VOLUME 3

TECHNICAL REQUIREMENTS

Construction of working-inspection/cycling path for the project BEGA

VI-84/1

VOLUME 3.3

TECHNICAL REQUIREMENTS
FOR WORKS

DUAL-USE PATH ALONG BEGEJ CANAL
SECTION I - ŽITIŠTE

1. PREPARATORY WORKS

1.01 STAKING AND SETTING OUT OF THE ROUTE AND BUILDING

Description of works

Road axis setting out shall include all measurements in order to transfer design data onto the land as well as securing, demarking and maintaining points established on the ground throughout the construction period, i.e until works are handed over to the Investor.

Road axis handover and acceptance

The Contractor shall hand over the Investor the operational polygon and permanent survey points (markers) with all necessary data in the form of drawings, layouts, tables, etc. The data on operational polygon and permanent survey points shall be delivered and received in writing.

Inspection during construction

The Contractor shall regularly inspect the set out road axis, road profiles, permanent survey points (markers) and polygon points. The Contractor shall repair any destroyed or damaged marker at its own expense. The Supervisor shall inspect the accuracy of the restored road axis, road profiles, permanent survey points (markers) and polygon points.

Handover and acceptance upon completion

The Contractor shall restore the road axis, chainage, polygon points and permanent survey points at the Investor's request and hand over them to the Investor upon completion of road works and prior to technical acceptance. The acceptance/handover record should be in writing.

Measurements and monitoring

Calculation and payment in square meters (m^2) and the unit price shall be a fee for setting out the road route.

1.02 DEMOLITION OF VEHICULAR ACCESSES CONSTRUCTED OF DIFFERENT MATERIALS

Demolish sidewalks and bike paths that need to be removed according to design. The average substrate thickness is 20-30 cm and is composed of different materials. If the sidewalks is paved with slabs, remove these slabs manually, clean and load them into a vehicle. The demolition waste is to be loaded into the vehicle, transported to the landfill determined by the Supervisor, unloaded and graded.

Costs shall be calculated per a square meter of demolished sidewalks and bike paths, including all works, materials and transport as described above.

1. 05 AS-BUILT DESIGN PREPARATION

Description of works

Upon completion of road construction works, the Investor and Contractor shall prepare an as-built design provided that there were major changes in relation to the conceptual design.

Execution of works

The as-built design shall include all building changes in relation to the conceptual design and all other elements prescribed by the Regulation on the Contents, Manner and Procedure of Producing Technical Documents and their Inspection according to the Structure Class and Intended Use.

Measurement and payment

Executed works shall be calculated and paid at an aggregate price for the entire as-built design.

2. EARTHWORKS

2.01 EARTH EXCAVATION

Description of works

The works involve open cut surface earth excavation along the route, in the borrow pit and below embankments in a design thickness, transport or mechanical pushing of excavated material to the roadside landfill and storage of excavated material. Average thickness of excavated earth material is 20 cm. The actual thickness to be removed shall be determined on site.

All works to be carried out must conform to the design and these technical requirements.

Execution of works

All excavated material should be deposited along the route outside the subsoil area so as to allow its undisturbed subsequent use and access. Excavated material is to be carefully transported or pushed to the landfill so as to preserve the quality of excavated material for subsequent use when making slopes and landscaping green areas and to prevent mixing of this material with other non-humus material.
Transport of any excess humus materials is also included in the scope of works for this item and is to be performed in order to preserve the embankment geometry.

Measurement and payment

Measurement and payment shall be made per a cubic metre (m^3) of excavated humus material deposited along the road or transported to the landfill, including all necessary works and materials.

2.02 GRADING OF AREAS NEXT TO PAVEMENT STRUCTURE

Description of works

Works include: formation works in the carriageway widening by cuts and fills, including coarse and fine grading, repair of individual non-homogenous points, soil wetting and drying. The described works are to be executed to the design elevations along the design formation width observing these technical requirements.

Execution of works

In case that compacted formation is exposed to adverse weather conditions or otherwise damaged, the Contractor shall bring it back to the condition required by these technical requirements.

Formation quality requirements

Flatness

The surface of the wearing course (formation) must be levelled so as allow maximum deviations from the measuring plane of -30mm. Flatness shall be measured by crosses or ropes on each profile and in all directions (perpendicular, longitudinal and diagonal).

Surface elevations

The elevations of the formation wearing course at any point may deviate from the design elevations by -30 mm maximum.

The elevations of individual measuring points shall be determined by a level, where the points will be determined by the Supervisor at its own choice and mandatorily on each cross-section.

The transverse and longitudinal slopes of the formations must be constructed in line with the design. The formation bellow shall be filled at the expense of the Contractor using base course materials. The formation above must be removed to the design elevation.

Acceptance of works

The formation shall be accepted by the Supervisor immediately prior to the next stage of works.

Measurement and payment

Measurements shall be made per a square meter (m^2) of the road formation based on design quantities.

2.03 CONSTRUCTION OF SHOULDERS USING EXCAVATED MATERIALS

Description of works

The slopes of cuts and fills shall be prepared for a humus layer and the shoulder base course shall be brought to a design elevation and then overlaid with a humus layer of a design thickness, graded and compacted on shoulder.

Execution of works

Humus layers are to be applied immediately after the asphalt works.
Prior to applying humus layers, the following requirements need to met in order to achieve stability:
• The surface water of the catchment area must be accepted and drained in a controlled manner.

The deviations of constructed shoulder elevations shall be ±□1 cm compared to design elevations shown in the design drawings. Crushed materials from borrow pits is to be used to fill humus material. Active humus materials that guarantees vegetation sustainability shall be used.

