS

The asphalt layer can be installed only in the period when the air temperatures are higher than 5 °C, no wind or min 10 °C with wind. Installation of the asphalt mixture should not be carried out when it is misty or rainy. The substrate temperature must not be lower than + 5° C.

QUALITY CONTROL

CURRENT EXAMINATIONS

The current works are carried out by the Contractor with the aim to have an insight into the quality of the composite materials at any time as well as the manufactured and embedded asphalt mixtures in order to intervene in the production process in case of need and to ensure the continuous production of the prescribed quality.

The Contractor's obligation is to influence the process of production and installation of the asphalt mixture on the basis of the results of the current tests in a manner that ensures uniform, technical conditions prescribed quality of the performed asphalt layer.

On the results of the examinations conducted in the capacity of ongoing examinations, the Contractor shall keep a written record which must be available to the Supervisory Authority.

During the construction of the road base from bituminous materials, the current tests include:

- ongoing testing of constituent materials

- ongoing testing of the production of asphalt mixtures

- ongoing tests for the installation of the asphalt mixture

All tests within the ongoing testing should be conducted to the extent and in the manner prescribed by the valid Serbian standards SRPS U.E9.021 / 86.

CONTROL EXAMINATIONS

Control tests are carried out by the Investor or a company for quality control at his expense. Based on the results of the control tests, the Investor, or its supervisory body, makes a final assessment of the quality of the provided asphalt layers.

Control tests include:

- control tests of constituent materials

- control examination of the produced asphalt mixture

- control tests of the provided asphalt layer

Control tests of materials

Control tests are performed on samples taken on an asphalt base.

From each type of material, one sample is taken per quantity of material required for the production of 8000 tons of asphalt mixture. The required quantities of materials are calculated based on the working composition of the asphalt mixture.

Filler

The following tests are performed:

|  |  |
| --- | --- |
| granulometric composition | SRPS B.B8.105 |
| share of the cavities in the dry-compressed state by Ridgen | SRPS B.B8.102 |

Sand

The following tests are performed:

|  |  |
| --- | --- |
| granulometric composition | SRPS B.B8.029 |
| sand equivalent | SRPS U.B1.040 |
| share of particles smaller than 0.09 mm | SRPS B.B8.036 |

Stone chippings

The following tests are performed:

|  |  |
| --- | --- |
| granulometric composition | SRPS B.B8.029 |
| share of particles smaller than 0.09 mm | SRPS B.B8.036 |
| grain shape |  |
| share of dilapidated grains | SRPS B.B8.037 |

Bitumen

Complete analysis according to SRPS U.M3.010 standard.

Control tests of the produced asphalt mixture

Samples of asphalt mixtures for the control test shall be taken at the place of installation of the asphalt mixture.

The composition and physical and mechanical properties of asphalt mixtures are checked by testing one sample for every 1200 tons of asphalt mixture produced.

The following properties are tested:

fraction of bitumen SRPS U.M8.090

granulometric composition SRPS U.M8.090

stability at 60 °C SRPS U.M8.090

stability and deformation ratio at 60 °C SRPS U.M8.090

share of cavities SRPS U.M8.090

filling of cavities with bitumen SRPS U.M8.090

Control tests of the produced asphalt layer

Physical and mechanical properties and thickness of the produced layer are examined on samples taken at least at each 2000 m2 of surface of the produced layer.

Sampling is performed according to SRPS U.M3.090.

The following features are tested:

share of cavities SRPS U.M8.090

degree of compactness SRPS U.M8.090

layer thickness -

The height, the cross-fall, and the position of the produced layer are checked by controlling the appropriate instruments, at least 20% of the data recorded by the Contractor during the current layer production control.

CRITERIA FOR CALCULATING EXECUTED WORKS

Flatness level of the layer and cross-fall

Measurement is performed by Contractor on cross-sectional profiles, with the distance between each other not exceeding 30 m. Measurement is performed with a 4 m long straighter (left, right, middle). The criteria are as follows:

|  |  |
| --- | --- |
| Flatness deviation from 0 to 8 mm | satisfactory |
| Flatness deviation from 8 to 12 mm | Not satisfactory and 5–25% of the surface value for the flatness is deducted |

|  |  |
| --- | --- |
| Flatness deviation from 8 to 12 mm | Not satisfactory and 5–25% of the surface value for the flatness is deducted |
| Flatness deviation above 12 mm | Not satisfactory and 100% of the surface value for the flatness is deducted |

The cross-fall of the surface of the produced asphalt concrete layer may deviate from the projected cross-fall for at most ± 0.4%.

Deviation of the surface layer from the projected reference level

The allowed height deviation of the surface of the produced bitumenous layer may deviate from the projected height for at most ± 10mm.

Horizontal deviation of the edge of the produced layer

The allowed horizontal deviation of the position of the left and right edges from the projected position is at most ± 25 mm.

Deviation in the thickness of the embedded layer

All deviations of the produced layer thickness from the projected layer thickness are subject to evaluation of the quality of the works performed if the Supervisory Authority estimates that the finished layer can remain in the road structure.

Measurement is done on each profile, and the criteria are as follows:

|  |  |
| --- | --- |
| for deviation of layer thickness of 10-13 mm | 10-25% of the value of this surface is deducted |
| for deviation of layer thickness of 13–17 mm | 26–50 % of the value of this surface is deducted |
| for deviation of layer thickness of more than 17 mm | The performed work is not accepted |

The percentage of the deduction will be determined by the Supervisory Authority based on the number of measurements and the percentage share of the results that deviate for more than -10% from the projected layer thickness.

Granulometric composition of the mineral mixture

If the granulometric composition of the extracted mineral mixture deviates from the limit curve in relation to the required granulometric curve, more than the tolerance standard, the Contractor will reduce the value of performed works of the bitumenous layer by 5.0% for the area covered by the sample tested. If there are several deviations from the tolerance standard, in all three components of the asphalt mixture, in the granulometric curve, in the filter and bitumen fractions, the asphalt layer cannot be accepted as valid.

Level of rolling (compactness) of the embedded layer

The acceptance criterion is the achieved degree of compaction that must be at least 98%. If there are more than 10% of tested samples with a degree of compactness of less than 98%, the works will be rejected.

MEASUREMENT AND PAYMENT

The calculation is done by 1 m³ of the performed work, which corresponds to the required quality prescribed by these Technical Terms and Limits of Tolerance.

3.05 CONSTRUCTION OF THE WEARING LEVEL OF ASFALT CONCRETE AB 11S WITH PMB 50/90 D = 4.0 CM THICK

ITEM DESCRIPTION

This item includes the procurement of materials, the preparation, spreading, installation and compacting of the asphalt mixture by hot work procedure for mineral material with polymer modified bitumen (PmB 50/90) in one layer of projected thickness of d = 4.0 and 5.0 cm, respectively, according to the levels and dimensions given in construction project.

MATERIALS

Composite materials for the production of the wearing layer:

- filler of carbonate composition

- crushed stone material of silicate composition 0/2 mm,

- crushed eruptive stone aggregate 2/4, 4/8, 8/11 mm

- Binder PmB 50/90

QUALITY OF MATERIAL

Filler

The filler must meet the criteria given in SRPS B.B3.045 for the first class of quality in all aspects.

granulometric composition (% passage through sieves) for I class of quality SRPS B.B8.105

plasticity index% (m / m) max. 4.0 SRPS B.B1.020

moisture content% (m / m) - SRPS U.B1.012

granulometric composition of particles smaller

than 0.063 mm% - SRPS U.B1.018

bituminous curing index 1.80 - 2.40 SRPS B.B8.104

Ridgen cavity% v / v - SRPS B.B8.102

Sand

Crushed sand must meet the quality requirements given in the following table in all aspects:

granulometric composition (% passage through

the sieve) according to SRPS U. E4.014/90 SRPS B.B8.029

share of particles smaller than 0.09mm

(% pass through the sieve) max. 10 SRPS B.B8.036

share of clay balls% (m / m) max. 0.5 SRPS B.B8.038

share of organic impurities% (m / m) max. 0.3 SRPS U.B1.024

sand equivalent,% min. 60 SRPS U.B1.040

fineness modulus 1.70 - 2.55 SRPS U.E4.014

density (kg / m3) - SRPS B.B8.031

Stone chippings

Stone chippings are obtained by crushing the mass of the eruptive composition. The rock mass should have the following properties:

medium compressive strength in dry state min. 160 MPa SRPS B.B8.012

water absorption max. 0.75% m/m SRPS B.B8.010

wearing by grinding max. 12 cm3/50 cm2 SRPS B.B8.015

Frost resistance max. 5% m/m SRPS B.B8.002

Stone chippings fractions should meet the following quality requirements:

Resistance to crushing and wear acc. to Los Angeles

(% m / m) max. 18% w / w SRPS B.B8.045

polishness values, VPK units min 48 VPK SRPSB.B8.120

frost resistance Na2SO4, loss

after 5 cycles max. 3% m/m SRPS B.B8.044

percentage of bitumen wrapping of total

area of all grains (%) min.100/90% SRPS U.M8.096

water absorption at fraction 4/8 mm max.1.6% m/m SRPS B.B8.031

Grain content in fractions above 4 mm

where the ratio of the highest to the

smallest dimension is > 3: 1 max. 20% m/m SRPS B.B8.048

share of weak grains in fractions

above 4mm max.3% m/m SRPS B.B8.037

fraction of clay balls in a single

fraction max. 0.25% m/m SRPS B.B8.038

heat resistance resistant -

For each fraction of stone chippings the granulometric composition of the fraction is tested in all aspects according to SRPS B.B8.029, and the content of particles is smaller than 0.09 mm according to SRPS B.B8.036 standard.

Bitumen

A polymer modified bitumen PmB 50/90 is used, which corresponds to the ONORM B 3613 criteria given in the following table:

|  |  |  |
| --- | --- | --- |
| Testing type | PmB 50-90C | Testing methods |
| Penetration at 25oC (1/10mm), (100g/5s) | 50 – 90 | SRPS B.H8.612 |
| Breaking point by Fras, (oC) | < - 19 | SRPS B.H8.616 |
| Ductility, (cm) na 25oC | > 50 | SRPS B.H8.615 |
| Flash point by Clevelend, (oC) | > 250 | DIN ISO 2592 |
| Reversible elastic deformation at 25oC, (%) | > 80 | ONORM S 9219 |
| homogeneity during storage, Δ PK, (oC) | < 2.0 | TL PmB tAIL 1 (1991) Tuba Test |
| After RTFOT according ASTM D 2872 | | |
| Mass loss, %(m/m) | < 0.5 | – |
| Change in penetration at 25 oC, %  decrease  increase | < 40  < 10 | SRPS B.H8.612 |
| Reversible elastic deformation at 25oC, (%) | > 80 | ONORM S 9219 |

PREVIOUS EXAMINATION OF THE ASPHALT MIXTURE

Prior to the commencement of works, the Contractor is obliged to create in the authorised laboratory the project of the previous asphalt mixture compliant with the requirements of these technical conditions in all respect.

The production of the asphalt mixture must not begin until the Contractor submits the previous mixture to the approval of the Supervisory Authority. Attestation of basic materials and the previous mixture must not be older than 6 months. If changes in basic materials occur or the choice of material changes, the Contractor is obliged to submit to the Supervisory Authority a written proposal for the change of the adopted asphalt mixture, or to propose a new prior blend to the consent before the beginning of the use of these materials.

The granulometric curve of the projected mineral mixtures must satisfy the boundary conditions given in SRPS U U.E4.014/90 for asphalt concrete AB 11s listed in the following table:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sieve openings (mm) | 0.09 | 0.25 | 0.71 | 2.00 | 4.00 | 8.00 | 11.2 | 16.0 | 0.09 | 0.25 |
| passages (%) | 3-11 | 8-18 | 16-30 | 31-48 | 49-65 | 75-87 | 97-100 | 100 | 3-11 | 8-18 |

Testing of constituent materials and quality of the previous composition of the asphalt mixture is done according to SRPS U. E4.014/90 and should satisfy the quality requirements for AB 11s.

The designer's consent to the previous composition of the asphalt mixture is mandatory.

TECHNOLOGY OF EXECUTION

PREPARATION AND TRANSPORT OF ASPHALT MIXTURE

Production of asphalt mixture is conducted by machine in the plant for the production of asphalt mixture. A continuous plant for the production of asphalt mixtures can be used if the quality of asphalt mixture produced through this process proves to be satisfactory.

The temperature of bitumen in tanks on an asphalt base is optimum 150° C, no more than 165° C. The temperature of the aggregate must not be higher than the bitumen temperature by more than 15° C, while the temperature of the output asphalt mixture is optimum 165 ± 10° C and at most 175° C.

Immediately after production, the asphalt mass is directly shipped to the place of installation.

PREPARATION OF THE ROAD FOUNDATION/SUBSTRATE

Before the construction of the asphalt layer, the Contractor shall record the level and the flatness of the road foundation. In areas where the surface of the substrate layer is higher than the designed levels, it is necessary for the Contractor to repair the road foundation according to the requirements of the design solution.

The laying of the asphalt mixture on a road foundation made of asphalt layer can begin when it is cleaned of bound and unbound material, dried and sprayed with polymer modified bituminous emulsion PmB KN-50 ili PmB KN-60 in the amount of 0.2 kg/m2. Spraying must begin at least 2-3 hours before laying asphalt, so that the water evaporates and the bitumen part is attached to the substrate. The laying of the asphalt layer can only begin when the substrate (asphalt layer) is cooled to the air temperature.

INSTALLATION OF ASPHALT MIXTURE

The installation of the asphalt mixture is done only in favourable weather conditions, when the surface and air temperature are higher than + 10° C. In specific weather conditions, such as strong winds, the Supervisory Authority may suspend work at temperatures lower than mentioned, if there is a suspicion that under these conditions the works will not be performed well. The temperature of the asphalt mixture at the site of installation should not be lower than 150° C and higher than 175° C.

Spreading of the asphalt mixture is done by machine and immediately after that, a suitable rolling mode must be provided to ensure the required compaction of the asphalt layer.

Other details of the performance technology of this item are given in the applicable standard SRPS U. E4.014/90 and other valid SRPS standards.

PERIOD OF EXECUTION OF WORKS

The asphalt layer can be installed only in the period when the air temperatures are higher than 10° C, no wind or min 15° C with wind. Installation of the asphalt mixture should not be carried out when it is misty or rainy. The substrate temperature must not be lower than + 10° C.

QUALITY CONTROL

CURRENT EXAMINATIONS

The current works are carried out by the Contractor with the aim to have an insight into the quality of the composite materials at any time as well as the manufactured and embedded asphalt mixtures in order to intervene in the production process in case of need and to ensure the continuous production of the prescribed quality.

The Contractor's obligation is to influence the process of production and installation of the asphalt mixture on the basis of the results of the current tests in a manner that ensures uniform, technical conditions prescribed quality of the performed asphalt layer.

On the results of the examinations conducted in the capacity of ongoing examinations, the Contractor shall keep a written record which must be available to the Supervisory Authority.

During the construction of the asphalt concrete surfacing, the current tests include:

- ongoing testing of constituent materials

- ongoing testing of the production of asphalt mixtures

- ongoing tests for the installation of the asphalt mixture

All tests within the ongoing testing should be conducted to the extent and in the manner prescribed by the valid Serbian standards SRPS U.E4.014/90.

CONTROL EXAMINATIONS

Control tests are carried out by the Investor or a company for quality control at his expense. Based on the results of the control tests, the Investor, or its Supervisory body, makes a final assessment of the quality of the provided asphalt layers.

Control tests include:

- control tests of constituent materials

- control examination of the produced asphalt mixture

- control tests of the provided asphalt layer

Control tests of materials

Control tests are performed on samples taken on an asphalt base.

From each type of material, one sample is taken per quantity of material required for the production of 5000 tons of asphalt mixture. The required quantities of materials are calculated based on the working composition of the asphalt mixture.