Measurement and payment

Measurements shall be performed per a square metre (m2) of the surface covered with humus of design thickness.

2.05 CONSTRUCTION OF EMBANKMENTS USING SELECTED EARTH MATERIAL

Description of works

The works include filling, spreading and coarse and fine grading, drying or wettings and compaction of embankment filling materials according to the sizes defined under the design.
This embankment or earth material filler shall be installed up to the humus level.

Material

Inorganic material of the prescribed quality will be used to construct the embankment.
No material can be incorporated into the embankment which, over time, could change its physical and mechanical properties due to biochemical effects.
The embankment material may be obtained from cuts on the route or from borrow pits provided that it is not sensitive to the presence of water.
When testing the suitability of earth materials for embankment construction, test materials from each cut and borrow pit as well as at any material change. Tests should be performed on at least two samples for each type of material.

Transportation and filling

Transportation and filling of material on prepared foundation soil or pre-constructed embankment capping layer may start only after the base courses are taken by the Supervisor.
Each individual course must be horizontally spread in a longitudinal direction or at most, in slope equal to design longitudinal slope. In the transverse sense, each individual course must have a two-sided or single-sided slope of 2 - 5% to drain storm water.
Each individual course must be filled according to the design cross section profile. When spreading materials, the vehicles must be as evenly distributed as possible along the entire formation width.
The height of each course must be consistent with the compaction effect on the depth of the compaction tool used, type of material filled and segregation phenomena, but must not be higher than 30 cm in loose state.
These materials are to be compacted by vibrating rollers (self-propelled or towed), vibrating plates and compactors depending on the materials used.
Each type of material to be installed in the embankment is to be tested on the test section and the machinery to be used is to be adopted according to the given procedure.

Compaction

Each embankment layer must be compacted in full width by a suitable mechanical means, with compaction generally being carried out from the edge towards the centre.
All inaccessible places for machinery or places at which the use of heavy duty machinery would be inappropriate (embankment behind the building, retaining walls, etc.) should be compacted using other suitable means or methods that will be approved by the Supervisor.
If the predominantly coherent material is used for embankment and weather prevents its use, it is permitted to apply other embankment construction procedures such as stabilisation, processing/treatment or replacement of materials that will be requested or approved by the Supervisor, provided that these costs will be borne by the Contractor.
When there is a risk of rain, the Supervisor will, if necessary, order the suspension of further embankment works, without an obligation to compensate the costs. The top layer of the embankment composed of coherent material shall be graded and rolled by a light-duty smooth wheel roller (3-5 tons) so as to obtain 2 to 5% sloped smooth surface without any recesses that could collect storm water. Prior to filling another layer, the smoothened surface shall be roughened in order to ensure better bonding between layers. This also applies to other prolonged suspension of embankment construction works (due to the end of construction season, etc.).

Measurement and payment

Measurements shall be made per a cubic metre (m3) of the constructed embankment measured on site without humus, including the shoulder core.

Transport of additional material for embankment construction shall be included in the unit price of the item.

3. CONSTRUCTION OF PAVEMENT STRUCTURE

3.01 CONSTRUCTION OF BASE COURSE USING 0/31.5mm CRUSHED STONE AGGREGATE

DESCRIPTION

The item includes procurement, transport, installation, coarse and fine grading, potential wetting and compacting of the 0/31.5 mm crushed stone base course in thickness defined by the Detailed Design.

CONSTRUCTION

The course is to be constructed in one or two layers depending on the machinery. The material must be graded in a longitudinal direction in a slope equal to slope of the finished level.
In the transverse sense, it must have the same slope as the finish level slope, i.e. slope required to drain storm water.

QUALITY CONTROL OF MATERIALS USED TO CONSTRUCT CRUSHED STONE BASE COURSE

The crushed stone aggregate must be used for the construction of the base course. The quality control during preliminary tests shall be performed in line with the following regulations:
SRPS B.B0.001 - natural aggregate and stone; sampling
SRPS B.B8.012 - natural stone, testing of compressive strength
SRPS B.B8.010 - determination of natural stone water absorption
SRPS B.B8.002 - soundness testing
SRPS B.B8.045 - abrasion resistance testing of natural and crushed aggregate rock by Los Angeles machine
SRPS B.B8.037 - determination of friable particles in coarse-grained aggregate
SRPS B.B8.047 - shape and surface appearance of aggregate particles, definitions
SRPS B.B8.048 - stone aggregate particle shape testing
SRPS U.B1.018 - determination of particle size distribution and determination of particles of 0.08 mm by aerometric methods (or according to SRPS B.B8.036)
SRPS B.B8.036 - determination of particles passing through 0.02 mm sieve mesh(the procedure from this SRPS- applies)
SRPS B.B8.038 - clay balls and silt content
SRPS B.B8.031 –water absorption
SRPS B.B8.030 –aggregate bulk density (in compacted and loose state)
SRPS B.B8.032 stone volume mass (determination of bulk density, density, coefficient of density, and porosity)
SRPS U.B1.012 – determination of moisture content
SRPS U.B1.016 – determination of soil density
SRPS U.B1.038 – determination of optimum water content
SRPS U.B1.042 - determination of the California bearing ratio

Tests are to performed for each material change, i.e. at least once every 1000 m2.

CRITERIA FOR ASSESSING BASE COURSE QUALITY

Crushed stone aggregate must meet the following requirements in terms of:

- physical-and mechanical and minerological and-petrographic properties of rocks and aggregates
- bearing capacity
- content of organic matter and light particles.

Crushed material grains must meet the following requirements:

Physical and-mechanical properties of stone:

Medium compressive strength (MPa) - dry	-	at least 120
-Water absorption (% of mass)	-	1.0
Frost resistance (25 freeze-thaw cycles)	-	(Stone shall be considered resistant to freezing if a medium compressive strength after freezing decreases up to 20% compared to the medium compressive strength in dry state).
Minerological and-petrographic content	-	Stone can be of eruptive, sedimentary, metamorphic rock origin. The presence of marls, clay shales, soft and clayey sandstones, conglomerates, decomposed granites and gneisses is not permitted.

Physical and -mechanical properties of crushed stone aggregate:

- Grain shape, content of inadequately shaped grains (3:1)	max 40%
- Water absorption (SRPS B.B8.031)	max 1.6%
- Friable grains	max 7%
- Abrasion resistance according to Los Angeles method	max 40%
Content of silt, clay and organic matter-	max 3%

Note: For unseparated stone materials, the prescribed limit value for the content of adequately shaped grains, friable -poor quality grains, water absorption, loss at Na2SO4 are to be calculated as a percentage of the mass in laboratory separated fractions or a fraction of grains greater than 4mm.

Additional quality criteria

In addition to the above defined criterion, the material must also meet the following requirements:
- resistant to disintegration by weathering
- not prone to degradation due to construction site traffic under different meteorological conditions
- fine fractions content (<80µm) should be < 6%
- plasticity index of fine particles Ip<12
- Uniformity coefficient Cu=15-30
- Californian bearing ≥80% at a degree of compaction of 98% compared to the -Modified Proctor test
- content of organic matter and light particles must not exceed 3% by weight

The grain size distribution curve of the mixture must be within the limits given in the following table:

Sieve mesh mm	0.09	0.25	0.5	1.0	2.0	4.0	8.0	16.0	31.5	45.0
min %	2.0	5.0	8.0	11.0	15.0	20.0	28.0	46.0	95.0	100
max %	9.0	15.0	21.0	30.0	40.0	50.0	62.0	75.0	100.0	100

The quality of material is to be confirmed by the Report on Material Quality and Usability not older than 6 months, which is issued by an accredited laboratory.

COMPACTION OF BASE COURSE

After coarse grading, compact the base course in a full width using adequate compaction means. All potentially inaccessible places for compaction shall be compacted by suitable compaction means applying specific procedures that must be approved by the Supervisor.

At the beginning of compaction works, moisture content of the base course must be sufficient in order to successfully compact it.
If the base course constructed on 0/31.5mm crushed stone aggregate is compacted much before the construction of base courses, it is necessary to inspect their compaction and readiness for further execution of works prior to continuing construction works.

CONSTRUCTION QUALITY

COMPACTION

The Contractor is required to prove the compaction of a capping layer by the test results.
The base course of DKA 0/31.5 mm must be compacted at least 98% of the maximum dry density obtained by the Modified Proctor Test.
At each measuring point, the compactness of the base course must reach the required values. Insufficiently compacted surfaces of the base course must be compacted by the Contractor to the required density as prescribed by these technical requirements without a right to compensation for this additional work.

BEARING CAPACITY

The Contractor must prove the achieved capacity bearing of the base course with the test results by measuring Ev2 deformation modulus. (These measurements do not exclude compaction tests).
At any measuring point, the requested deformation modulus values (Ev2) must not be less than 160 MPa.
The Ev1/Ev2 deformation moduli are to be measured by a Φ300mm plate.
The Ev2/Ev1 ration must not exceed 2.5. If the measured value of the deformation modulus Ev1 exceeds 50% of the Ev2 value, the required ratio will not be decisive for the assessment of the bearing capacity of the course.
At each measuring point, the bearing capacity of the base course must meet the set requirements.

BASE COURSE FLATNESS

Base course flatness measured by a 4m long level parallelly laid with the road axis must be at least 1 cm.

HEIGHT POSITION

At the point of measurement, the base course surface must not deviate from the design elevations by more than 1.0 cm.

QUALITY CONTROL

MATERIAL QUALITY CONTROL

Prior to executing these works, the Contractor shall inspect the conformity of the quality of materials with these technical requirements and provide them to the Supervisor for review.

CONSTRUCTION QUALITY INSPECTION

ONGOING AND CONTROL TESTING

Based on the results of the previous tests, the Supervisor will decide on the scope of testing when constructing the base course.

A) The ongoing tests to be performed by the Contractor include:

Testing of materials prior to construction:

Moisture testing
Particle size distribution testing
maximum dry density and optimum moisture testing (Modified Proctor Test)
California bearing ratio testing

Base course testing during and after construction:

moisture content and compaction at 50m,
bearing capacity by deformation modulus at 50m,
flatness at 25 m,
height position at 40 m or on each profile.

B) Control tests that must be performed by the Investor account for 25% of the prescribed scope of ongoing tests.

If, in the course of ongoing testing, the Supervisor observes significant differences from the results of previous tests, it will decide on further work. If necessary, the Supervisor may request to perform the more frequently than prescribed by these technical requirements.

CALCULATION AND PAYMENT

Calculation and payment shall be made per a m3 of the installed and compacted base layer that is accepted by the Supervisor.
The Contractor cannot request any payments for any works that fail to meet these technical requirements or any works that are not instructed by the Supervisor.