Filler

The following tests are performed:

|  |  |
| --- | --- |
| granulometric filler composition | SRPS B.B8.105 |
| share of the cavities in the dry-compressed state by Ridgen | SRPS B.B8.102 |

Sand

The following tests are performed:

|  |  |
| --- | --- |
| granulometric composition | SRPS B.B8.029 |
| sand equivalent | SRPS U.B1.040 |
| share of particles smaller than 0.09 mm | SRPS B.B8.036 |

Stone chippings

The following tests are performed:

|  |  |
| --- | --- |
| granulometric composition | SRPS B.B8.029 |
| share of particles smaller than 0.09 mm | SRPS B.B8.036 |
| grain shape |  |
| share of dilapidated grains | SRPS B.B8.037 |

Bitumen

The following properties have to be tested:

|  |  |
| --- | --- |
| Penetration at 25° C | SRPS B.H8.612 |
| Softening point by PK | SRPS B.H8.613 |
| Breaking point by Frass | SRPS B.H8.616 |
| Ductility at 25° C | SRPS B.H8.615 |
| Penetration index | SRPS B.H8.614 |

For every 10,000 tons of asphalt mixtures produced, all the properties of bitumen are tested according to SRPS U.M3.010 standard.

Control tests of the produced asphalt mixture

Samples of asphalt mixtures for the control test shall be taken at the place of installation of the asphalt mixture.

The composition and physical and mechanical properties of asphalt mixtures are checked by testing one sample for every 600 tons of asphalt mixture produced or at least 5,000 m² surface of the produced layer.

The following properties are tested:

|  |  |
| --- | --- |
| fraction of bitumen | SRPS U.M8.090 |
| granulometric composition | SRPS U.M8.090 |
| stability at 60° C | SRPS U.M8.090 |
| stability and deformation ratio at 60° C | SRPS U.M8.090 |
| share of cavities | SRPS U.M8.090 |
| filling of cavities with bitumen | SRPS U.M8.090 |

For each 5,000 t of produced asphalt mixture, changes of extracted binder type are tested by defining the following:

|  |  |
| --- | --- |
| Penetration at 25° C | SRPS B.H8.612 |
| Softening point by PK | SRPS B.H8.613 |
| Breaking point by Frass | SRPS B.H8.616 |

Control tests of the produced asphalt layer

Physical and mechanical properties and thickness of the produced layer are examined on samples taken at least at each 2000 m² of surface of the produced layer.

Sampling is performed according to SRPS U.M3.090.

The following features are tested:

|  |  |
| --- | --- |
| share of cavities | SRPS U.M8.090 |
| degree of compactness | SRPS U.M8.090 |
| Layer thickness | - |
| Layer flatness | - |
| Roughness and resistance to slipping | - |
| Adhesiveness of the layer | - |

The height, the cross-fall, and the position of the produced layer are checked by controlling the appropriate instruments, at least 20% of the data recorded by the Contractor during the current layer production control.

CRITERIA FOR CALCULATING EXECUTED WORKS

Flatness level of the layer and cross-fall

Measurement is performed by Contractor on cross-sectional profiles, with the distance between each other not exceeding 30 m. Measurement is performed with a 4 m long straighter (left, right, middle). The measurement results shall be submitted to the Supervisory Authority for inspection. The criteria are as follows:

|  |  |
| --- | --- |
| Flatness deviation from 0 to 4 mm | satisfactory |
| Flatness deviation from 4 to 10 mm | Not satisfactory and 5–25% of the surface value for the flatness is deducted |
| Flatness deviation above 10 mm | Not satisfactory and 100% of the surface value for the flatness is deducted |

The cross-fall of the surface of the produced asphalt concrete layer may deviate from the projected cross-fall for at most ± 0.4%.

Deviation of the surface layer from the projected reference level

The allowed height deviation of the surface of the produced wearing layer may deviate from the projected height for at most ± 5mm.

Horizontal deviation of the edge of the produced layer

The allowed horizontal deviation of the position of the left and right edges from the projected position is at most ± 25 mm.

Deviation in the thickness of the embedded layer

All deviations of the produced layer thickness from the projected layer thickness are subject to evaluation of the quality of the works performed if the Supervisory Authority estimates that the finished layer can remain in the road structure.

Measurement is done on each profile, and the criteria are as follows:

|  |  |
| --- | --- |
| for deviation of layer thickness of 6-8 mm | 10-25% of the value of this surface is deducted |
| for deviation of layer thickness of 8–10 mm | 26–50 % of the value of this surface is deducted |
| for deviation of layer thickness of more than 10 mm | The performed work is not accepted |

The percentage of the deduction will be determined by the Supervisory Authority based on the number of measurements and the percentage share of the results that deviate for more than -10% from the projected layer thickness.

Granulometric composition of the mineral mixture

If the granulometric composition of the extracted mineral mixture deviates from the limit curve in relation to the required granulometric curve, more than the tolerance standard, the Contractor will reduce the value of performed works of the wearing layer by 5.0% for the area covered by the sample tested. If there are several deviations from the tolerance standard, in all three components of the asphalt mixture, in the granulometric curve, in the filter and bitumen fractions, the asphalt layer cannot be accepted as valid.

Level of rolling (compactness) of the embedded layer

The acceptance criterion is the achieved degree of compaction that must be at least 98%. If there are more than 10% of tested samples with a degree of compactness of less than 98%, the works will be rejected.

Roughness and adhesiveness of the layer

The surface of the produced wearing layer must be rough, adhesive and slip resistant. These properties are tested according to SRPS U.C4.018 standard.

MEASUREMENT AND PAYMENT

The calculation is done by 1 m³ of the performed work, which corresponds to the required quality prescribed by these Technical Terms and Limits of Tolerance

3.06 LAYING OF CONCRETE PAVEMENTS

The work includes laying of concrete pavements measuring 18/24 cm. The pavements are laid on a prepared concrete base MB 15 of thickness of 10 cm, according to the design. Some details about the excavation, concrete substrate, concrete laying, grouting of joints and the rest should be carried out according to the details of the design. Watering of joints 1 cm wide. Application of cement mortar, which is made in a ratio of 1: 3. The height and position of the pavement must be in accordance with the design. The pavements must be MB 40 and have the attestations of the required quality. Only whole and undamaged pavements can be installed.

The calculation of the performed works is done per meter of the alongside laid pavements, for all work and material, including the supply and transport of the trench drains.

4. DRAINAGE

4.01 DRAIN MANUFACTURING

Production of concrete drains from finished vibrated concrete reinforced concrete pipes of Ø500mm with production of bottom from the compressed concrete MB20, with thickness of 12 cm. On the upper surface of concrete pipes - drains, the frame for the grid at the terrain level should be installed. Calculation by piece of a built-in drain set.

The drain is connected to the sewage. The price should include both piercing and connection of the sewage - drainage connections to the manhole.

The calculation of the performed works is done according to the piece of built drain, according to the above description, and the price includes all the costs of procurement and production. At the given location, the existing drains are being sealed and new ones are being built along the new edge of the pavement as a consequence of the expansion, so that the existing drainage connections can be kept, shortened and used for new drains.

ADDITIONAL WORKS

5.1 CLEANING, REGULATION AND PROFILING OF THE EXISTING DRAINAGE TRENCHES

5.2 EXCAVATION AND REGULATION OF NEW DRAINAGE TRENCHES

A drainage trench, without cladding, is created by excavating the soil according to details from the design or by the provisions of the Supervisory authority, in all categories of soil. All excavation surfaces, the bottom and the lateral sides of the trench, must be flat and with prescribed drops of the bottom and inclinations of the slopes. Excavation should be done mechanically, and manual work should be minimised and applied only where machinery cannot be operated.

Considering the urban conditions and the sporadic interruptions of the existing absorption ditches, these two items are calculated per length meter.

SAFETY AT WORK MEASURES

In terms of the Law on Safety at Work in Construction and the Law on Safety and Health at Work („Official Gazette” No. 101/2005 and 91/2015), the hazards that may arise during the construction and exploitation of roads and traffic signalling system, as well as the protection measures which should be undertaken can be classified into two groups:

A) Hazards during the execution of works and

B) Hazards during the exploitation of facilities

A.1) Hazards during the execution of works may arise:

• Due to damages and injuries from electrical and other lines and installations,

• Traffic hazards,

• Hazards from mechanical machines and tools

• Other hazards of injuries to persons when working with building materials and their transport.

A.2) In order to eliminate hazards during the execution of works, the following measures should be taken:

• Define the place, the area and the manner of depositing of building materials

When organising the site, it is necessary to take into account the location and the method of depositing the building materials. Materials resistant to external influences such as timber, finished coatings, reinforcement, concrete curbs, pipes, sand should be stored in the open space near the installation site or near the processing site. In the case of heavy rain, winds or frosts, they should be protected by covering them with nylon, paper or textile coverings. For works carried out in a free area under unfavourable climate, atmosphere or other influences, the use of appropriate personal protective equipment or equipment during the execution of these works is envisaged. The first aid cabinet must be installed on the construction site.

• Measures of protection during transportation, loading, unloading and depositing of the building materials

For the transport of building materials by freight motor vehicles on the construction site, the provisions of the regulations on safety and health at work in the maintenance of motor vehicles and transport by motor vehicles shall be applied (Official Journal of the SFRY No. 55/65) and the Rulebook on Safety at Work in loading freight onto freight motor vehicles (Official Journal of the SFRY No. 17/66).

The required building materials are transported by trucks. The transport of asphalt mass from the asphalt base is carried out by trucks, whereby the truck is covered with a solution of potassium soap. Transport vehicles for the transport of building materials, other load can be loaded up to the allowed weight on the public road and construction site.

Transportation of machinery from base to construction site shall be carried out with appropriate means of transport, with the prior approval of the competent authorities and in the manner prescribed by such approval.

Measures of protection by providing space for the storage of hazardous materials

Materials that can cause fire, explosion, poisoning and similar harmful effects on the life and health of workers and damage to material goods are considered as hazardous material on the construction site. Therefore, it is necessary to take the following protection measures:

- all easily flammable materials (billets, battens, boards ...) should be stored in places far enough away from the heat source

- all places on the construction site where there is a possibility of fire have to be provided by special protection measures according to the applicable regulations

- control of all places where harmful gases and excessive dust may occur, and provision of security to these places

Manner of securing hazardous sites and endangered areas on the construction site

The provisions of the Rulebook on jobs with special working conditions define the activities and tasks that pose an increased risk to the life and health of workers, which can not be removed by the prior general occupational safety measures. These tasks include:

- handling of construction machinery

- maintenance of installations, construction machinery and vehicles

- installation of asphalt mass

For work in places with increased danger to life and health, the following conditions must be met according to the above mentioned Rulebook:

- that the worker is above 18 and under 55 years of age

- that the worker is physically and mentally healthy

- that he/she is professionally competent for the work to be done

- that he/she is familiar with the dangers and safety measures at work

- to ensure that personal protective equipment and equipment are provided and made available to workers, in accordance with the provisions of the Rulebook on the Use and Maintenance of Personal Protective Equipment and Tools

- placement of construction machinery and the manner of their provision

Construction machines must be inspected and checked for their roadworthiness before putting them in operation. The machinery is located along the route of the road. The security of construction machinery is carried out by an organised guard service.

The operator of a construction machine driven by an internal combustion engine must be protected against the harmful effects of exhaust gases. Parts of self-propelled construction machines must be easily and safely replaced. The handling site must be positioned in such way that the machine operator is enabled to have a clear visibility of the ground on which it is moving. Self-propelled construction machinery must have a device for producing sound signals.

Measures of protection at work during the performance of earth and asphalt works

When carrying out earthworks, special attention should be paid to taking protective measures against collapsing. If it is a land in which there is a possibility of collapse, it is necessary to take into account the inclination of the slopes, that is, the angle of internal friction, which will not cause slipping. Mechanical handling during earthworks can only be entrusted to skilled workers familiar with occupational hazards.

During machine digging, the excavated land should be disposed of at a distance that does not endanger the stability of the side excavation due to other excavation work.

Prior to the concreting, any sharp edges or edges of the bonding means protruding from the panelling must be tucked in or covered. Concrete work is done by trained workers.

For asphalt works, the material used for road asphalting (bitumen) must be heated only in special closed vessels. If the asphalt mass catches fire, it must not be extinguished with water. Extinguishing tools (sand, seal, etc.) must be prepared in advance. Coating and wetting of the roller for flattening the asphalt is carried out using especially designed appliances. A worker is forbidden to walk in front of the motorised flattening roller while coating it and wetting it.

Asphalt works can be performed only by healthy persons specially trained and equipped for such tasks.

- Measures for protection of electrical installations

All works on performing, repairing, maintaining and removing electrical installations, devices and equipment should be performed by a professionally qualified person in accordance with technical regulations and standards. All cables laid on the ground should be protected from mechanical or other damage. Before commissioning, a detailed control of all electrical installations, devices and equipment should be conducted.

Personal protective equipment

Personal protective equipment (protective equipment) should be provided for all workers at the site exposed to weather influences.

The quality of equipment materials as well as resistance to harmful effects (high or low temperature, fire, impacts, corrosion, water, toxic gases and dust) is primarily dependent on the purpose i.e. workplace. All outdoor workers, as well as persons visiting the site, must wear protective helmets. Protective clothing and footwear are envisaged as personal protective equipment.

Fire protection

In all places on the construction site where there is a risk of ignition of highly flammable materials, it is mandatory to implement the measures of the PPE. For this purpose, a sufficient number of fire extinguishers, sand barrels, two barrels with water, a pick, shovel, etc. should be provided.

It is also necessary to place all fire protection products in accessible places and paint them in red, as well as keep them in the usable state.

Organisation of first aid

In order to provide first aid to injured workers at the construction site, it is necessary to ensure that a first-aid worker has at his disposal one medical kit with proper medical supplies.

B.1 Hazards during exploitation can be caused by the traffic for which they are intended and the hazards of damage to certain parts of the facility.

B.2 In order to eliminate traffic hazards in the design and technical documentation, adequate traffic signalisation is foreseen, which road users must adhere to, as well as the Law on Road Traffic Safety.

MEASURES FOR ENVIRONMENTAL PROTECTION

In terms of environmental protection, it is necessary to provide the following:

1. Measures for protection against air pollution and

2. Measures for the protection of green areas

In order to protect the environment, it is necessary to implement appropriate preventive measures in accordance with the environmental conditions during designing and the execution of the design.

Measures for protection against air pollution

Air protection is achieved by undertaking measures of systematic monitoring of air quality, reducing air pollution by polluting substances below prescribed limit values ​​and undertaking technical and other necessary measures to reduce emissions, monitoring the impact of polluted air on human health and the environment. Air protection measures provide the preservation of the atmosphere as a whole with all its processes and climate features.

Measures for the protection of green areas (soil and land)

Protection, use and organisation of soil, agricultural and forest land and resources of general interest include the preservation of productivity, structure, layers, formations of rocks and minerals, as well as their natural and transitional forms and processes.

On the surface or below the surface of the soil, activities can be carried out and materials that do not pollute or damage the land could be deposited.

During the realisation of projects, as well as before their execution (construction, exploitation of mineral resources, etc.), the protection of soil and land is ensured.

WORKS of traffic signalization project

**TECHNICAL REPORT**

Subject:

*Tecnical documentation for enhanced maintenance of IB class state road No.15,*

*Section: Hun/Ser Border (Bački Breg) – Sombor from km 0+000.00 to km 24+264.52*

*(intersection Sombor (Bezdan) at km 53+613.00) and*

*IB class state road No.12, Section: from km 53+613.00 to km 56+622.87*

*Book 2:*

IB class state road No.12, Section: from km 54+963.24 to km 56+622.87

Investor:

*„PUTEVI SRBIJE“ Public Company, Belgrade*

Design organisation:

*VIA PROJEKT DOO, Belgrade*

Responsible designer:

*Branislav Jovanović, B.Traff.Eng.*

This design envisages enhanced maintenance of roads fromthe border crossing Bački Breg to the city of Sombor, so the given design includes the following sections of the state roads according to the books:

Book 1: IB class state road No.15, section: Hun/Ser border (Bački Breg) - Bezdan from km 0 + 000.00 to km 10 + 254.76

Book 2: IB class state road No.15, section: Bezdan - Sombor, from km 10 + 254.76 to km 24 + 264.52 (intersection Sombor (Bezdan) at km 53 + 613.00) and the IB class state road No.12, Section: from km 53 + 613.00 to km 54 + 963.24

Book 3: class state road No.12, Section: from km 54 + 963.24 to km 56 + 622.87

INTRODUCTION

Technical documentation for enhanced maintenance of the I-class state road No.18, Section: Bački Breg - Bezdan from km 0 + 000.00 to km 10 + 254.76, I-class state road No. 17.1, Section: Bezdan - Sombor from km 42 + 754.00 to km 58 + 107.34 and Matije Gupca Street in Sombor was prepared in 2011. This project was certified by the responsible Ministry of Infrastructure and Energy and a certificate on the receipt of technical documentation No. 344-08-25465 / 2012-03 from 26/06/2012 was issued for it.