3,02 CONSTRUCTION OF STABILISED SHOULDER

Description
This item includes the construction of a shoulder covered with sand gravel or stone chippings of the design thickness and width. The minimum thickness of the course is 10 cm.
Material
On either side of the carriageway, up to the finish level of the base course, the shoulder is to be constructed using the same materials of the same thickness as for the base coarse.
Material that meets the requirements for the material intended for the construction of the embankment base course layer of the embankment according to these technical requirements shall be used for the construction of the shoulder above the finish level of the base course.
The 0/8mm grain size sand or gravel and 0/30 mm stone chippings can be used to construct the embankment finish. However, their quality needs to conform to SRPS U.E9.020.
Performance and quality of works
All works must be carried out according to the detailed drawings enclosed with the design and engineering documentation, unless otherwise specified by these requirements.
Materials used to construct the shoulder finish must be compacted. In principle, the regulations in these technical requirements should be observed.
The surface of the installed course must be transversely and longitudinally sloped according to the design, taking into account the lowering of the finish level (for the thickness of the compacted layer of sand gravel and stone chippings).
The intended materials are to placed over the shoulder in the designed thickness according to the designed profile, with a specific superelevation due to compaction.
Horizontal shoulder edges must be constructed according to the design. Deviations from the design lines are allowed only to avoid visual disturbance.
The permitted elevations of the shoulder finish shall range within 1 cm below the design surface.
The allowed deviations in the thickness of the installed compacted course compared to the design thickness shall range ±1 cm.
The same requirements for the associated items under technical requirements shall apply to flatness, compaction and thickness (embankment capping layer, base course of the pavement structure).
Measurement and payment
Quantities to be for calculation shall be determined in square meters (m2) of the design thickness of the capping layer based on the actual work performed under the design.
The shoulder core above the base course shall be measured as an embankments, while the shoulder core on both sides of the carriageway to the base course elevation shall be measured as part of the quantities used to construct the base course.
Payments shall be made in line with the contract terms - Contract Ref. No.RRSP/ENJ-IIA170RBB/2014-12.

3.03 CONSTRUCTION OF BITUMINOUS WEARING COURSE (BNHS 16)

ITEM DESCRIPTION

The item includes procurement of materials, mixing, spreading, installation and compaction of a hot mix asphalt of mineral materials and road bitumen BIT 50/70 in one layer of design thickness of t = 6.0 cm according to the elevations and dimensions given in the construction design.

MATERIALS

Building materials for the construction of the bituminous wearing course:
- carbonate stone filler,
- crushed carbonate stone aggregate 0/4, 4/8, 8/16
- binder BIT 50/70

QUALITY OF MATERIALS

Filler

The filler must in all ascpects meet the criteria defined for the 1st quality class under SRPS B.B3.045.

Particle size distrbution (% sive passage)	for the 1st quality class	SRPS B.B8.105
Plasticity index % (m/m)	max.4.0	SRPS B.B1.020
Moisture content % (m/m)	-	SRPS U.B1.012
particle size distribution for particles less than 0.063 mm %	-	SRPS U.B1.018
Bitumen hardening index	1.80 - 2.40	SRPS B.B8.104
Rigden voids in % v/v	-	SRPS B.B8.102

Sand

Crushed stone must in all aspects meet the quality requirements shown in the table below:

Particle size distrbution (% sive passage)	according to SRPS U.E9.021/86	SRPS B.B8.029
content of particles less than 0.09 mm (% sieve passage)	max. 10	SRPS B.B8.036
Content of clay balls % (m/m)	max. 0.5	SRPS B.B8.038
Content of organic impurities % (m/m)	max. 0.5	SRPS U.B1.024
Sand equivalent, %	min. 60	SRPS U.B1.040
Fineness modulus	-	SRPS U.E4.014
density (kg/m3)	-	SRPS B.B8.031

* the value in parenthesis refers to crushed sand of silicate composition

Stone chippings

Stone chippings fractins should meet the following quality requirements:

Abrasion resistance and resistance to wear according to Los Angeles (%m/m)	max. 30 % m/m	SRPS B.B8.045
resistance to freezing Na2SO4, loss after 5 cycles	max. 5 % m/m	SRPS B.B8.044
percentage of unocovered area of all grains (%)	max. 20%	SRPS U.M8.096
water absorption for 4/8 mm fraction	max. 1.2 % m/m	SRPS B.B8.031
grain content in fractions above 4 mm where the ratio of the largest to the smallest dimension is> 3: 1	max. 20 % m/m	SRPS B.B8.048

clay lumps in fractions	max. 0.25 % m/m	SRPS B.B8.038
density	-	SRPS B.B8.031

The particle size distribution of fractions shall be tested for any stone chippings fraction according to SRPS B.B8.029, while the content of particles less than 0.09 mm shall be tested according to SRPS B.B8.036.

Bitumen

Bitumen BIT 50/70 shall be used and must meet the criteria given in SRPS U.M3.010. for BIT 50/70 in all aspects.

PRELIMINARY TESTING OF APSPHALT MIXTURE

Prior to commencement of works, the Contractor shall prepare a preliminary asphalt mixture design in an authorized laboratory in accordance with these technical requirements.

Asphalt mixture can be produced only after the Contractor has provided the preliminary mixture to the Supervisor for approval. The certificates of basic materials and preliminary mixture must not be older than 6 months. If there are any changes in the basic materials or changes in the choice of materials, the Contractor shall provide the Supervisor with a written proposal for the change of the adopted asphalt mixture or proposal for a new preliminary mixture for approval before using these materials.

Particle size distribution of mineral mixture

The particle size distribution curve of the design mineral mixture must meet limit conditions provided under SRPS U.E9.021/86 for bituminous wearing courses BNS 22A, which are given in the table below:

Sieve mesh (mm)	0.09	0.25	0.71	2.00	4.00	8.00	11.2	16.0
passage (%)	4-14	7-37	12-53	21-65	30-74	44-85	54-92	70-100

The building materials and quality of preliminary asphalt mixture shall be tested according to SRPS U.E9.021/86 and should meet BNHS16 quality requirements.