Due to the amendment of the Rulebook on Traffic Signalisation and the issued new reference system of state roads in the Republic of Serbia, the technical documentation was adapted. Changes in the name of the technical documentation have been made so that the number of roads and chainages is in accordance with the valid reference system of the state roads of the Republic of Serbia. New design solutions for traffic signalisation and traffic signalisation in the work area were provided in accordance with the valid regulations on traffic signalisation.

The following table gives a comparative overview of the title of the designs, books and volumes of the technical documentation from 2011 and the names and contents of the technical documentation should have in order to be in line with the valid reference system of state roads in the Republic of Serbia:

|  |  |
| --- | --- |
| The name of the technical documentation according to the old reference system  (Technical documentation from 2011) | Name of technical documentation according to new - valid reference system |
| **Technical documentation for enhanced maintenance of I-class state road No. 18 Section: Bački Breg - Bezdan from km 0 + 000.00 to km 10 + 254.76 I-class state road No.17.1 Section: Bezdan - Sombor from km 42 + 754.00 to km 58 + 107.34**  **and Matije Gupca Street in Sombor** | **Technical documentation for enhanced maintenance of I-class state road No.15, Section: HUN/SER border (Bački Breg) - Sombor from km 0 + 000.00 to km 24 + 264.52 (intersection Sombor (Bezdan) at km 53 + 613.00) and I-class state road No.12, Section: from km 53 + 613.00 to km 56 + 622.87** |
| * **Book 1** * **Section: Bački Breg - Bezdan from km 0 + 000.00 to km 10 + 254.76** * Volume 1.1Route * Volume 1.2.1 Typical and critical cross- sectional profiles from km 0 + 000.00 to km 4 + 996.63 * Volume 1.2.2 Typical and critical cross-sectional profiles from km 4 + 996.63 to km 10 + 254.76 * Volume 1.3 Facilities on the route * Volume 2 Traffic signalisation and equipment * Volume 3 Temporary traffic signalisation and equipment | * **Book 1** * **IB-class state road No.15, Section: Hun/Ser border (Bački Breg) - Bezdan from km 0 + 000.00 to km 10 + 254.76** * Volume 1.1Route * Volume 1.2.1 Typical and critical cross- sectional profiles from km 0 + 000.00 to km 4 + 996.63 * Volume 1.2.2 Typical and critical cross-sectional profiles from km 4 + 996.63 to km 10 + 254.76 * Volume 1.3 Facilities on the route * Volume 2 Final design for traffic signalling system * Volume 3 Final design for traffic signalling system in the working zone |
| * **Book 2**   **Section: Bezdan – Sombor from km 42+754.00 to km 58+107.34**   * Volume 1.1Route * Volume 1.2.1 Typical and critical cross- sectional profiles from km 42+754.00 to km 50+505.00 * Volume 1.2.2 Typical and critical cross-sectional profiles from km 50+505.00 to km 58+107.34 * Volume 1.3 Facilities on the route * Volume 2 Traffic signalisation and equipment * Volume 3 Temporary traffic signalisation and equipment | * **Book 2** * **IB-class state road No.15, Section: Bezdan - Sombor from km 10+254.76 to km 24+264.52 (intersection Sombor (Bezdan) at km 53+613.00) IB-class state road No.12, Section: from km 53 + 613.00 to km 54 + 963.24** * Volume 1.1Route * Volume 1.2.1 Typical and critical cross- sectional profiles in the IB-class state road No.15 from km 10+254.76 to km 18+005.78 * Volume 1.2.2 Typical and critical cross-sectional profiles in the IB-class state road No.15 from km 18+005.78 to km 24+264.52 IB class state road No.12 from km 53+613.00 to km 54+963.24 * Volume 1.3 Facilities on the route * Volume 2 Final design for traffic signalling system   Volume 3 Final design for traffic signalling system in the working zone |
| * **Book 3**   **Matije Gupca Street in Sombor from km 0+000.00 to km 1+662.551**   * Volume 1.1Route * Volume 2 Traffic signalisation and equipment * Volume 3 Temporary traffic signalisation and equipment | * **Book 3**   **IB class state road No.12, Section: from km 54+963.24 to km 56+622.87**   * Volume 1.1Route * Volume 2 Final design for traffic signalling system * Volume 3 Final design for traffic signalling system in the working zone |
| **Book 4: Road structure of the I-class state road No.18, Section: Bački Breg - Bezdan from km 0 + 000.00 to km 10 + 254.76 and I-class state road No.17.1 Sections: Bezdan - Sombor from km 42 + 754.00 to km 58 + 107.34 and Matije Gupca Street in Sombor 0 + 000.00 to km 1 + 662.551** | **Book 4: Road structure of the IB class state road No.15, Section: HUN/ SER border (Bački Breg) border - Sombor from km 0 + 000.00 to km 24 + 264.52 (Sombor (Bezdan) intersection at km 53 + 613.00) and IB class state road No.12, Section: from km 53 + 613.00 to km 56 + 622.87** |

**Note**: In 2011, Matije Gupca Street in Sombor was not part of the state road, but a street in the settlement, while the other processed sections of the roads were part of the state roads. According to the valid state road network, all analysed roads and streets are state roads of IB class number 12 and 15, including the street of Matija Gupca, which is classified into part of the IB class state road No.12.

Within the framework of the design for enhanced maintenance (improvement), the design for traffic signalisation and equipment for the section of the IB class state road No.12, Section: from km 54 + 963.24 to km 56 + 622.87 was also drafted.

The design was drafted on the basis of the construction design for enhanced maintenance and on the basis of the visit of the given section when the real state of the spatial and physical structure in the beltway were identified as well as components that are significant for traffic safety and design of traffic signalisation and equipment.

During the drafting of the design, the Designer noted certain deviations of the construction design in relation to the existing situation on the field. These deviations refer to the geodetic basis used as the grounds for the development of the construction solution and include existing crossings with the field roads, the position of the road approaches, the location of the tree-lined paths, access roads to the hiking trails, and so on. This traffic signalling and equipment design was made based on and in accordance with the solution from the **construction design**.

For the purpose of the design development, the Traffic Signalling system Designer took over the completed substrates from the construction design in dwg format (situational plan, longitudinal profile and transverse profiles) from the construction designer.

Based on the analysis of the taken documentation and conducted field surveys, the design of the traffic signalisation and equipment was prepared in relation to driving-dynamic and optical analysis, and in the function of the applied elements of the design geometry. This primarily refers to the definition of the maximum speed of the vehicle in free flow in the curves, checking the conformity and dynamic homogeneity of the pathway elements, determining the required clear sight, the available and overtaking visibility etc. In addition to this, the Designer has paid special attention to the analysis of the sections where the existing condition of the guardrail for vehicles was screen, in the vicinity of school zones and other locations where there is a higher degree of vulnerability of participants in the traffic.

Traffic signalisation and equipment foreseen by this design is compliant with the applicable regulations. During the development of the design, the technical control of the design was carried out simultaneously. The designer acknowledged the remarks and suggestions of technical control and in accordance with the possibilities arising from the regulations related to the subject area, applied adequate traffic technical measures.

The given design was developed based on the following conditions, data and regulations:

1. Agreement concluded with the investor;

2. Terms of reference;

3. Construction design of relevant sections of the road and data obtained from the construction designer;

4. Field research;

5. Applicable Law on Traffic Safety on Roads;

6. Applicable Law on Roads;

7. Applicable Rulebook Traffic Signalisation;

8. Applicable standards;

9. Technical instructions issued by the PC Putevi Srbije.

After surveying the terrain, it was determined that the existing traffic signalisation was not mutually harmonised, that it was mostly worn out and that was is not more in line with the Rulebook on Traffic Signalisation, so the design envisages the removal of the existing and the installation of new traffic signalisation.

INTERSECTIONS OF THE GIVEN ROAD:

At the intersections with the aforementioned road, that is, on the secondary access points, the designer applied the appropriate traffic technical measures depending on the construction solution or the substrate he used when drafting the design. In fact, most crossroads were processed but also geodetically surveyed so the construction solution was provided only in the belt covered by the intersections while further access solution was not shown. In accordance with the abovementioned and depending on the specific solution of the intersection, the designer carried out traffic regulation with adequate vertical signalling, while horizontal signalling was applied only at intersections at which conditions existed for its application. Where there were no conditions for marking the signs on the roadway on the side access roads, the traffic signalisation was fitted into the existing state.

## APPLIED ELEMENTS OF TRAFFIC SIGNALISATION AND EQUIPMENT

## Traffic and technical equipment is displayed graphically in clear sight traffic situations in the scale of 1: 1000.

## The position of the signalling and equipment elements is determined by the chainage which is registered next to them, and their position in the cross section is defined by the data given in special supplements (details of traffic signalisation and equipment). More precise data needed for the design and implementation of signalisation and equipment elements are given in separate drawings. These drawings are an integral part of the design and the contractor is obliged to adhere to them.

Applicable elements of traffic signalisation and equipment are shown in the specification that is an integral part of the design.

Conditions that the applied elements of traffic signalling and equipment must satisfy, the material used for their production, the method of installation, etc. are all given in the Technical Conditions which are also an integral part of the design.

**TRAFFIC SIGNS AND SUPPORTS**

This category of traffic signalisation includes: traffic signs warning of danger, explicit orders and notifications, signs for marking the beginning and ending of the populated place, signs of traffic guidance (road signs) and traffic sign supports.

In the graphic part of the design, the traffic situation presents the disposition of all traffic signs, including their symbol, code and chainage installation.

### TRAFFIC SIGNS

Traffic signs are harmonised with regard to the layout and position with the Traffic Safety Signal and the Rulebook on Traffic Signalisation, as well as the applicable Serbian standards.

Traffic signs have dimensions that meet the traffic conditions on the designed section (I-class state road): triangular with sides of 90 cm, round with diameter of 60 cm, octagonal with 60 cm in diameter and rectangular of 60 x 90 cm, as well as additional boards of appropriate dimensions.

The position of the sign in the transverse profile and the manner of installation in relation to the direction and route of the vehicle movement is given in a special detail.

Standard signs are all made according to the details of the drawings in Serbian standards, under the names, codes and appearance according to the Rulebook on Traffic Signalling (SRPS Z.S2 from 301 to 309). Standard signs are made from materials and in the manner prescribed in SRPS EN 12899.

The material used to create the front part of the sign must have retro reflective properties of classes II and III.

### NOTIFICATION SIGNS FOR TRAFFIC GUIDANCE

All these signs are specifically designed for their construction. The elements of these signs are conformed to Serbian standards. This group of signs used in this design include road sign boards (III-206).

In accordance with the Law on the Official Use of the Language and Scripts of the Republic of Serbia, the use of Cyrillic and Latin letters is foreseen on all signs.

These signs are made from materials and in the manner prescribed in SRPS EN 12899 (technical conditions - general requirements for preparation and testing). The material used for the production must have retroreflective properties of class III.

The graphic part of the design gives an overview of all the details necessary for creating and placing signs. The signs are set so that their flat surface deviates by 3 to 5° in the field from the perpendicular field to the axis of the road.

Signs are mounted on supports consisting of two or more parallel vertical supports, in the manner specified by the design, in situations and in detailed drawings. The signs must be secured from turning and sliding with steel clamps with screws.

For these signs, a static construction budget was made, where the required supports and foundations were designed.

### SUPPORTS OF TRAFFIC SIGNS

In the framework of the design, single pillar pipe supports were applied.

In the specification, bill of quantities and the calculation, the supports applied in the design are presented.

Pillars are placed on concrete foundations, prefabricated or poured on site, with minimum of MB 20brand. The dimensions of the foundations are also determined by the influence of the wind, given the size and number of signs on the support.

The length (height) of the support is determined from the details of the position of the sign, and according to the size and number of signs on them, the depth of the foundation and the chosen method of attachment of the signs to the support. Extension, or shortening due to the slope of the terrain, is determined by the manufacturer in the field or in the design.

## ROAD MARKINGS

Horizontal signalling elements: longitudinal lines (SRPS U.S4 222, 223, 224 and 231), transversal markings (SRPS.U.S4. 225) and other markings on the roadway (SRPS U.S4 229, 230 and 233) which are intended to separate and direct traffic flows as well as to limit areas not intended for the movement of vehicles (routing fields), to indicate the purpose of the traffic lane (arrows) and places reserved for bus stops marked in yellow.

The longitudinal markings (dividing and boundary lines) are made in white and have a thickness of 15 cm.

The edges are marked with the entire length of the given road with the interrupted line of the 1 + 1 raster, except where it is possible to separate the traffic flows and at the places where there are pavements, as shown in the situational plans.

In the connector zones, the unbroken dividing line is interrupted by the line 1 + 1 m.

The routing fields are marked according to the drawings or situational plans in the design. The width of the lines to which the field is paved is 0.15 meters.

The designer marked pedestrian crossings at locations where they were marked in the existing state. Given the intensity of vehicle and pedestrian flow, there is no need to mark additional pedestrian crossings.

The project gives an overview of the solutions of individual marking positions on the roadway. The situational plans and detailed drawings provide dispositions and all necessary dimensions of individual elements of horizontal signalling, for their effective marking in the field.

Dimensions, colours and rhythm of breaks are given in the drawings in the design.

Material, performance technology and other properties are determined in technical conditions.

## ELEMENTS OF TRAFFIC EQUIPMENT

## GUARDRAILS

The guardrail represents the most frequently used element of road equipment that directly and exceptionally significantly influences the implementation of passive traffic safety. The design of the guardrail was carried out on the basis of the Technical Instructions for the Implementation of the Vehicle Retention System on the State Roads of the Republic of Serbia issued by PE Putevi Srbije.

The design also envisages the installation of a guardrail (N2W4) in the shoulder, on micro-location and in the length of the existing guardrail in the field.

The specification, bill of quantities and the pro forma invoice shall indicate the continuous length of the applied guardrail with the length of the sloping ends.

The detail of the installation of the guardrail is shown in detailed drawings. In the situational plans, the end and the beginning of the rail setting are defined by chainage and are determined in the direction of the growth of the chainage.

The distance between the pillars of the guardrail is 2.0 meters.

The sloping end elements of the guardrail are installed by descending and digging in parallel to the edge of the roadway, according to detailed drawings.

Reflecting bodies (catadiopters) are built into the grooves of the guardrail, whose colour is the same as in direction posts. They are placed at a distance of 8 meters.

**CALCULATION FOR THE BOARD CONSTRUCTION**

Within the calculation of the construction of boards, taking into account the effect of the wind on the surface of the board, the following calculations were made: the number and types of pillars, pillar beds and foundations.

**CALCULATION FOR THE ROAD SIGN BOARD CONSTRUCTION III-206 (12.1)**

Geometry of the road signboards:

Width: B = 1.4 m

Height: H = 1 m

Lower edge distance from the ground: h = 1.4 m

Horizontal impact on the structure (wind):

Zone: 2

**Distributed wind load w=0,7 kN/m2**

Calculation for the quantity and type of pillars:

**Grate type: R-60-30-1**

Pillar U: HOP Pipe D=60,3 x 3,2 l=2.4 m PCS 2

Pillar O: HOP Pipe D=60,3 x 3,2 l=1.8 m PCS 2

Filling D: HOP Pipe D=17,1 x 2 l=0.67 m PCS 6

Filling V: HOP Pipe D=17,1 x 2 l=0.3 m PCS 4

Distance between pillars: 63.97 cm

Maximum forces and voltages in bars:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **O** | **U** | **D** | **V** |
| **F [kN]** | 2.12 | 3.1 | 1.1 | 0.49 |
| **sdop [MPa]** | 59.88 | 125.13 | 66.59 | 136.25 |
| **sstv [MPa]** | 3.7 | 5.41 | 11.56 | 5.17 |

Calculation for the pillar beds:

Tensile force in the pillar support: 3.1 kN

Required anchor diameter:



Required anchor length:

 **Adopted anchors: 4 M12...300**

Required bed panel thickness:

 Adopted bed panels**: 160 x 5...160**

Foundation calculation:

Ht= 0.8 m

Bt= 0.8 m

M= 1.32 kNm

 **Adopted foundation: H x B x L = 0,8 x 0,8 x 0.5 m**

***CALCULATION FOR THE ROADSIGN BOARD CONSTRUCTION III-206(12.2)***

*Geometry of the road* signboards:

Width: B = 1.4 m

Height: H = 1 m

Lower edge distance from the ground: h = 1.4 m

Horizontal impact on the structure (wind):

Zone: 2

**Distributed wind load w=0,7 kN/m2**

Calculation for the quantity and type of pillars:

**Grate type: R-60-30-1**

Pillar U: HOP Pipe D=60,3 x 3,2 l=2.4 m PCS 2

Pillar O: HOP Pipe D=60,3 x 3,2 l=1.8 m PCS 2

Filling D: HOP Pipe D=17,1 x 2 l=0.67mPCS 6

Filling V: HOP Pipe D=17,1 x 2 l=0.3m PCS 4

Distance between pillars: 63.97 cm

Maximum forces and voltages in bars:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **O** | **U** | **D** | **V** |
| **F [kN]** | 2.12 | 3.1 | 1.1 | 0.49 |
| **sdop [MPa]** | 59.88 | 125.13 | 66.59 | 136.25 |
| **sstv [MPa]** | 3.7 | 5.41 | 11.56 | 5.17 |

Calculation for the pillar beds:

Tensile force in the pillar support: 3.1 kN

Required anchor diameter:



Required anchor length:

 **Adopted anchors: 4 M12...300**

Required bed panel thickness:

 **Adopted bed panels: 160 x 5...160**

Foundation calculation:

Ht= 0.8 m

Bt= 0.8 m

M= 1.32 kNm

 **Adopted foundation: H x B x L = 0,8 x 0,8 x 0.5 m**

**NOTICE TO THE CONTRACTOR**

The obligation of the Contractor is to pay particular attention to the following facts:

1. **Since the Designer did not have sufficient precise data on the access points to the relevant road and field merges, it is necessary to interrupt the unbroken edge and dividing lines, the 1 + 1 line in the access zone and the merges during the execution of the works;**
2. **Considering that on the construction substrate, which was used for designing, insufficient segment of the side access points was covered, the design envisages integration of traffic signalisation into the existing state**
3. **When performing works on the placement of traffic signs, the contractor may determine the second micro location for the installation of signs in relation to the design, if the traffic sign placed on the intended location would not be visible or if there is some physical obstacle to its installation.**

**ENCLOSED MEASURES FOR SAFETY AT WORK AND ENVIRONMENTAL PROTECTION**

**SAFETY AT WORK MEASURES**

In terms of the Law on Safety at Work in Construction and the Law on Safety and Health at Work („Official Gazette” No. 101/2005 and 91/2015), the hazards that may arise during the construction and exploitation of roads and traffic signalling system, as well as the protection measures which should be undertaken can be classified into two groups:

A) Hazards during the execution of works and

B) Hazards during the exploitation of facilities

**A.1)** Hazards during the execution of works may arise:

• Due to damages and injuries from electrical and other lines and installations,

• Traffic hazards,

• Hazards from mechanical machines and tools

• Other hazards of injuries to persons when working with building materials and their transport.

**A.2)** In order to eliminate hazards during the execution of works, the following measures should be taken:

• Define the place, the area and the manner of depositing of building materials

When organising the site, it is necessary to take into account the location and the method of depositing the building materials. Materials resistant to external influences such as timber, finished coatings, reinforcement, concrete curbs, pipes, sand should be stored in the open space near the installation site or near the processing site. In the case of heavy rain, winds or frosts, they should be protected by covering them with nylon, paper or textile coverings. For works carried out in a free area under unfavourable climate, atmosphere or other influences, the use of appropriate personal protective equipment or equipment during the execution of these works is envisaged. The first aid cabinet must be installed on the construction site.

• Measures of protection during transportation, loading, unloading and depositing of the building materials

For the transport of building materials by freight motor vehicles on the construction site, the provisions of the regulations on safety and health at work in the maintenance of motor vehicles and transport by motor vehicles shall be applied (Official Journal of the SFRY No. 55/65) and the Rulebook on Safety at Work in loading freight onto freight motor vehicles (Official Journal of the SFRY No. 17/66).

The required building materials are transported by trucks. The transport of asphalt mass from the asphalt base is carried out by trucks, whereby the truck is covered with a solution of potassium soap. Transport vehicles for the transport of building materials, other load can be loaded up to the allowed weight on the public road and construction site.

Transportation of machinery from base to construction site shall be carried out with appropriate means of transport, with the prior approval of the competent authorities and in the manner prescribed by such approval.

* Measures of protection by providing space for the storage of hazardous materials

Materials that can cause fire, explosion, poisoning and similar harmful effects on the life and health of workers and damage to material goods are considered as hazardous material on the construction site. Therefore, it is necessary to take the following protection measures:

* All easily flammable materials (billets, battens, boards ...) should be stored in places far enough away from the heat source
* all places on the construction site where there is a possibility of fire have to be provided by special protection measures according to the applicable regulations
* control of all places where harmful gases and excessive dust may occur, and provision of security to these places
* Manner of securing hazardous sites and endangered areas on the construction site

The provisions of the Rulebook on jobs with special working conditions define the activities and tasks that pose an increased risk to the life and health of workers, which cannot be removed by the prior general occupational safety measures. These tasks include:

* handling of construction machinery
* maintenance of installations, construction machinery and vehicles
* installation of asphalt mass

For work in places with increased danger to life and health, the following conditions must be met according to the above mentioned Rulebook:

* that the worker is above 18 and under 55 years of age
* that the worker is physically and mentally healthy
* that he/she is professionally competent for the work to be done
* that he/she is familiar with the dangers and safety measures at work
* to ensure that personal protective equipment and equipment are provided and made available to workers, in accordance with the provisions of the Rulebook on the Use and Maintenance of Personal Protective Equipment and Tools
* placement of construction machinery and the manner of their provision

Construction machines must be inspected and checked for their roadworthiness before putting them in operation. The machinery is located along the route of the road. The security of construction machinery is carried out by an organised guard service.

The operator of a construction machine driven by an internal combustion engine must be protected against the harmful effects of exhaust gases. Parts of self-propelled construction machines must be easily and safely replaced. The handling site must be positioned in such way that the machine operator is enabled to have a clear visibility of the ground on which it is moving. Self-propelled construction machinery must have a device for producing sound signals.

* Measures of protection at work during the performance of earth and asphalt works

When carrying out earthworks, special attention should be paid to taking protective measures against collapsing. If it is a land in which there is a possibility of collapse, it is necessary to take into account the inclination of the slopes, that is, the angle of internal friction, which will not cause slipping. Mechanical handling during earthworks can only be entrusted to skilled workers familiar with occupational hazards.

During machine digging, the excavated land should be disposed of at a distance that does not endanger the stability of the side excavation due to other excavation work.

Prior to the concreting, any sharp edges or edges of the bonding means protruding from the panelling must be tucked in or covered. Concrete work is done by trained workers.

For asphalt works, the material used for road asphalting (bitumen) must be heated only in special closed vessels. If the asphalt mass catches fire, it must not be extinguished with water. Extinguishing tools (sand, tarp, etc.) must be prepared in advance. Coating and wetting of the roller for flattening the asphalt is carried out using especially designed appliances. A worker is forbidden to walk in front of the motorised flattening roller while coating it and wetting it.

Asphalt works can be performed only by healthy persons specially trained and equipped for such tasks.

- Measures for protection of electrical installations

All works on performing, repairing, maintaining and removing electrical installations, devices and equipment should be performed by a professionally qualified person in accordance with technical regulations and standards. All cables laid on the ground should be protected from mechanical or other damage. Before commissioning, a detailed control of all electrical installations, devices and equipment should be conducted.

* Personal protective equipment

Personal protective equipment (protective equipment) should be provided for all workers at the site exposed to weather influences.

The quality of equipment materials as well as resistance to harmful effects (high or low temperature, fire, impacts, corrosion, water, toxic gases and dust) is primarily dependent on the purpose i.e. workplace. All outdoor workers, as well as persons visiting the site, must wear protective helmets. Protective clothing and footwear are envisaged as personal protective equipment.

* Fire protection

In all places on the construction site where there is a risk of ignition of highly flammable materials, it is mandatory to implement the measures of the PPE. For this purpose, a sufficient number of fire extinguishers, sand barrels, two barrels with water, a pick, shovel, etc. should be provided.

It is also necessary to place all fire protection products in accessible places and paint them in red, as well as keep them in the usable state.

* Organisation of first aid

In order to provide first aid to injured workers at the construction site, it is necessary to ensure that a first-aid worker has at his disposal one medical kit with proper medical supplies.

**B.1** Hazards during exploitation can be caused by the traffic for which they are intended and the hazards of damage to certain parts of the facility.

**B.2** In order to eliminate traffic hazards, adequate traffic signalisation is foreseen in the design and technical documentation as well as the Law on Road Traffic Safety, which road users must adhere to.

**MEASURES FOR ENVIRONMENTAL PROTECTION**

In terms of environmental protection, it is necessary to provide the following:

1. Measures for protection against air pollution and

2. Measures for the protection of green areas

In order to protect the environment, it is necessary to implement appropriate preventive measures in accordance with the environmental conditions during designing and the execution of the design.

* Measures for protection against air pollution

Air protection is achieved by undertaking measures of systematic monitoring of air quality, reducing air pollution by polluting substances below prescribed limit values ​​and undertaking technical and other necessary measures to reduce emissions, monitoring the impact of polluted air on human health and the environment. Air protection measures provide the preservation of the atmosphere as a whole with all its processes and climate features.

* Measures for the protection of green areas (soil and land)

Protection, use and organisation of soil, agricultural and forest land and resources of general interest include the preservation of productivity, structure, layers, formations of rocks and minerals, as well as their natural and transitional forms and processes.

On the surface or below the surface of the soil, activities can be carried out and materials that do not pollute or damage the land could be deposited.

During the realisation of projects, as well as before their execution (construction, exploitation of mineral resources, etc.), the protection of soil and land is ensured.

**6. TECHNICAL CONDITIONS FOR WORK PERFORMANCE**

Technical conditions for carrying out works are harmonised in all with the rules on traffic signalisation and specification of works for this design. The item numbers in the technical conditions for performance are in line with the item numbers in the Traffic Signalling Regulation.

The contractor must submit the appropriate documentation to the supervisory authority: the quality certificate of the film classes 1 and 2 and 3, the certificate of quality of the traffic sign board and their compliance with the standard SRPS EN 12899 (Official Gazette of the RS No.134 dated 11th December, 2014), Article 84 Minimum Conditions):

1. Class load-based safety factor (PAF1)

2. Wind pressure class (WL5)

3. Dynamic snow pressure class (DSL1)

4. The largest temporary class deflection (TDB4),

issued by an accredited laboratory.

Traffic signalisation must be produced in accordance with Technical Instructions Nos. BS-02/2013 and BS-03/2013.

Elements of traffic signalisation, covered by this project are:

**1. TRAFFIC SIGNS**

**2. MARKINGS ON THE ROAD**

**6. LIGHTING MARKINGS ON THE ROAD**

**7. ROAD EQUIPMENT**

**8. TECHNICAL MEANS FOR SLOWING DOWN THE TRAFFIC**

**10. OTHER WORKS**

• Technical conditions for the design, procurement and installation of certain elements of traffic signalisation are explained through individual items of these works.

• Ordering of traffic signalling elements is conducted on the basis of design specifications.

• The construction of certain elements is performed on the basis of European regulations, SRPS standards, the Traffic Signalling Rulebook ("Official Gazette of the Republic of Serbia" No. 134/2014, hereinafter referred to as „the Rulebook“) as well as detailed drawings in the design. In the process of creating traffic signs, their manufacturers are obligated to abide by the provisions of the Technical Instructions (with binding application) on the manner of testing and the procedure of assessing the conformity of traffic signs on the state roads of the Republic of Serbia with the requirements of the standards, adopted by the PC "Putevi Srbije" Belgrade.

• Traffic requirements for the background of the traffic sign: For all traffic signs including constructive reinforcements, the traffic sign should be painted gray in accordance with RAL 7043, minimum thickness of 12 μm (in accordance with EN 13523-1).

• Traffic sign design Requirements: traffic signs with an area not exceeding 1.1 m2 must be compact. Traffic signs whose surface exceeds 1.1 m2 may comprise more components, with necessary construction reinforcement on the back of the sign.

• The installation or execution of certain elements of traffic signalisation is carried out on the basis of situational solutions, transversal profiles and other drawings from the design, as well as on the basis of the Traffic Signalling Rulebook and SRPS standards.

**1. TRAFFIC SIGNS**

Traffic signs are made of metal and in the manner prescribed by the Rulebook. Standard traffic signs are made of the following materials:

 galvanized steel sheet with bevelled edge (abbreviated GSSBE),

 aluminium sheet (AS),

 clamp-reinforced aluminium sheet (CRAS),

 Aluminium sheet with bevelled edge (ASBE).

 For the production of traffic signs, aluminium materials with tensile strength of 155 N / mm2 for traffic signs with bevelled edges and extruded aluminium profile (clamps) and minimum 200 N / mm2 for straight signs are allowed to be used.

 Materials in accordance with DIN EN 573-1 and 573-2, or materials with the following labels can be used:

- EN AW 52 51 H 24 / H 34,

- EN AW 30 05 H 22 / H 49,

- EN AW 57 54 H 22 / H 34 / H 42.

 Aluminium materials can be used for making components of the sign assembly and extruded elements in accordance with DIN EN 573-3, i.e. materials with the following labels:

* EN AW 60 60 T 4 / T 66,
* EN AW 60 05 A / T 6.

The front of the sign, with all the symbols, letters and numbers, must have reflective properties of classes II and III.

Since the subject of processing includes sections in the settlements and traffic junctions of the reference system on the state road, the design envisages setting of standard traffic signs for this road category in accordance with the Traffic Signalling Rulebook, Technical Recommendation and SRPS standard.

* Traffic signs along the road are set at a height of 1.20 to 1.40 m, except for signs of traffic guidance in the zone of intersection, which are set at a height of 1.40 m.
* The set signs must be secured from turning and sliding.
* The set signs must be maintained regularly.
* The signs are set so that their flat surface deviates from the horizontal by 3 to 5º in the perpendicular field to the axis of the road.
* The position of the sign in the transversal profile is determined by the design.
* Traffic signs are placed on the pillar next to the roadway on the right side, in the direction of movement.
* Not more than two traffic signs may be placed on the same pillar, with or without a supplementary table per sign.
* The height is calculated from the surface of the roadway to the lower edge of the traffic sign.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign located on the road, intersections and in the settlement, outside the pedestrian area, shall be between 0.75 to 1.50 m. Exceptionally, it is 0.5m high if there is a protective fence and if the traffic profile contains emergency lanes.
* The manufacturer must guarantee unchanged quality of the sign for at least 5 years from the date of installation, or 7 years from the date of manufacturing.
* The manufacturer is obliged to print on the back of the sign the code of the sign from the design, and in the case of placement of the package, the sign code sign must be on it.

QUALITY CONTROL

The manufacturer must possess an attestation for all materials used in the production of standard traffic signs. Quality control is performed in accordance with SRPS Z.S2.300.

WORK CALCULATION

The price of the traffic sign includes the purchase, delivery and transport to the agreed place of delivery at the request of the contractor, all mounting elements on the carrier (reinforcement, clamps, clamping screws, etc.), as well as quality control.

The calculation for each type of work is done by quantity (**q**) of the traffic signs.

**1.3.2 Traffic Guide Notification Signs**

- The item includes the manufacture, procurement and installation of traffic guide notification signs (signs that are made according to the drawings in the design).

- Traffic guide notification signs are designed in accordance with the Traffic Signalling Rulebook ("Official Gazette of the Republic of Serbia" No. 134/2014) and Serbian traffic signs standards for traffic guide in the zone of the crossroads SRPS Z.S2.313, SRPS Z. S2.314, SRPS Z.S2.315, SRPS Z.S2.316, SRPS Z.S2.318 and SRPS Z.S2.319 from February 2014 as well as the Law on Official Use of Languages and Scripts of the Republic of Serbia ( "Official Gazette of the Republic of Serbia", No. 45/91, 53 / 93,67 / 93, 48/94, 101/2005) and the Decree on the categorisation of state roads ("Official Gazette of the Republic of Serbia", No. 105 and 119/2013)

- Signs of traffic management notices covered by this project are:

* Traffic guide notification signs included in this design are as follows:

1.3.2.2 Switching lanes

* Notification signs for switching lanes are mounted on supports consisting of one or more parallel vertical supports or semi-portal supports, as foreseen by the design in situations.
* The set signs must be secured from turning and sliding.
* The set signs must be maintained regularly.
* The signs are set so that their flat surface deviates from the horizontal by 3 to 5º in the perpendicular field to the axis of the road.
* The position of the sign in the transversal profile is determined by the design.
* Traffic signs are placed on the pillar next to the roadway on the right side, in the direction of movement.
* Traffic signs along the road are placed at a height of 1.2 and 1.4 m.
* The height is calculated from the surface of the roadway to the lower edge of the traffic sign or the support (semi-portal).
* The distance between the edge of the roadway and the most protruding edge of the traffic sign located on the intersections and in the settlement, outside the pedestrian area, shall be between 0.75 to 1.50 m. Exceptionally, it is 0.5m high if there is a protective fence and if the traffic profile contains emergency lanes.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign being installed in the pedestrian areas shall be between 0.30m and 1.5m.
* The manufacturer must guarantee unchanged quality of the sign for at least 5 years from the date of installation, or 7 years from the date of manufacturing.
* The manufacturer is obliged to print on the back of the sign the code of the sign from the design, and in the case of placement of the package, the sign code sign must be on it.