The designer's approval for a composition of preliminary asphalt mixture is mandatory.

CONSTRUCTION TECHNOLOGY

ASPHALT MIXTURE PREPARATION AND TRANSPORT

The asphalt mixture is to be mechanically produced in an asphalt mixing plant. A continuous asphalt mixing plant may be used if satisfactory performance is demonstrated by the quality of asphalt mixture produced by this procedure.
The optimum bitumen temperature in asphalt tank trailers is 150 ^{o}C, while the maximum temperature is 165 ^{o}C. The aggregate temperature must not exceed the bitumen temperature by more than 15^{o}C, while the temperature of the asphalt mixture when leaving the mixer is optimally 160 $\pm$ 10oC and not more than 175^{o}C.
The asphalt mixture is to be transported to the point of installation immediately after its mixing.

SUBSTRATE PREPARATION

Prior to casting asphalt course, the Supervisor shall survey the substrate level and flatness. In the parts where the substrate layer is higher than the design elevations, the Contractor shall repair the substrate in line with the design requirements.
The asphalt mixture can be laid on a substrate composed of mechanically stabilized granular only after the substrate has been tested and accepted by the Supervisor. The time interval between the substrate testing and installation of the asphalt mixture must not be longer than 24 hours and during this time, transportation on the tested substrate should be prohibited.
Prior to installing bituminous wearing course, the substrate must be clean and must not be frozen.

INSTALLATION OF ASPHALT MIXTURE

Asphalt mixture is to be installed only in favourable weather conditions. The temperature of the substrate and air must be higher than +5^{o}C. In special weather conditions such as strong winds, the Supervisor may suspend the works even at temperatures higher than the aforementioned, if it is suspected that under these conditions the quality of works will be compromised. The asphalt mixture temperature at the point of installation must not be lower than140^{o}C and higher than 175^{o}C.
The asphalt mixture is to be mechanically laid and immediately afterwards an adequate rolling regime must be provided to ensure the required compaction of the asphalt course.
Other construction technology details for this item are given in the applicable standard SRPS U.E9.021/86 and other applicable SRPS standards.

PERIOD OF EXECUTION OF WORKS

The asphalt can only be installed in the period when the air temperatures are higher than 5^{o}C without wind or at least 10^{o}C with wind. Asphalt mixture must not be installed in misty and rainy weather conditions. The substrate temperature must not be lower than +5^{o}C.

QUALITY CONTROL

TESTING

Ongoing testing shall be performed by the Contractor in order to have at all times the best insight into the quality of the building materials as well as the asphalt mixtures produced and installed, in order to intervene in the production process if necessary and to ensure the continued production of the prescribed quality.
The Contractor shall influence the process of production and installation of the asphalt mixture based on the results of the ongoing tests in a way that ensures the uniform and technically compliant quality of the produced asphalt course.
The Contractor shall keep a written record of the results of the tests carried out as part of ongoing tests, which must be made available to the Supervisor.
The ongoing testing during the construction of the bituminous wearing course includes:

- ongoing testing of building materials
- ongoing testing of asphalt mixture
- ongoing testing of installed asphalt mixture

All tests to be conducted as part of ongoing testing need to be carried out to the extent and in the manner prescribed by the applicable Yugoslav standards SRPS U.E9.021 / 86.

CONTROL TESTS

Control tests are to be carried out by the Contractor as part of its Quality Assurance Program in order to obtain a more realistic picture of the achieved quality of the asphalt course installed according to these Technical Requirements.
Control tests include:

- control tests of building materials
- control tests of produced asphalt mixture
- control tests of installed asphalt mixture

Control tests of materials

Control tests shall be performed on samples taken on an asphalt base.
One sample is to be taken from each type of material per quantity of material required to produce 1000 tonnes of asphalt mixture. The required quantities of material are to be calculated on the basis of the working composition of the asphalt mixture.

Filler
The following tests shall be carried out:

Particle size distribution	SRPS B.B8.105
Void fraction in dry compacted state - Ridgen voids	SRPS B.B8.102

Sand

The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Sand equivalent	SRPS U.B1.040
Content of partciles less than 0.09 mm	SRPS B.B8.036

Stone chippings
The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Content of partciles less than 0.09 mm	SRPS B.B8.036
Grain shape	
Friable particles	SRPS B.B8.037

Bitumen

All analyses are to be conducted in line with SRPS U.M3.010.

Control tests of produced asphalt mixture

Asphalt mixture samples for control tests shall be taken at the point of installation of asphalt mixture.
The composition and physical and mechanical properties of the asphalt mixture are to be checked by testing one sample for every 350 tonnes of produced asphalt mixture.

The following properties are to be tested:

Bitumen content	SRPS U.M8.090
Particle size distribution	SRPS U.M8.090
Stability at 60 °C	SRPS U.M8.090
stability and deformation at 60 °C	SRPS U.M8.090
Void volume fraction	SRPS U.M8.090
bitumen filled voids	SRPS U.M8.090

Control tests of produced asphalt course

The physical and mechanical properties and thickness of the produced course shall be tested on samples extracted at least every 200 m of the produced course.
Sampling according to SRPS U.M3.090.

The following properties are to be tested:

Void volume fraction	SRPS U.M8.090
Degree of compactness	SRPS U.M8.090
Course thickness	-

The height, transverse slope and position of the produced course shall be inspected by appropriate instruments, at least 20% of the data recorded by the Contractor during the ongoing testing of the course production and installation.

CRITERIA FOR THE CALCULATION OF EXECUTED WORKS

Course flatness and crossfall

The Contractor shall make measurements on cross section profiles, provided that spacing does not exceed 30 m. Measurements are to be performed using a 4 m long screed (left, right, middle). Criteria are as follows:

Fatness deviations ranging between 0 to 8 mm	shall be deemed satisfactory
Fatness deviations ranging between 8 to 12 mm	shall be deemed unsatisfactory and 5-25% of the value of this flat area shall be deducted.
Flatness deviations exceeding 12 mm	shall be deemed unsatisfactory and 100% of the value of this flat area shall be deducted.

The maximum deviation of the transverse slope of the asphalt concrete course from the design transverse slope is ± 0.4%.

Deviation of the course surface from the design elevation of the level finish

The maximum permissible height deviation of the surface of the constructed bituminous wearing course from the design height is ± 10mm.

Horizontal deviation of the edge of the installed course

The maximum permissible deviation of the position of the right and left edge from the design position is± 25 mm.

Deviation in the thickness of the installed course

All deviations of the installed course thicknesses from the design course thickness, provided that the Contractor assesses that the installed course may remain in the pavement structure, shall be the subject to the quality assessment of the executed of works.
The measurements shall be performed on each profile and the criteria are as follows:

For a course thickness deviation of 10 -13 mm	10-25% of the value of this surface shall be deducted.
For a course thickness deviation of 13 -17 mm	26-50% of the value of this surface shall be deducted.
For a course thickness deviation exceeding 17 mm,	the executed works shall not be accepted.

The deduction value in percentages shall be determined by the Supervisor based on the number of measurements and percentage of results that deviate more than -10% of the design course thickness.

Particle size distribution of mineral mixture

If the particle size distribution of the extracted mineral mixture deviates from the boundary curve compared to the required granulometric curve, i.e. exceeds the standard tolerances, the Contractor shall reduce the value of the works of the bituminous wearing course works by 5.0% for the area covered by the tested sample. If deviations exceed the standard tolerances in all three components of the asphalt mixture, in the granulometric curve, filler and bitumen fraction, the asphalt course cannot be accepted.

Compaction degree of installed course

The criterion for the acceptance of works is the degree of compaction achieved, which must be a minimum of 98%. If more than 10% of the tested samples show a compaction degree less than 98%, the works will be rejected.

MEASUREMENT AND PAYMENT

Costs shall be calculated per 1 m2 of executed works that comply with the quality requirements prescribed hereunder and tolerance limits.

3.04 CONSTRUCTION OF 20 CM THICK CEMENT STABILISED BASE COURSE

Description
The item includes grinding of existing soil, grading, on-site blending with cement and water, necessary transport of materials, installation, compaction and curing of the applied course and application of bitumen emulsion in a design thickness in line with these Technical Requirements and Detailed Design requirements.

Grinding and blending with cement and water will be performed on site with one or two recycler passes. In case of two recycler passes, the first pass will be made to break up the soil into loose soil and grade it, while the second pass will be made for soil stabilisation with binders and blending with additional materials.

The works are to be executed by suitable construction machinery suitable for meeting all the requirements prescribed by these Technical requirements (cement sprayer, water tanks, recycler - stabilizer, roller set, grader, tank with emulsion to protect the installed course, etc.).

Basic materials
Basic materials are:
Local soil,
Cement: Cement CEM 32.5R (or Cement CEM 32.5 N or hydraulic road binder HRB 22.5 E),
Construction water,
Bitumen emulsion to protect the installed course - unstable cationic bitumen emulsion KN 60.

Quality of basic materials

All basic materials used must meet the quality criteria specified in these Technical Requirements.

Binder
The following types of cement according to SRPS EN 197-1 and SRPS B.C1.011 and hydraulic road binders according to EN 13282 may be used as a binder:

- Cement CEM 32.5 N,
- Cement CEM 32.5 R.

HRB 22.5 E can be used as a hydraulic binder for road stabilization. It must fully conform to EN 13282 and its compressive strength after 7 days must not exceed 50% of the compressive strength after 28 days as prescribed by EN 196-1.

Construction water
Construction water suitable for use in construction shall be used as prescribed by EN 1008 and SRPS U.E9.024.
Water that meets the following requirements shall be used:

- pH value higher than 6,
- sulphate content (SO3) less than 2700 mg/l of water,
- chloride (Cl) content less than 300 mg/l of water,
- organic matter indicator expressed as mass of potassium permanganate (KMnO4) consumed in oxidation is less than 200 mg/l of water.
- total amount of salt, expressed as dry residue, is less than 500 mg/l water.

Drinking water or water from the public water supply system can be used without testing.

Bitumen emulsion
Unstable cationic emulsion KN 60 is ro bw used for protection against drying of the installed course according to the requirements of SRPS EN 13808.

The bitumen emulsion must have and identification and prescribed valid certificates and quality reports issued by an accredited laboratory and submitted by the manufacturer. It is to be stored, heated and used in accordance with the manufacturer's instructions and these technical requirements.

Preliminary mixture
Prior to commencement of works, the Contractor shall prepare a preliminary asphalt mixture design in an accredited laboratory and conduct all necessary tests in accordance with these technical requirements and submit it to the Supervisor for approval.