- The front of the notification sign for switching lanes must have reflective material properties (foil) of class 3.

1.3.2.4 Direction pointer

* Signs of larger dimensions must have appropriate reinforcements that ensure the compactness of their surface, in which case the sign is fastened to the support by means of them.
* These reinforcements can only be on the back of the sign. There should be no reinforcements on the front of the sign (screws, nails, etc.), as well as potential joints of individual sheet plates, which would interfere with the legibility and reflection of the sign, both in the daylight and in the lighting of the car's headlights.
* Notification signs for traffic guidance are placed on supports consisting of one or more parallel vertical supports as envisaged by the design in situations.
* The set signs must be secured from turning and sliding.
* The set signs must be maintained regularly.
* The signs are set so that their flat surface deviates from the horizontal by 3 to 5º in the perpendicular field to the axis of the road.
* The position of the sign in the transversal profile is determined by the design.
* Traffic signs are placed on the pillar next to the roadway on the right side, in the direction of movement.
* Traffic signs along the road are placed at a height of 1.6m.
* The height is calculated from the surface of the roadway to the lower edge of the traffic sign.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign located on the intersections and in the settlement, outside the pedestrian area, shall be between 0.75 to 1.50 m. Exceptionally, it is 0.5m high if there is a protective fence and the traffic profile contain emergency lanes.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign being installed in the pedestrian areas shall be between 0.30m and 1.5m.
* The manufacturer must guarantee unchanged quality of the sign for at least 5 years from the date of installation, or 7 years from the date of manufacturing.
* The manufacturer is obliged to print on the back of the sign the code of the sign from the design, and in the case of placement of the package, the sign code sign must be on it.

- The front of the notification sign for traffic guidance with all symbols, letters and numbers must have reflective material properties (anti-graphite foil) of class 2.

1.3.2.5 Roadside boards

* Signs of larger dimensions must have appropriate reinforcements (bracing structure) that ensure the compactness of their surface, in which case the sign is fastened to the support by means of them.
* These reinforcements can only be on the back of the sign. There should be no reinforcements on the front of the sign (screws, nails, etc.), as well as potential joints of individual sheet plates, which would interfere with the legibility and reflection of the sign, both in the daylight and in the lighting of the car's headlights.
* Notification signs for traffic guidance are placed on supports consisting of one or more parallel vertical supports of special structure (grate supports) or semi-portal supports, depending on the design for particular situations.
* The set signs must be secured from turning and sliding.
* The set signs must be maintained regularly.
* The signs are set so that their flat surface deviates from the horizontal by 3 to 5º in the perpendicular field to the axis of the road.
* The position of the sign in the transversal profile is determined by the design.
* Traffic signs are placed on the pillar next to the roadway on the right side, in the direction of movement.
* Notification traffic signs for traffic guidance are placed at a height of 1.6m.
* The height is calculated from the surface of the roadway to the lower edge of the traffic sign or the support (semi-portal).
* The distance between the edge of the roadway and the most protruding edge of the traffic sign located on the intersections and in the settlement, outside the pedestrian area, shall be between 0.75 to 1.50 m. Exceptionally, it is 0.5m high if there is a protective fence and the traffic profile contain emergency lanes.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign being installed in the pedestrian areas shall be between 0.30m and 1.5m.
* The manufacturer must guarantee unchanged quality of the sign for at least 5 years from the date of installation, or 7 years from the date of manufacturing.
* The manufacturer is obliged to print on the back of the sign the code of the sign from the design, and in the case of placement of the package, the sign code sign must be on it.

- The front of the notification sign for traffic guidance with all symbols, letters and numbers must have reflective material properties (anti-graphite foil) of class 2.

**1.5 Information boards (more traffic signs on a single fluorescent base)**

* Signs of larger dimensions must have appropriate reinforcements (bracing structure) that ensure the compactness of their surface, in which case the sign is fastened to the support by means of them.
* These reinforcements can only be on the back of the sign. There should be no reinforcements on the front of the sign (screws, nails, etc.), as well as potential joints of individual sheet plates, which would interfere with the legibility and reflection of the sign, both in the daylight and in the lighting of the car's headlights.
* Notification signs for traffic guidance are placed on supports consisting of one or more parallel vertical supports of special structure (grate supports) or semi-portal supports, depending on the design for particular situations.
* The set signs must be secured from turning and sliding.
* The set signs must be maintained regularly.
* The signs are set so that their flat surface deviates from the horizontal by 3 to 5º in the perpendicular field to the axis of the road.
* The position of the sign in the transversal profile is determined by the design.
* Traffic signs are placed on the pillar next to the roadway on the right and left sides.
* Notification traffic signs for traffic guidance are placed at a height of 1.4m.
* The height is calculated from the surface of the roadway to the lower edge of the traffic sign or the support (semi-portal).
* The distance between the edge of the roadway and the most protruding edge of the traffic sign located on the intersections and in the settlement, outside the pedestrian area, shall be between 0.75 to 1.50 m. Exceptionally, it is 0.5m high if there is a protective fence and the traffic profile contain emergency lanes.
* The distance between the edge of the roadway and the most protruding edge of the traffic sign being installed in the pedestrian areas shall be between 0.30m and 1.5m.
* The manufacturer must guarantee unchanged quality of the sign for at least 5 years from the date of installation, or 7 years from the date of manufacturing.
* The manufacturer is obliged to print on the back of the sign the code of the sign from the design, and in the case of placement of the package, the sign code sign must be on it.

- The front of the notification sign for traffic guidance with all symbols, letters and numbers must have reflective material properties (anti-graphite foil) of class 3.

**1.7 Installation of traffic signs on the supporting pillars**

Mounting the sign on the built-in support (the price includes the transport of the sign and the worker from the check point to the place of work, setting and fixing the sign on the pillar by fastening the sign to the pillar by screwing clips and side-cutting the nuts so that they can not easily be pulled out. The purchase of the sign with transportation from the manufacturer to the installation point is not included in the price).

**1.8 Supports of traffic signs**

This item includes the creation, procurement and installation of traffic signs supports:

***1.8.1. Pipe supports***

* Pillar pipe supports are made of a steel-drawn pipe of uniform cross-section and thickness, depending on the number and type of signs that are placed on the support, which is indicated in the specifications, or the dimensions of the supports in the design.
* All metal parts of supports and structures should be protected by hot dip galvanizing with zinc with thickness of 60μm. The supports must be protected against corrosion by artificial resin or non-staining coating, in a dark-gray tone.
* From the top, the pillar must be protected from rain, i.e. closed with a plastic plug or welded.
* A single pipe support must be prevented by bars in the foundation.
* The pillars are placed in the concrete foundations of MB 15 quality and in portable rubber supports.
* Excavation of the foundation pit should be carried out, and then the foundation of the pillar should be concreted with MB 15 tamped concrete, together with the steel pillar.

*1.8.2 Grate supports*

 The grate supports are made of a steel-drawn tube of uniform cross-section and thickness, depending on the number, type and square of the signs that are placed on the support, which is indicated in the specifications, or the bill of quantities of the supports in the design.

 All metal parts of supports and structures should be protected by hot dip galvanizing with zinc thickness of 60μm. The supports must be protected against corrosion by artificial resin or non-staining coating, in a dark-gray tone.

 From the top, the pillar must be protected from rain, i.e. closed with a plastic plug or welded.

 Grate supports are designed and produced separately, according to the signs they designate, and based on the measures given in the traffic design.

 All the above elements are made in accordance with the specification, based on the static budget that is an integral part of the design.

 The pillars are placed in the concrete foundation of MB 30 quality.

*  Excavation of the foundation pit should be carried out, and then the foundation of the pillar should be concreted with MB 30 tamped concrete, together with the steel pillar.

QUALITY CONTROL

The manufacturer must possess an attestation for all materials used in the construction of traffic signs.

WORK CALCULATION

The price of single and grate supports includes the following works:

- procurement of a traffic sign support, as well as quality control

**1.9 Development of the foundation and installation of traffic sign supports**

1.9.1 Development of the foundation of traffic signs

The foundation construction consists of two phases:

- Earth works - include the excavation of earth or other material for foundations, transport to landfill or spreading of materials in the surrounding area. Works are calculated per m3 of excavated material.

- Concrete works - procurement, transport and installation of concrete label min, MB 20 for pipe supports and MB 25 for grate and semi-portal supports.

1.9.2 Mounting the supports

- installation of traffic sign supports or anchor bolts in the concrete footing and assembly of the pillar on the foundation. (includes the transport of pillars and workers from the check point to the place of work, setting the pillar or anchor bolts in the poured foundation, fixing the pillar until the concrete is hardened. After hardening of the concrete, the pillar with anchor plate is mounted on the foundation).

The calculation for each type of work is done by number (No) of the supports of the traffic sign and the concrete rate for the traffic signs.

**2. MARKINGS ON THE ROAD**

**ITEM DESCRIPTION**

The item includes the production, procurement and installation of materials used for the construction of elements of horizontal traffic signalisation, i.e. marking of the roadway.

MATERIALS

The materials used to produce horizontal traffic signal elements may be of the following types of material:

- Applicable materials (tape) which are installed by sticking them on the roadway,

- Road colour.

The applicable material (tape) must be extremely durable and resistant, it must be retroreflective, appropriately resistant to slip and it must be yellow. Applicable materials must possess retroreflective properties, according to SRPS EN 1436. In addition, they must be removable (detachable) without damaging the roadway.

Material, performance technology and other properties of the road colour are prescribed by SRPS U. S2. 240.

Paints for producing horizontal signalling elements should be made of natural and artificial resins with additives, white and yellow in colour.

PRODUCTION

The works are carried out according to detailed drawings and situational plans from the design of traffic signalisation.

Applicable tapes can be placed (glued) during the construction of the upper, hot asphalt layer or can be installed on top of already made asphalt.

The materials must have the prescribed slip resistance class S1, SRT ≥ 45, whereas night retroreflection must be of class R5 ≥300 mcd • m-2 • lx-1.

Thickness of elements painted with road paint must be at least 600 microns, which corresponds to the colour consumption of 1 kg / m2 and reflective grains of 400 g / m2 of painted surface.

All painted surfaces must have a prescribed friction adhesive coefficient, which must not be less than the friction coefficient of the roadway adhesiveness.

The edges of the lines and shapes must be sharp and straight, with a deviation of the projected line of not more than 5 mm. Permitted deviations from the measures given in the design amount to a maximum of 5%.

The work is carried out mechanically or manually.

QUALITY CONTROL

All materials must satisfy the requirements for certain durability and quality, and for each material the contractor must provide an attestation.

WORK CALCULATION

The prices of works on the implementation of horizontal signalling are calculated per m2 (square meter). The price includes field surveying, cleaning and degreasing of roadway, installation (gluing) of applicable strips and control of the quality of materials used and of all construction works on the installation of materials.

**6. LIGHTING MARKINGS ON THE ROAD**

ITEM DESCRIPTION

The item includes the development, procurement and installation of signposts and catadiopters. The number of delineators and catadiopters is displayed in the bill of quantities and pro forma invoice.

MATERIALS

Delineators and catadiopters must be visible in all weather conditions, especially in case of reduced visibility (night, fog, snow, etc.) with their shape, measures and manner of production. Delineators and catadiopters are installed so that participants in traffic in night hours and in conditions of reduced visibility are able to spot the contour of the road in a timely manner.

CONSTRUCTION AND INSTALLATION

Delineators and catadiopters are installed according to the situational plan in the design. Delineators and catadiopters are installed according to valid standards with reflective fields from materials of class III. Delineators and catadiopters must have reflective shapes of a certain surface (foil or other reflecting bodies), as follows: red on the right and white on the left in the direction of movement of the vehicle. Delineators are made according to standard SRPS.Z.S2.235.

QUALITY CONTROL

Before installing delineators, the contractor will prove their quality with an attestation, which will be presented to the supervisory authority.

WORK CALCULATION

The price of the delineators and catadiopters is calculated according to the built-in delineators and catadiopter and includes all work on delivery, transport and installation, as well as quality control.

**ROAD EQUIPMENT**

**7.1.6 ROAD MIRROR**

**ITEM DESCRIPTION**

The position includes the manufacture, procurement and installation of traffic mirrors.

**MATERIALS**

The optical part of traffic mirrors is made of atmospheric and mechanical impact resistant polycarbonate, which is applied to a layer of highly reflective material providing reflection without changing the colourimetric characteristics of the intake air.

Traffic mirror frame is made of reinforced polyester resin with glass fibres whose width is 8 cm.

**CONSTRUCTION AND INSTALLATION**

Disposition of traffic mirrors is shown in the graphic enclosure, while the micro location and installation angle need to be determined on site, during installation, depending on the conditions of the road and the environment. The dimensions of the traffic mirrors are 1000 x 800 mm.

Supports for traffic mirrors are made of steel pipes of an external diameter of 60 mm. A single pipe support must be secured from turning with bars in the foundation.

QUALITY CONTROL

Prior to the installation of traffic mirrors, the contractor shall prove their quality with an attestation, which will be presented to the supervisory authority.

WORK CALCULATION

The price of traffic mirrors includes delivery and transport to the place of installation, the price of the support to which it is fastened, all mounting elements for the support, mounting of the sign on the built-in support, and quality control.

7.2 Guardrails

ITEM DESCRIPTION

The item includes the production, procurement and installation of a guard rail for vehicles, entirely according to Serbian standards. The brand and type of the guardrail are defined within the scope of this design and according to the classification given in the Technical Instructions for the Implementation of the Vehicle Retention System on the State Roads of the Republic of Serbia issued by PC Putevi Srbije and the standard SRPS EN 1317.

MATERIALS

The material for making each of the elements of the guardrail must entirely comply with the requirements of standard SRPS EN 1317.

CONSTRUCTION AND INSTALLATION

The guardrail is set according to the situation in the design. The location plan explicitly determines the length of the guardrail, the micro location on which it is placed, the length of the end-part of the rail etc.

The protective bumper fence is placed on pillars of appropriate length so that the upper edge of the bumper is at a height of 0.75 m from the nearest edge of the lane.

The fence must be protected from corrosion by galvanizing, at the choice of the investor. The closing elements of the fence according to shape and length must meet the technical conditions for installation given in SRPS EN 1317. The length of the finishing elements is defined in the situational plan.

At the distance of 12 and 24 meters, the reflecting body-catadiopters are installed in the groove of the fence, whose colour is the same as in the direction posts.

The distance between the pillars is 2.0 and 1.33 m.

The ending elements of the fence are installed by descending and partial burial into the ground, and their length is defined in the situational plan.

QUALITY CONTROL

Prior to the installation of a guardrail, the Contractor shall prove its quality with an attestation, which will be presented to the Supervisory Authority.

WORK CALCULATION

The price of the guardrail is calculated by the length of the installed guardrail. The cost of final and transitional structures is calculated per piece.

**8. TECHNICAL MEANS FOR SLOWING DOWN THE TRAFFIC**

**VIBRATION BANDS**

Vibration bands are technical means for slowing down the traffic, which produce stronger vibrations and sound effects when the vehicle is crossing over them to warn drivers to reduce the speed of movement, or to adjust their driving to the prescribed speed limit.

The item includes the production, procurement and installation of technical means for slowing down the traffic, hereinafter referred to as the vibrating band, in a raster (3x2 bands), 3 m in length, width d = 12 cm. Vibrating bands are placed in pairs at a mutual distance of 1.8 m (2.0 m), if necessary, can be repeated several times.