The preliminary mixture for cement stabilisation shall be prepared fully in line with the Austrian technical specifications RVS 08.17.01 / 2009 - Technische Vertragsbedingungen, Betondecken, mit bindemittel stabilisierte tragschichten – Technical contract conditions, Concrete pavements, Base and Sub-Bases stabilized with Binders and RVS 08S.05.13 –Technical contract conditions, Pavement construction (without asphalt construction), Base course, Base course stabilized with Binder for ST-Z cement-based base courses or ST-T hydraulic road binder- stabilised base courses and in accordance with the relevant EN and SRPS standards. Criteria for the preliminary mixture are given in Table 1. Preliminary mixture sampling and control testing shall be performed according to the standard Proctor test in 10 or 15 cm diameter moulds.

The following data must be available for the preliminary mixture for cement stabilisation.

- particle size distribution of local soil,
- binder content (cement),
- water content
- optimum moisture and maximum dry density of the mixture,
- required physical and mechanical properties of the mixture,

In addition to the preliminary (laboratory) composition, the Contractor must submit to the Supervisor appropriate evidence of the selection and suitable quality of all basic materials issued by an accredited laboratory, which will be used in the preparation of the preliminary mixture (recipe). The Contractor shall start the works only after it receives an approval for the preliminary mixture by the Supervisor. For any change in the basic materials (type, origin, major deviation from the particle size distribution, etc.), a new preliminary mixture must be made.

Preliminary mixture design

It is necessary to determine the quality and usability of the base materials and their content in the mixture, in particular the dry density, proportion of binders and water, as well as all parameters that need to be kept constant during the execution of works.

Number of preliminary mixtures and sample size

It is necessary to check whether the local soil and basic mineral materials of uniform quality will be available throughout the. If necessary, the section under construction can be divided into separate homogeneous sections and treated separately as such.

Optimum moisture content

For cement-stabilised or hydraulic binder-stabilised sub-base and base courses, the optimum binder content and standard Proctor density of the mixture is to be determined based on the planned binder content. When using a Proctor mould with a diameter of 10 cm, grains of aggregates larger than 22mm are to be replaced by 4/22mm fractionated material, while when using moulds with a diameter of 15cm, grains larger than 32mm are to be replaced by 4/32 mm fractionated material in the same proportion.
The basic material, binders and water are to be mixed by hand or by a mixer until the mixture has a uniform colour. If the aggregate grains are crushed by Proctor hammer, it is necessary to prepare a new sample for each test separately and these activities need to be recorded and presented in the report. Standard Proctor density is a reference value for the execution of works and control tests.

Sample preparation for testing

The cylindrical samples with optimum water content are prepared and compacted to a reference density with a minimum of 2 different binder contents.
For cement-stabilised or hydraulic binder-stabilised base courses, the samples shall be prepared in 10 or 15 cm diameter Proctor moulds according to EN 13286-2 or SRPS U.B1.038. Prior to applying the next course, the course substrate needs to be roughened. The prepared sample is to be levelled and grinded and then immediately left for 7 days in air with a minimum of 95% of relative humidity at a temperature of 20 °C.

Mechanical characteristics

For cement or hydraulic binder stabilised base courses: samples are to be prepared with a minimum of 2 different binder contents and for each binder 3 seven-day old samples are to be placed in water at 20 ° C for 4 hours to test uniaxial compressive strength according to standard SRPS U.B1 .030 or EN 13286-41 and indirect tensile strength according to EN 13286-42. To execute works at temperatures below + 10 ° C, at least one binder of the preliminary mixture needs to be tested for uniaxial compressive strength after 28 days.

Work technology

The basic material is to be blended with water and binders and then compacted using suitable blending equipment (grinder, stabilizer, recycler).

Cement stabilised and hydraulic road binder-stabilised base courses are to be constructed in a design thickness. In exceptional cases, the total thickness of the course may be up to 40 cm, but it will be installed in two layers.

Machinery, plants and equipment

The appropriate construction machinery and equipment shall be used to achieve sufficient precision and uniformity of binder dosing and blending/installation homogeneity.

It must be selected and used appropriately to guarantee achievement all the required properties.

It is necessary to use devices that can measure and evenly distribute the amount of binders and water to be added to the mineral mixture.

The cement spreader and dispenser must have a cement doser to dose the cement taking into account the length or distance travelled by the machine. The blending equipment (grinder, stabilizer, recycler) must have a device for the controlled dosing of pressurized water.

Requirements

The execution of works may start immediately after obtaining an approval for the preliminary mixture by the Supervisor.
The cement or hydraulic binder stabilised base course construction works may be executed only at air temperatures higher than +5 C°. Materials to be stabilised and/or course below the stabilised course must not be frozen.

Installation

For on-site cement or hydraulic binder stabilised base courses, the required amount of binder in kg/m² to be added is to calculated based on the optimum binder content value in the preliminary mixture in kg/m³ increased by 1.10 coefficient factor and multiplied by a nominal course thickness. After defining the technology for performing the works on a test section and performing all the necessary control tests, at a later stage of the works, if the results of the control tests prove an acceptable level of uniaxial compressive strength achieved, the coefficient is to be reduced to 1.05.

Immediately after spreading the binder, it is necessary to blend it together evenly adding the required amount of water to achieve the required moisture.

If compaction begins half an hour later, the fresh mixture must be re-mixed. Works must be stopped in case of unacceptable weather conditions such as strong winds.

Compaction is to be done as evenly as possible using vibrating rollers or rubber rollers to achieve the required compactness and provide a compacted and smooth surface of the course.

The compaction process must be completed before the mixture begins to hardens and enters a state when compaction is no longer possible. Light rain does not interfere with installation, but installation must be stopped during heavy rainfall.

Transverse and longitudinal connection joints

The stabilisation procedure and on-site blending require a longitudinal overlap of an adequate width to be made in order to prevent formation of longitudinal joints.