Vibration bands are made of cold plastic. Cold plastic must be resistant to all atmospheric effects, UV rays, petroleum products, oils, salts and abrasion (wear).

Vibration bands must have the necessary attestations from the competent authorities and / or laboratories to demonstrate their technical characteristics and guarantee the possibility of their use in the function of making technical means for slowing down the traffic.

The price is calculated by the length meter of the installed band. The price is expressed per meter, as well as the price of assembly, which includes all the necessary work, as well as all the costs required for the turnkey installation, which means that after the completion of the works by the contractor, the traffic can be regular and safe at places where vibration bands are placed.

**10. OTHER WORKS**

10.1. Removal of traffic signs and hoardings

The contractor is obligated to safely remove all elements of the sign, accessories and sign, to remove the pillar with concrete foundation and to fill the hole of the foundation and to bring the shoulder in the functional state. All elements of the damaged pillar and the old foundation should be removed in a place designated by the supervisory authority. All disassembled elements should be transported to the Orderer's warehouse at the order of the Supervising Authority, while the excess material that has been created by demolition or removal should be transported to a landfill designated by the Supervisory Authority. The price of the works includes all necessary work for the execution with all the costs of loading and unloading, dismantling and transport, as well as repairs to the shoulder, while the calculation is shown by piece.

**10.2.Relocation of existing traffic signs**

Relocation of existing traffic signs on a box support (dismantling of traffic signs, disassembly of the box support, foundation construction, installation of a box support and installation of a traffic sign). The calculation is expressed per piece.

**10.3. Relocation of existing traffic light**

Relocation of the existing traffic light at the pedestrian crossing (dismantling of lanterns, traffic light poles and control devices, laying of foundations and manholes, installation of pillars, commanding device and lanterns, installation of equipment and commissioning). As part of thisitem, a traffic light design is also needed. The calculation is expressed per piece.

1. WORKS of traffic signalization project

Includes traffic signals to regulate traffic on IB state road No 12, section Matije Gupca street in the City of Sombor, from km 54+963.24 to km 56+622.87 during construction works at the increased maintenance. In preparing the project traffic signals, it is necessary to conclude recorded current situation and predict the actions necessary for the completion of vertical and horizontal traffic signs on the road. It should take into consideration all the interventions proposed construction projects that anticipate changes in relation to the original state before of this project. The project should include the development of plans of horizontal and vertical signalization and traffic equipment with all necessary details, in accordance with Rules on traffic signs. The function of the real state of spatial and physical structures in the road area, check the available sight and the amount of available profiles. The project should show the necessary solutions vertical traffic signs and equipment on motorways: traffic signs, their pillars carrier support structure, foundation budget, protective steel railings for vehicles, signpost, markers and other elements with retro-reflection properties. Characteristics of vertical signage applied according to SRPS standards. Materials for making traffic signs on the road to anticipate the reflective properties, in accordance with the provisions of the Rules on traffic signs. Proposed solutions and system traffic control system signpost signage should ensure the smooth and safe traffic on the state road signs to the mandatory application of the number of times the state. Through the design solution is necessary to provide appropriate levels of notifications intended for road users. Comply with the provisions of the existing law on the official use of languages ​​and scripts.

For all non-standard traffic signs and boards do budget construction traffic sign boards and the impact of wind on the structure, which includes a budget number and types of columns, as well as the budget of the foundation. In the field of vehicle restraint systems, project the elements of the protective guard rail steel according to the provisions of IEC 1317.

The designer is required to determine the required levels of retention, depending on traffic conditions and areas of needed protection. It is necessary to attach a tabular overview of all elements of design protective fence, in accordance with the requirements of Contracting Authority. The solution should comprise administering retro reflective material of the class II to the separation distance of 24m, ie. 12m in the zone of dangerous places.

 All metal parts of the carrier of traffic signs, support structures, and elements for assembly, and the elements of the protective railing of steel, should be protected by hot dip galvanizing procedure to the average thickness of the zinc coating of 70 μ. Signposts should be designed according to the SRPS Z.S2.235, with the application of retroreflecting body class II. Road markings should include solutions that provide for the installation of code with the characteristics of retro-reflection, noting that materials must comply with the provisions of IEC 1436. Markings carried out by staining with min. the value of the coefficient ofretroreflection of 100mcd / lx / m² to a dry white horizontal markings of permanent nature. Design solutions should be designed in accordance with applicable laws, standards and technical recommendations. Pursuant to Article 8 of the "Rules of traffic signs" from 2010, and in accordance with the Contracting Authority, designers can predict traffic signs and other traffic equipment for which there is no corresponding Serbian standard. This refers to the projected traffic signaling and equipment from the program dangerous curves, where necessary pr Pursuant to Article 8 of the "Rules of traffic signs" from 2010, and in accordance with the Contracting Authority, designers can predict traffic signs and other traffic equipment for which there is no corresponding Serbian standard.

The project should contain general information about the project documents, technical reports, bill of quantities of works, signage plans, etc. For all solutions designed to attach graphical, numerical and text attachments, as well as all the necessary details. The planned temporary traffic signals is determined by the rank and geometric characteristics covered roads, traffic flow parameters and the technology works. Applying specific, efficient traffic-technical measures provided for the project is carried out its main purpose, which includes: ϖ safe traffic ϖ safely and carry out the work on the site ϖ satisfactory level of customer service sections of which the works are carried Traffic-technical measures are provided by this project include in particular the work in the neighborhood, and in particular designs not village, which is accomplished through the three type-specific traffic situations can be foreseen in the course of work on the enhanced maintenance of roads subject:

A. Work on an open stretch of road (which is more than 170 meters from the intersection)

B. Papers in the wider zone of the junction (about 150 m on each side)

C. Papers in the intersection Works is performed on one side of the pavement, and then in the other (articles divided into two phases). Extensions in the settlement are carried out by building concrete edge strip width of 0.30m, a van settlement expansion is carried out with the buffer layer with the final layer of asphalt concrete (AB). Out of settlement as noted above works out the settlement is carried out on one side , and on the second (split articles in two steps) as follows:

- First, works are carried out on road widening on one side, which consists of the works on the excavation of earth layers , filling and rolling stone layers to the level of the existing pavement.

- After the work is completed, the same type of work is done on the other side of the road along with the preparatory work for paving and asphalting the whole other side of the carriageway. - After that go to the preparatory works for asphalting and paving side of the road on which they start work.

- The dynamics of work means that the site moves only when they finish all the above works. When performing this type of work it is essential to start work on the side where provided greater expansion. The first enlargement should be made so that a layer of crushed stone is at the level of the existing pavement, regardless of the anticipated new heights, to the side of the road alternately allow the movement of vehicles during the works in phase II.

 For this purpose the proforma invoice are provided the necessary quantities of crushed stone. In the settlement as mentioned above works in the colony are carried out on one side, and on the second (split articles in two steps) as follows:

- First, works are carried out on road widening on one side, which consists of the works on the excavation of earth layers, filling and rolling stone layers and pouring concrete curb lane. These works last successively until the end of all construction works on the curb lane on one side of the road in one village.

 - After the work is completed, and the completion of the setting process exceeds to the preparation of asphalt for paving and the traffic lane on which the extension is carried out.

- After completion of the one lane changes to the widening on the other lane the same manner as in the first phase. When performing this type of work it is essential to start work on the side of August where provided greater expansion. At the start of work in the colony is necessary to place non-standard characters with a fluorescent substrate (I-19, IV-2 and II-30) at the entrance to, or at the place of beginning of the construction of the concrete of the strip edge. How to work on the construction of edge strips shift required is built next to the curb lane set of vertical barriers, to prevent damage to the freshly cast strip. That set of vertical barriers should be maintained along the entire village to the end of the paving lane along which were built curb lane.

A. Works on the open section of the road (which is more than 170 m from the intersections) Van settlements on these parts of the section are provided for articles that include the dynamics of work, a distance of about 500 meters. Regulating the traffic into the zone of operations is performed using a light traffic signs (traffic light), and the traffic sign of technical equipment (flashers TS-1, TS-2 and TS-4). Tables with the present traffic load underlying shares are presented in the technical report, the main project of the course.

From the above analysis of the traffic load extracted data for the year 2012 so that traffic flows have the following features:

• shares of Bezdan to Sombor− average annual daily traffic: AADT = 2,613 veh / day − applicable traffic load is determined on the basis of experience in analyzing data from the automated traffic counters and about 8% of PGDS, and the qm = 208 transporter / time traffic, the new regime is based on the alternating passing traffic with light traffic signs (traffic light). For this type of site is based on the proposed technology works, and traffic parameters, the construction site, the length of 500m. For all of the sections of the project in the determination of the cycle time is used, the values ​​of the traffic flow for high wear section or section from the bottomless to Sombor, because they would not receive significant savings on the slight reduction of the cycle compared to the less loaded section from Backi Breg to the bottomless pit.

For the determination of the cycle time is used, the values ​​of traffic load foreseen "technical instructions for marking zone of maintenance work, state roads in Serbia" 200 transporter / h: q1 + q2 (veh / h) The duration of the individual phases of the cycle (s) Length cycle (s) 200 43 2 36 3 45 39 168.

Following the introduction of the new traffic regime and application of the proposed traffic-technical measures should not expect major problems in the transport of the necessary time loss due to waiting for the light signal. It should be noted that by reducing the length of the site to get favorable parameters of light signals (to reduce the time losses, the number of vehicles in order and likely stopping) and better throughput stocks, however, as noted above, the requirements of technology site, and quality of work have caused the presented solution.

raffic signals provided by the project is temporary, but in everything she has to meet the requirements posed by the rank of the road on which it is set, so the projected traffic signaling standard sizes and designed to provide a good visibility. Signaling is designed in accordance with existing SRPS standards, applicable regulations, standards and recommendations. Although traffic signals provided by the project of a temporary nature in all it has to meet the requirements posed by the rank of the road on which it is mounted, therefore, the projected traffic signaling standard sizes and designed to provide a good visibility. Routing and traffic management is carried out by means of vertical obstacles, details of which are located in the graphical part of the project. The formation of the site was done in accordance with the applicable technical guidelines to the extent permitted existing buildings and pavement condition, as well as the technology works.

 At night and in low visibility conditions, when no works are carried out, all traffic equipment is removed from the road and cover the traffic lights and signs I-20!

  Traffic with access roads, whose intersection with the status of the section has no intersection (summer, the connection paths and the like.), Being suspended in contact with the zone of the construction.

 Traffic suspension will be in effect during the execution of the works and the time required to consolidate the pavement. In addition, in the area of ​​operations is provided for installing and flashing lights TS-1, TS-2 and TS-4 designs.

These light sources must be provided with energy via a reliable power source for the duration of the changed traffic regime.

  Disposition of traffic signals and equipment is given in the graphic part of the project, which were presented and details necessary to perform signaling.

The contractor is required to provide continuous, seamless operation of a complete traffic signalization and equipment covered by this project!

Before starting work the contractor is obliged to changes in the regime of traffic inform the competent authority of the Ministry of Interior of the Republic of Serbia, traffic-competent inspection authority and the public through the media.

Upon completion of the work, the contractor is obliged to transport equipment and signaling to its original state! In the complex at those portions of the section are provided for articles that include the dynamics of work in lengths up to 400 meters.

Regulating the traffic into the zone of work exclude the possibility to regulate the traffic by applying light signals due to a problem with the traffic which originates in a number of vehicular access in residential areas. This traffic, due to the existence of regulation of traffic lights would not be able to safely engage in the mainstream, due to the order before the signal, and because of the lack of transparency and specific modes of transport (transport takes place one lane). On the other hand, Traffic control is not only vertical signalization can not be applied due to the length of the construction site larger than 50 meters. Therefore, as the most appropriate solution is selected traffic regulation using signal flags. In addition to intended support traffic signs and traffic-technical equipment, the primary control, traffic in this type of site administered by two workers ( with signals in hands) by means of signal flags of red and green. Flags must be square-shaped dimensions 40 x 40 cm. Disposition of workers who regulate traffic at the intersection zone is provided in the attached graphic.

Before starting work it is necessary to train workers for the regulation of traffic, where they should be familiar with the basic principles of:

¬ Micro location where there are workers must be chosen to clearly see each other, or in the case by when they cannot be binoculars have established radio contact.

 ¬ Workers provide signals of hands (at a right angle relative to the body) with a flag corresponding color (red-restriction, and green light allowed to pass through) so that the signal is visible to the drivers on the ramp and the corresponding second worker.

¬ At the beginning of the free passage (green flag) gives “figure man”( workers with sign ) the main flow and the direction is not impeded work. Other departments have a restriction (red flag). Free passage lasts until the "empty" homogeneous columns on the driveway, but no longer than 2 minutes.

¬ In the next stage have a free passage of the vehicle on the main flow from the direction where there is a construction site.

 ¬ Figure man may allow the passage of vehicles only after the narrow part of the road and leave the last vehicle from the opposite direction when it is satisfied that the other workers raised red flags.

¬ Free passage lasts until the "empty" homogeneous columns on the driveway, but no longer than 2 minutes.

 ¬ Figure man cease to regulate traffic only when the train traffic for a full profile on the section of road where works are carried out. Traffic signals provided by the project is temporary, but in everything she has to meet the requirements posed by the rank of the road on which it is set, so the projected traffic signaling standard sizes and designed to provide a good visibility. Signaling is designed in accordance with the existing Testing Standards applicable legislation norms and recommendations.

  Although traffic signals provided by the project of a temporary nature in all it has to meet the requirements posed by the rank of the road on which it is set, so the projected traffic signaling standard sizes and designed to provide a good visibility. Directing and managing traffic in the area of ​​the site is carried out by means of vertical obstacle, whose details are located in the graphical part of the project. On the side approaching the intersection, which are side-streams, is also provided for signaling that indicates a risk of the road works and traffic regulation flags or slabs. On the landing zone of the works on the main traffic flow, in addition to vertical traffic signs, envisages the installation of warning lights TS-1 and TS -2. These light sources must be provided with energy via a reliable power source for the duration of the changed traffic regime. The formation of the site was done in accordance with the applicable technical guidelines to the extent permitted existing buildings and pavement condition, as well as the technology works. At night and in conditions of reduced visibility, when not carrying out the works, all traffic equipment is removed from the roadway, in addition to vertical obstacles arranged along constructed lip, means III-303 are covered, while the other traffic signs and special characters with a fluorescent substrate (I-19 , IV-2 and II-30) are retained! Disposition of traffic signals and equipment is given in the graphic part of the project, which were presented and details necessary to perform signaling.

The contractor is required to provide continuous, seamless operation of a complete traffic signalization and equipment covered by this project!

 Before starting work the contractor is obliged to changes in the regime of traffic inform the competent authority of the Ministry of Interior of the Republic of Serbia, traffic-competent inspection authority and the public through the media. Upon completion of the work, the contractor is obliged to transport equipment and signaling to its original state!

  B. Papers in the wider zone of the junction (about 150 m on each side) of works in the wider zone of the junction (about 150 m on both sides of the center of the intersection) excludes the possibility of traffic control application of light signals due to a problem with the traffic flows, which have a source of the side approaching the intersection. These flows, due to the existence of regulation of traffic lights at close range (20-30 feet) would not be able to safely engage in the mainstream, due to the order before the signal, and because of the lack of transparency and specific modes of transport (transport takes place one lane

 Routing and traffic management is carried out by means of vertical obstacles, details of which are located in the graphical part of the project. On the side, an active approach to the intersection, which is the side-stream, also provided signaling that indicates the risk of road works and traffic regulation flags or boards. The traffic on the approach road to the side where the works are performed, will be terminated at the contact zone with the works. Traffic suspension will be in effect during the execution of the works and the time required to consolidate the pavement. Due to the suspension of traffic on the approach road, going in a shorter period of time, to rationalize the number of traffic signals, keeps the traffic signals over the driveway, which is set during the execution of works in the wider area of ​​the intersection, as well as the figurant to inform drivers about the brief closure intersection in this approach. Since the node 1203 is not foreseen expansion of them, stopping traffic approaching from a side is not required, it is necessary to traffic on this node regulated by means of the signaling flag in the manner described above.

The elements of traffic signs of elements of traffic signs, are encompassed by this project are:

1. Traffic signs
2. Road markings (supply, transport and marking).
3. Temporary traffic signals
4. Other works

Technical requirements for manufacture, supply and installation, or perform some signaling elements are explained by the position of these works: - signaling elements are ordered on the basis of quantities for the project. - Some elements are made on the basis of quantities for the project. - Some elements of signage placed or executed on the basis of situational plans and other drawings of the project, and based on the Rules on traffic signs, Serbian standards and recommendation for labeling zone where the works are performed. The contractor must provide the supervisory authority corresponding documents (certificates, certificates, etc.) Issued by the competent institution proving that the applied elements used for making signage meet the requirements defined by the following technical guidelines with mandatory application issued by JP Roads of Serbia: Technical Instructions BS-02/2013 and Technical Instructions BS-03/2013.

TRAFFIC SIGNALS Positions DESCRIPTION includes the development, procurement and installation of standard traffic signs (sign used in all made according to the detailed drawings in SRPS standards, under the name, password, and the appearance in conformance with the Regulations on the traffic signs) and non-standard characters.

MATERIALS

Standard and non-standard characters are made of materials and in the manner prescribed in SRPS Z.S2. 300 (Technical conditions- general requirements for the development and testing). Standard and non traffic signs are made of aluminum sheet, or of galvanized steel sheet. The face of the sign, with all symbols, letters and digits, must have reflective properties of the materials of class II of the standard characters reflection and reflective properties of Class III reflections at non-standard characters. Production and installation dimensions of standard traffic signs are in function of their shape and rank of the road on which they are located. Standard characters in all detail drawings made by the Serbian standards, under the name, code and appearance according to the Rules on Traffic Signs (SRPS Z.S2.From Nos. 301 to 309).

Non-standard characters are made all in accordance with the details and quote in the project. On-site sign can not be any fixation (bolts, rivets, etc.) that would interfere with the readability of the sign and reflection, both in daylight and in the light of car headlights. The back of the characters including all the elements for attachment to the carrier, must be protected from artificial resin paint, dark-gray tone. Signs are attached to Single Column bracket of pipes using clips placed on the back of the sign. Signs must be secured from rotation and shear inserting plastic cuffs and collars between pillars - (unless the holder of the sign powder coated). Signs are placed so that their plane departs horizontally from 3-50 in the field normal to the axis of the road. If you set a new traffic signs, the manufacturer is obliged to sign the back of the printed code characters by the Rules on traffic signs, with the possible content (the number or inscription) in the building; if the sign is placed in opaque cover, duty extends to cover. If you set a new traffic signs, the manufacturer is required to supply the signs in the protective envelope, on which must be written in code symbol. The position of a character in the transverse profile is determined by the project on a separate graphic enclosure.

 QUALITY CONTROL

The manufacturer must have a certificate for all the materials that are used when creating a standard traffic signs. Quality control is carried out in accordance with SRPS Z.S2.300.

 CALCULATION OF the price

Calculation of the standard and non-standard of a road sign is included and delivery and delivers them to the place of installation, all the elements for the fastening of the mounting bracket (reinforcement, clamps, screws et al.), Mounting the sign on a built-in bracket, as well as quality control by SRPS Z .S2.300.

**SUPPORTS**

Traffic signs, a mobile base and the foundation to describe the position Rank includes the development, procurement and installation of single tubular supports of traffic signs, moving the stand, the concrete foundation and sacks with sand.

 MATERIALS

Tube carriers are made of steel drawn tube of uniform cross-sectional thickness and, depending on the number, type and squaring of characters that are placed on the carrier. The movable stands are made from concrete, solid metal, plastics or other modern materials that ensure the stability of the set of signaling.

 MANUFACTURE AND ASSEMBLY

code carrier individually positioned on the traffic sign, the outer diameter of the pipe should not be less than 50 mm, and the carrier provided for the setting of multiple characters must have an external diameter of at least 60 mm. Poles are placed on mobile stand or concrete foundations according to how the project is provided in situations. Bags filled with sand are placed on mobile stand in order to ensure their added stability. The length (height) of the carrier is determined from the details of the position of characters, according to the size and number of characters to them, and the chosen route of anchoring the characters on the carrier. Single Column pipe bracket must be secured from turning into a mobile base. Carriers must be protected by hot dip galvanizing. On the upper side of the column bracket must be protected from rain, ie. closed by a plastic plug or welded.

QUALITY CONTROL

The manufacturer must have a certificate for all materials used in making carrier traffic signs. Billing for works in the cost of moving the stand, single unit foundation and the carrier included in the drive to the delivery and mounting location, the price of equipment for connection between the leg elements, the crossbar of the mobile frame, as the price of the carrier seal against rain as well as quality control of the materials used. Mobile pedestals and foundations are calculated per piece. Nylon bags are filled with 50kg of sand. Portable rubber mounts and 50kg bags with sand are calculated per piece.

 2. The road markings (Supply, transport and labeling) the horizontal elements of traffic signs, are encompassed by this project are: transverse markings SRPS U.S4.225, SARD U.S4.227 I SRPS U.S4.228 DESCRIPTION Positions includes the development, supply and installation of application materials used for the production of elements of horizontal traffic signalization. Making materials of all elements markings used application materials. Application materials must be extremely durable and durable, must have retro reflection, appropriate adequate skating and it is necessary to be yellow. All the elements are yellow, they must have retroreflection features and the ability to remove (peel) without damaging the pavement, according to EN 1436.

MAKING Works are carried out according to detailed drawings and plans of the project situational traffic signals. The applied film can be configured (to apply glue) during the preparation of the above, a hot asphalt layer or may be placed over an already prepared asphalt. The materials must have the prescribed coefficient of slip resistance of class S1, SRT ≥ 45, while nighttime retroreflection must be Class I R5 ≥ 300 mcd • m-2 • lX-1. Edge lines and figures have to be sharp and straight, with deviation from the projected line of up to 5 mm. Tolerances of the measures set out in the project amounted to more than 5%. Execution of works is done by machine or by hand.

QUALITY CONTROL 2

All materials must meet the requirements for a particular sustainability and quality, and for each material the contractor must provide a certificate.

CALCULATION OF WORKS

Prices of works on construction of road markings are calculated per m2 (square meter). Price among other things, includes the measuring of field, setting (paste) and removing (peeling) application sheet and quality control of the materials and all derived works on installation materials.

**TEMPORARY TRAFFIC SIGNALS**

 DESCRIPTION OF OBSTRUCTION

Positions include the design, supply and installation of horizontal and vertical barriers.

MATERIALS

Horizontal and vertical barriers are made of plastic materials, aluminum or galvanized steel. Barrier body is made of massive plastic material, rubber, concrete or metal. Production and installation of horizontal and vertical barriers are set according to situations and detailed drawings of the project. Horizontal placed perpendicular to the axis of time in places where there was a narrowing of the road. Horizontal barriers are placed at the beginning and end of the site, the entire width of the occupied site or obstacles. The horizontal and vertical barriers are covered with a reflective foil class II. Horizontal is placed at a height of 1.0 m from the surface pavement, the tubes made from metal tubes with diameter 50 mm. Brackets are installed in a mobile stand made of solid plastic, concrete, metal or rubber. Dimension table frontal bumper is 0.25 length 2.5 m. Vertical barriers are placed at the distance all in accordance with the layout plan.

 QUALITY CONTROL

The Contractor will set up a horizontal and vertical barriers to prove its quality test certificate, which will be presented to the Supervisory Authority.

CALCULATION OF WORKS

Price horizontal obstacle is calculated by piece without tubular supports and stands, a vertical price barriers are calculated to stand.

**5. LIGHT TRAFFIC SIGNALS DESCRIPTION**

Positions include the design, procurement and installation of light characters of light to control the traffic and light signs to indicate road works.

MATERIALS Luminous signs must be made of such materials and in such a way, to ensure reliable operation and in the most adverse weather and climatic conditions.

MAKING AND MOUNTING

Lighting signs for traffic regulation devices are provided with three-color lights (traffic lights) having a radius of the lantern of at least 210 mm. The traffic lights are placed on the site of approach from either direction, to the right of the traffic lane which is used for the traffic seen from the driving direction to which the signal relates, at a distance of 20 m from the beginning of the narrowing. Traffic lights have to be connected by cable or radio connection with a common control device. Managing work traffic light devices for alternating passing vehicles is done automatically by the program built into the controller. Luminous signs for road works are provided by permanent orange light and a flashing orange light. In places where it is not possible to provide a network of electrical connection, the power light characters can be used and the corresponding rechargeable battery. Orange flashing lights that are used for channeling and directing traffic should be directed towards oncoming vehicles, "running" effect should be realized in the direction of the vehicle. Luminous signs are placed on the barriers, obstacles or special mounts at a height of 1.30 to 2.0 meters above the pavement surface.

QUALITY CONTROL

The Contractor shall before installing light signals to show their quality attestation, which will be presented to the Supervisory Authority.

CALCULATION OF WORKS

The price of light characters are included in the cost of their purchase, costs of delivery and delivery to the site, installation and programming of the traffic light device.  Other equipment Manual regulation of traffic in the zone of works is carried out by at least two, for this particular employee of the contractor in a manner to face the direction of travel of the vehicle where the sign flag. Traffic regulation is carried out by flags red and green color dimension of at least 40 cm x 40 cm, which have the following meaning:

raised the green flag - the free passage of the vehicle in the direction where this flag is raised,

the red flag - no passing of vehicles from the direction where the flag is raised. City workers on their way to carry out manual regulation is specified in the layout plan. In the case of workers who regulate traffic do not see each other, use the radio connection to their communication. Manual traffic regulation in the area of ​​work is performed in conditions of good visibility and no action takes place at night.

TEMPORARY TRAFFIC SIGNALS

TECHNICAL REPORT

The project envisages traffic signalisation for traffic regulation on the IB class state road number 12, section: from km 54 + 963.24 to km 56 + 622.87, during the execution of works on enhanced maintenance.

The planned traffic signalisation depends on the ranking and geometrical features of the covered traffic roads, traffic flow parameters and the technology of carrying out the works.

The implementation of specific, efficient traffic and technical measures foreseen by the Design, its main goal is achieved, including the following:

Safe traffic

Safe and undisturbed work on the site

A satisfactory level of service for the users of the section where the works are being carried out

The traffic and technical measures envisaged by this Design include special works in the settlement, especially works outside the settlement, which are covered by three typical, specific traffic situations that can be predicted during the works on enhanced maintenance of the given roads:

Works on the open section of the road (located more than 170 m away from intersections)

Works in the wider zone of the intersection (about 150 m on both sides)

Works at the intersection itself

The works are performed first on one side of the roadway, and then on the other (works divided in two phases), where the roadway is expanded depending on the individual activities from a minimum of 6.00m to 7.20m. The extensions are performed with bumper layers whose finishing layer is asphalt concrete (AB).

As it was mentioned above, works are done first on one side of the roadway and on the other (works divided in two phases) in the following manner:

- First, the works on the extension of the roadway on one side are carried out, which includes works on the excavation of earth layers, backfilling and rolling of the stone layers to the level of the existing roadway.

- After these completed works, the same type of work is carried out on the other side of the roadway, along with preparatory work for asphalting and asphalting of the entire side of the roadway where te works have already commenced.

- After that, the preparatory works for paving and asphalting the side of the road where works have already started follow.

- The dynamics of works means that the construction site is moved only when all the above mentioned works are completed.

When performing this type of work, it is important to start works on the side of the roadway where a larger expansion is envisaged. The first extension of the roadway must be carried out so that the layer of crushed stone is at the level of the existing roadway, regardless of the height of the new roadway, in order to allow the side of the roadway to alternate the movement of vehicles during Phase II of works. For this purpose, the calculation envisages the required quantities of crushed stone.

*A. Works on the open section of the road (located more than 170 m away from intersections)*

In these segments of the given road, works that involve the dynamics of works in the length of 400 meters are foreseen. Traffic regulation in the work area excludes the possibility of regulating traffic by using light signals due to traffic problems that have a source in numerous road approaches in settlements. The traffic as such, due to the existence of traffic lights, could not provide safe merge in due to the queue in front of the signal, as well as due to insufficient visibility and a specific traffic regime (the traffic is carried out in a single traffic lane). On the other hand, even traffic regulation by vertical signalling cannot be applied due to the length of the construction site larger than 50 meters. Therefore, the most appropriate solution is the regulation of traffic by means of signalling flags.

In addition to the envisaged traffic signalisation and traffic equipment, the primary traffic control on this type of construction site is carried out by two workers (demonstrators) using red and green flag signals. Flags must be of a square shape of 40 x 40 cm.

Disposition of traffic control workers in the intersection zone is given in the graph provided below. Prior to the commencement of works, it is necessary to carry out trainings for traffic regulation workers, whereby they should be familiarised with the basic principles of work:

The microlocation where demonstrators are located must be selected so that they can clearly see each other, or where they cannot do that, they need to have a radio connection established.

Demonstrators give signals by lifting their hands (at right angles from the body) with a flag of appropriate color (red-ban passage, green-permit passage) so that the signal is visible to drivers at the appropriate access and to the other demonstrator as well.

At the beginning of the work, the free passage (green flag) is provided by the demonstrator on the main road and in a direction that is not obstructed by the works. Other directions have a passage ban (red flag). The free passage lasts until a "homogenous" line is emptied at this approach, and no longer than 2 minutes.

In the next stage, vehicles on the main road from the direction where the site is located have free passage.

The demonstrator may allow the passage of the vehicle only when the narrowed part of the road is emptied and when the last vehicle from the opposite direction has passed and when they are sure that the other demonstrators have raised red flags.

The free passage lasts until a "homogenous" column is emptied at this approach, and no longer than 2 minutes.

Demonstrators cease to regulate traffic only when the entire road profile on this section where the works are being carried out is usable.

Traffic signalisation foreseen by this design is of a temporary character, however, it must meet the requirements assumed by the ranking of the road on which it is located in all cases. Therefore, traffic signalling is of standard dimensions and it has been designed in such way to ensure its good visibility. The designed signalling is in accordance with the existing SRPS standards, the applicable legal norms and recommendations. Although traffic signalisation is foreseen by this temporary design, it must meet the requirements assumed by the traffic route rank where it is located in all cases and therefore traffic signalling of standard dimensions has been designed to ensure its good visibility.

Routing and traffic guidance in the construction site zone is carried out using vertical barriers, the details of which are in the graphic part of the design.

At the lateral approaches to the intersections which represent secondary traffic flow, signalisation indicating the danger of road works and the regulation of traffic with flags or boards is also provided.

In addition to the vertical traffic signalisation, at the approach point to the work area at the main traffic flow, installation of warning lights TS-1 and TS-2 is also planned. These light sources must be supplied with energy through a reliable power supply for the duration of the modified traffic regime.

Construction of the site was done in accordance with the valid technical instructions to the extent allowed by the existing construction and condition of the roadway, as well as the technology of work performance.

At night and in conditions of reduced visibility, when no work is done, all traffic equipment is removed from the roadway, and the signs III-303 are covered!

Disposition of traffic signalisation and equipment is given in the graphic part of the design, which also shows some details necessary for the execution of signalling.

The contractor is obliged to provide permanent, impeccable operation of the complete traffic signalisation system and equipment covered by this design!

Prior to the commencement of works, the contractor is obliged to notify the competent authority of the Ministry of the Interior of the Republic of Serbia, the competent traffic supervisory authority and the public through the means of public information about changes in the traffic regime.

Upon completion of the works, the contractor is obliged to bring the traffic equipment and signalisation to the original state!

B. Works in the wider zone of the intersection (about 150 m on both sides)

Performing works in the wider area of ​​the intersection (about 150 m on both sides of the intersection centre) excludes the possibility of regulating traffic by using light signals due to problems with traffic flows that have a source in the bypass crossings. These flows, due to the existence of traffic lights at close range (20-30 meters), would not be able to safely merge in the main road, due to the line in front of the signal, as well as due to insufficient visibility and a specific traffic regime (traffic is carried out in a single traffic lane). On the other hand, even traffic regulation by vertical signalling cannot be applied due to the length of the construction site larger than 50 meters. Therefore, the most appropriate solution is the regulation of traffic by means of signalling flags.

In addition to the envisaged traffic signalisation and traffic equipment, the primary traffic control on this type of construction site is carried out by two or three workers (demonstrators) using red and green flag signals. Flags must be of a square shape of 40 x 40 cm.

Disposition of traffic control workers in the intersection zone is given in the graph provided below. Prior to the commencement of works, it is necessary to carry out trainings for traffic regulation workers, whereby they should be familiarised with the basic principles of work:

The microlocation where demonstrators are located must be selected so that they can clearly see each other, or where they cannot do that, they need to have a radio connection established.

Demonstrators give signals by lifting their hands (at right angles from the body) with a flag of appropriate color (red-ban passage, green-permit passage) so that the signal is visible to drivers at the appropriate access and to the other demonstrator as well.

At the beginning of the work, the free passage (green flag) is provided by the demonstrator on the main road and in a direction that is not obstructed by the works. Other directions have a passage ban (red flag). The free passage lasts until a "homogenous" line is emptied at this approach, and no longer than 2 minutes.

In the next stage, vehicles on the main road from the direction where the site is located have free passage.

The demonstrator may allow the passage of the vehicle only when the narrowed part of the road is emptied and when the last vehicle from the opposite direction has passed and when they are sure that the other demonstrators have raised red flags.

The free passage lasts until a "homogenous" line is emptied at this approach, and no longer than 2 minutes.

Demonstrators cease to regulate traffic only when the entire road profile on this section where the works are being carried out is usable.

Traffic signalisation foreseen by this design is of a temporary character; however, it must meet the requirements assumed by the ranking of the road on which it is located in all cases. Therefore, traffic signalling is of standard dimensions and it has been designed in such way to ensure its good visibility. The designed signalling is in accordance with the existing SRPS standards, the applicable legal norms and recommendations. Although traffic signalisation is foreseen by this temporary design, it must meet the requirements assumed by the traffic route rank where it is located in all cases and therefore traffic signalling of standard dimensions has been designed to ensure its good visibility.

Routing and traffic guidance in the construction site zone is carried out using vertical barriers, the details of which are in the graphic part of the design.

At the lateral approaches to the intersections which represent secondary traffic flow, signalisation indicating the danger of road works and the regulation of traffic with flags or boards is also provided.

In addition to the vertical traffic signalisation, at the approach point to the work area at the main traffic flow, installation of warning lights TS-1,TS-2 and TS-4 is also planned. These light sources must be supplied with energy through a reliable power supply for the duration of the modified traffic regime.

Construction of the site was done in accordance with the valid technical instructions to the extent allowed by the existing construction and condition of the roadway, as well as the technology of work performance.

At night and in conditions of reduced visibility, when no work is done, all traffic equipment is removed from the roadway, and the signs III-303 are covered!

Disposition of traffic signalisation and equipment is given in the graphic part of the design, which also shows some details necessary for the execution of signalling.

The contractor is obliged to provide permanent, impeccable operation of the complete traffic signalisation system and equipment covered by this design!

Prior to the commencement of works, the contractor is obliged to notify the competent authority of the Ministry of the Interior of the Republic of Serbia, the competent traffic supervisory authority and the public through the means of public information about changes in the traffic regime.

Upon completion of the works, the contractor is obliged to bring the traffic equipment and signalisation to the original state!

C. Works at the intersection itself

Carrying out works at the crossroads and the area of about 50 m on both sides of the intersection centre also excludes the possibility of regulating traffic by using light signals due to problems with traffic flows that have a source in the bypass crossings. The secondary traffic flow at whose junction with the main flow the works are being performed, had to be completely closed for traffic, while the secondary flow from the opposite side (where the works are not carried out) would be between two light signals and would have no access control.

On the other hand, even traffic regulation by vertical signalling cannot be applied due to the length of the construction site larger than 50 meters. Therefore, the most appropriate solution is the regulation of traffic by means of signal flags. In addition to the envisaged traffic signalisation and traffic equipment, the primary traffic control on this type of construction site is carried out by two or three workers (demonstrators) using red and green flag signals. Flags must be of a square shape of 40 x 40 cm.

Disposition of traffic control workers in the intersection zone is given in the graph provided below. Prior to the commencement of works, it is necessary to carry out trainings for traffic regulation workers, whereby they should be familiarised with the basic principles of work:

The micro location where demonstrators are located must be selected so that they can clearly see each other, or where they cannot do that, they need to have a radio connection established.

Demonstrators give signals by lifting their hands (at right angles from the body) with a flag of appropriate color (red-ban passage, green-permit passage) so that the signal is visible to drivers at the appropriate access and to the other demonstrator as well.

At the beginning of the work, the free passage (green flag) is provided by the demonstrator on the main road and in a direction that is not obstructed by the works. Other directions have a passage ban (red flag). The free passage lasts until a "homogenous" line is emptied at this approach, and no longer than 2 minutes.

In the next stage, vehicles on the main road from the direction where the site is located have free passage. In the third stage, the free passage is allowed only for vehicles in the secondary flow.

The demonstrator may allow the passage of vehicles only when the last vehicle from the previous stage has passed and when they are sure that the other demonstrators have raised red flags.

The free passage lasts until a "homogenous" line is emptied at this approach. In the fourth stage, free passage is provided for vehicles from the opposite side of the secondary flow.

Demonstrators cease to regulate traffic only when the entire road profile on the section being reconstructed is usable.

If it is an intersection with only one side approach, the traffic is regulated by three demonstrators located on the main direction, on both sides of the construction site and in the secondary approach in the manner described in the previous text, but the fourth phase being omitted.

If this is an intersection with only one side approach, during work on the side of the approach, the traffic is regulated by two demonstrators located on the main road, on both sides of the site, in the manner described above, leaving out the phase in which free passage is provided for vehicles coming from the side road approaches.

Traffic signalisation foreseen by this design must meet the requirements assumed by the ranking of the road on which it is located in all cases. Therefore, traffic signalling is of standard dimensions and it has been designed in such way to ensure its good visibility. The designed signalling is in accordance with the existing SRPS standards, the applicable legal norms and recommendations. Although traffic signalisation is foreseen by this temporary design, it must meet the requirements assumed by the traffic route rank where it is located in all cases and therefore traffic signalling of standard dimensions has been designed to ensure its good visibility.

Routing and traffic guidance is carried out using vertical barriers, the details of which are in the graphic part of the design.

At the lateral, active approach to the intersections which represent secondary traffic flow, signalisation indicating the danger of road works and the regulation of traffic with flags or boards is also provided.

Traffic on the access crossings on the side where the works are carried out will be suspended at the point where works are being performed. The suspension of traffic will be effective during the execution of the works and during the time necessary to consolidate the road structure. Given that the suspension of traffic on the access crossroads takes shorter period of time, in order to rationalise the number of traffic signals, traffic signalisation is maintained at the access point set during the works in the wider zone of the intersection, as well as a demonstrator that informs the drivers of the short-term closing of crossroads on this approach.

In addition to the vertical traffic signalisation, at the approach point to the work area at the main traffic flow, installation of warning lights TS-1 andTS-2 is also planned. These light sources must be supplied with energy through a reliable power supply for the duration of the modified traffic regime.

Construction of the site was done in accordance with the valid technical instructions to the extent allowed by the existing construction and condition of the roadway, as well as the technology of work performance.

At night and in conditions of reduced visibility, when no work is done, all traffic equipment is removed from the roadway, and the signs III-303 are covered!

Disposition of traffic signalisation and equipment is given in the graphic part of the design, which also shows some details necessary for the execution of signalling.

The contractor is obliged to provide permanent, impeccable operation of the complete traffic signalisation system and equipment covered by this design!

Prior to the commencement of works, the contractor is obliged to notify the competent authority of the Ministry of the Interior of the Republic of Serbia, the competent traffic supervisory authority and the public through the means of public information about changes in the traffic regime.

Upon completion of the works, the contractor is obliged to bring the traffic equipment and signalisation to the original state!

The pro forma invoice shows the value of traffic signalisation and equipment necessary for traffic regulation. In addition to the value of purchasing the elements of traffic signalisation and equipment, the value of lease of items that can be leased, for the period of 3 months, is also shown.

**2. TECHNICAL CONDITIONS**

Elements of traffic signalisation, included in this design are as follows:

**1. TRAFFIC SIGNS**

**2. MARKINGS ON THE ROAD (Procurement, transport and marking)**

**3. TEMPORARY TRAFFIC SIGNALISATION**

**4. OTHER WORKS**

The technical conditions for the design, procurement and installation of certain signaling components are explained through the items of these works:

- Signaling components are ordered based on design bill of quantities.

- Some components are made on the basis of the design bill of quantities.

- Some components of signaling are placed on the basis of situational plans and other drawings in the design, as well as on the basis of the Traffic Signs Rulebook, Serbian Standards and Recommendations for marking the zones where the works are being carried out.

The contractor must submit to the supervisory authority the appropriate documentation (attestations, certificates, etc.) issued by the competent institutions confirming that the applied components used for the design of the signaling meet the requirements defined by the following technical instructions with binding application issued by PC Putevi Srbije: **BS-02/2013 and BS-03/2013 Technical Manual.**

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| **1.** | **TRAFFIC SIGNS** |
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| **1.1** | **TRAFFIC SIGNS** |
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|  | ITEM DESCRIPTION  The item includes the production, procurement and installation of standard traffic signs (signs that are made in detail according to detailed drawings in SRPS standards, under names, code and appearance in accordance with the Traffic Signs Rulebook).  MATERIALS  Standard characters are made from materials and in the manner prescribed in SRPS Z.S2. 300 (Technical conditions - general requirements for preparation and testing).  Standard traffic signs are made of aluminum sheet, or galvanized steel sheet, according to the choice of the investor.  The front of the sign, with all the symbols, letters and numbers, must have reflective properties of Class II reflection material. |
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|  | CONSTRUCTION AND INSTALLATION |
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|  | The dimensions of the standard traffic signs are in function of their shape and the rank of the road on which they are located.  Standard signs are all made according to elaborate drawings in Serbian standards, under the names, code and appearance according to the Traffic Signs Rulebook(SRPS Z.S2 from 301 to 309).  There must be no fastening structure at the front of the sign (screws, rivets, etc.), which would interfere with the legibility and reflection of the sign, both in daylight and in the lighting of the car's headlights.  The back of the sign, including all the fastening elements on the support, must be protected with artificial resins and in a dark-gray tone.  The signs are attached to a single pipe pillar support using clamps placed on the back of the sign.  The signs must be secured from turning and sliding by inserting a plastic cuff between the clamp and the pillar - (unless the support is coated).  The signs are set so that their flat surface deviates horizontally by 3-50 in the perpendicular field to the axis of the road.  .  If new traffic signs are being set, the manufacturer is obliged to print on the back of the sign the code of the sign in accordance with the Traffic Signs Rulebook, with the possible content (numerical or inscripted) in the brackets; if a sign is placed in an opaque wrapper, the obligation applies to the wrapper as well.  If new traffic signs are being set, the manufacturer is obliged to deliver the signs in the protective package, on which the code number must be printed.  The position of the sign in the transversal profile is determined by the design in a special graphic attachment.  QUALITY CONTROL  The manufacturer must possess an attestation for all materials used in the production of standard traffic signs. Quality control is performed in accordance with SRPS Z.S2.300.  WORK CALCULATION  The price of the standard and non-standard traffic sign includes delivery and transport to the place of installation, all mounting elements for the support (reinforcement, clamps, screws, etc, screwing clamps.), mounting of the sign on the built-in support, as well as quality control according to SRPS Z.S2 .300. |
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|  | **1.2. TRAFFIC SIGN SUPPORTS AND PORTABLE STANDS** |
|  | ITEM DESCRIPTION  The item includes the manufacture, procurement and installation of single pipe supports of traffic signs, mobile stands and sand sacks.  MATERIALS  Pipe supports are made of a steel-drawn pipe of uniform cross-section and thickness, depending on the number, type and square of the signs that are placed on the supports. The movable stands are made of concrete, solid metal, plastic or other modern materials that ensure the stability of the set signalling.  PRODUCTION AND INSTALLATION  In the case of individually set traffic signs, the outer diameter of the pipe must not be less than 50 mm, while the supports intended for placing of more than one signs must have an outside diameter of at least 60 mm. |
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|  | Pillars are placed on the mobile stand according to the project's design in situations.  Sacks filled with sand are placed on mobile stands to provide additional stability.  The length (height) of the support is determined from the details of the item of the signs, and according to the size and number of signs on them, and the selected method of fastening the signs to the support.  A single pillar pipe support must be secured from rotation in the movable stand.  The supports must be protected in a hot galvanization process.  From the top of the pillar, the support must be protected from the rain, i.e. closed with a plastic plug or welded. |
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|  | QUALITY CONTROL  The manufacturer must possess an attestation for all materials used in the construction of traffic sign supports.  WORK CALCULATION  The price of mobile stands, foundations and single supports includes the delivery and transport to the place of installation, the price of accessories for connections between the support components, support seals for the rain protection as well as the quality control of the materials used. The mobile stands and foundations are calculated by piece. Nylon sacks are filled with 50kg of sand. Portable rubber supports and 50kg sacks of sand are calculated per piece. |
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|  | **5. TEMPORARY TRAFFIC SIGNALISATION**  **5.1 BARRIERS**  ITEM DESCRIPTION  Position includes the production, procurement and installation of horizontal and vertical barriers.  MATERIALS  Horizontal and vertical barriers are made of plastic materials, aluminum or galvanized steel sheet. The barrier stand is made of solid plastic materials, rubber, concrete or metal.  CONSTRUCTION AND INSTALLATION  Horizontal and vertical barriers are placed according to the situations and detailed drawings in the design.  Horizontal barriers are placed vertically on the axis of the road at the places where the narrowing of the road occurs. Horizontal barriers are placed at the beginning and at the end of the construction site, over the entire width occupied by the site or barriers.  Horizontal and vertical barriers are coated with reflective Class II film.  Horizontal barriers are placed at a height of 1.0 m from the surface of the roadway, on supports made of metal pipes of 50 mm in diameter. Supports are built into mobile stand made of solid plastic, concrete, metal or rubber.  The front bench board dimensions are 0.25 x 2.5 m.  Vertical barriers are placed at the mutual distance in everything according to the situation plan.  QUALITY CONTROL  Prior to setting horizontal and vertical barriers, the Contractor shall prove their quality with an attestation, which will be presented to the supervisory authority.  WORK CALCULATION  The cost of horizontal barriers is calculated by piece without pipe supports and stands, and the price of vertical barriers is calculated with the stand included. |
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|  | **5.2 LIGHTING TRAFFIC SIGNALISATION**  ITEM DESCRIPTION  The item includes the construction, procurement and installation of light signs for marking works on the road.  MATERIALS  Lighting signs must be made of such material and in such way as to ensure reliable operation even in the most unfavorable weather and climatic conditions.  CONSTRUCTION AND INSTALLATION  Luminous signs for marking works on the road are provided by a permanent orange light and blinking orange light.  In places where it is not possible to secure a grid power outlet, suitable car batteries can be used to power the lighting signs.  Orange blinking lights used for channeling and directing traffic should be directed to thefront-end vehicles, the "running" effect should be realised in the direction of the vehicle's movement.  Light signs are placed on barriers, obstacles or special supports at a height of 1.30-2.0 meters above the roadway surface.  QUALITY CONTROL  Before the installation of lighting signals, the contractor will confirm their quality with an attestation, which will be presented to the supervisory authority.  WORK CALCULATION  The price of light signs includes the costs of their purchase, shipping and delivery costs to the place of installation and installation. |
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|  | **5.3 OTHER EQUIPMENT**  The manual regulation of traffic in the work zone is done by at least two designated workers for the work, towards the direction of movement of the vehicle movement by giving a sign by a flag.  Traffic is regulated with flags of red and green color of dimensions of at least 40 cm x 40 cm, which have the following meaning:  1) raised green flag - free passage for vehicles from the direction where this flag was raised,  2) raised red flag - prohibited passage for vehicles from the direction where this flag was raised.  The place of workers on the road that perform manual regulation is determined in the situational plan.  In the case where traffic controllers do not see each other, a radio link is used for their communication.  Manual regulation of traffic in the work area is carried out under conditions of good visibility and is not performed in night conditions.  The cost of hiring personnel for traffic regulation is calculated per person for a period of three months. |
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|  | **6. OTHER WORKS**  CRUSHED STONE AGREGATE 0 / 31.5mm  The work includes the procurement and installation of granular stone material for levelling the extended part of the roadway to the level of the existing roadway. Materials for the production of the bearing layer may be crushed stone material. The specified material must fulfill certain conditions regarding mechanical properties, granulometric composition, bearing capacity and other conditions according to the applicable standards.  The material must also meet the requirements for resistance to cold. The upper surface of the bearing layer should be made to the level of the existing roadway.  Calculation of performed works is carried out per cubic meter of finished bearing layer from mechanically compacted grain material, for all work, material, procurement and transport of stone material and control tests.  **7. REMARKS**  **Bill of quantities is a part of Volume 4 of this dossier** |
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