The longitudinal connection joints are to be made with vertical edges. The compacted mixture on the joint must be of the same thickness as the stabilisation layer.

When executing works on the transverse joint, care must be taken to avoid damage to the already formed course when compacting the fresh mixture.

Curing and protection of courses

The cement or hydraulic binder stabilised base courses must be sprayed or protected with coatings that prevent their drying. Protection against drying is to ensured by using bitumen emulsion with an effective content of 0.6 kg/m² of residual bitumen (spraying min. 1.0 l / m2 of unstable bituminous emulsion KN 60).

If the cement stabilised course finish is dry, it is necessary to spray it with water prior to applying the required amount of bitumen emulsion.

Stabilized courses may be exposed to traffic loads only if it is demonstrated that no visible damage due to their impact will be caused.

Stabilized courses must be protected against negative freezing effects (i.e. by appropriate textile coats).

Prior to the first application of road defrosting salt, the stabilized courses must be fully protected with subsequent asphalt courses of the pavement.

Materials and requirements for the execution of works

All basic materials used must be compatible with each other and must not have any adverse effect on subsequent courses (courses above the stabilised course) in the pavement structure.
For base courses stabilized with hydraulic binders or cement, the Contractor, through its hired accredited laboratory, must demonstrate before the start of the work that satisfactory efficiency of the working mixture can be achieved with the designed preliminary mixture of the same basic materials. To this end, a sufficient quantity of fresh mixture will be sampled at ten test points on the test section in order to prepare two samples for each test point (see Item 7.1.4.1.4. Samples). One sample is to prepared without re-mixing while the other sample is to prepared by re-mixing, with a minimum of five minutes of continuous mixing (in a laboratory mixer or manually). One-axial compressive strength test after 7 days is to be performed on the samples prepared in this manner, while the result of the test, i.e. the efficiency value of the mixture, shall be expressed in% based on the ratio of the average strength value of the non-re-mixed samples multiplied by 100 and the strength of the re-mixed samples.

The efficiency of the working mixture must be at least 85%. If it is necessary to improve the efficiency of the working mixture, the mixing time is to be adjusted (or the speed of the stabilizing machine).

Criteria for the produced and installed cement stabilised mixture

The ongoing tests during the stabilisation of recycled pavement and crushed stone aggregate with cement or hydraulic binder include:

- preliminary tests,
- control tests.

Preliminary tests involve:

- Performing all preliminary tests of component materials and preparing the preliminary mixture in laboratory conditions,
- Transferring the preliminary mixture to the machinery for stabilisation and determining the required composition of the working mixture to be used for construction on the test section.
- Determination and adoption of construction technology on the test section with all necessary tests defined in Table 2,

Submission of the results of all tests and construction technology proposals to the Supervisor for approval.
When transferring the produced preliminary mixture - recipe to the construction site machinery, the exact weight ratios for dosing the individual component materials are to be established. The existing moisture content of the basic material shall also be taken into account and only the difference in the amount of water required to achieve prescribed moisture content level is to be added.

From the test production, samples of the fresh mixture shall be taken to test the test section in order to confirm the required stabilization properties. At least three samples of the mixture shall be tested by controlling all the properties defined in Table 2.

If the results of the tests carried out ensure that the results are consistent with the laboratory findings and design requirements, stabilization may be initiated subject to the approval of the Supervisor.

In the event that the results are inconsistent, the necessary adjustments shall be made before commencement of works. It is the obligation of the Contractor to maintain the approved working composition during the execution of works at the construction site.
The test section area should be at least 600 m2.

If the tests show that the quality achieved corresponds to that obtained in the laboratory conditions and these Technical Requirements, the works may be continued, otherwise the work will be suspended and a new test section shall be prepared.

The following table shows the on-going testing that, as a minimum of construction testing, is to performed by the Contractor as part of its quality assurance program. Control tests to performed by the an accredited testing laboratory hired by the Supervisor (Investor) in the account for 25% of total amount of Ongoing Tests.

(Description of tests for cement or hydraulic road binder stabilised base course Type: ST-Z or ST-T)	*(Requirements for the cement or hydraulic road binder stabilised base course) Type: ST-Z or ST-T)*	*(Testing method)*	*(Testing frequency)*
(Preliminary mixture performance)	≥ 85%	*(Technical requirements)* and RVS 8S.05.13 and RVS 08.17.01	On test section, and subsequentl y in case of doubt
(Particle size distribution)	*(Particle size distribution curve must be within the required boundary)*	SRPS U.B1.018	3.000 m^2
(Binder quality)	*(According to the defined quality in the preliminary mixture: standard consistency, binding time, volume constancy, residues on sieves)*	SRPS EN 196-3, SRPS EN196-6	For every 100 t of binder consumed
(Binder content)	*(Binder content may deviate ± 10% from the preliminary mixture)*	*(Inspection of cement dosing equipment)*	Measureme nt shall be performed every 10,000 m^2 while the total binder consumption is to be controlled on a daily basis.
(Reference dry density [Kg/m^3] and optimum moisture [w_{opt} %])	*(is to be determined in line with)* [4])	SRPS U.B1.038 or EN 13286 - 2	5.000 m^2
(Moisture [w %])	*(compared to the optimum moisture content of the preliminary mixture ranges between)* (w_{opt} - 2,0) < w < (w_{opt} + 1,0)	SRPS U.B1.012	500 m^2
(Uniaxial compressive strength after 7 days) β_{D7} [N/mm²] [1])	*(depending on the type of the binder used)* HRB 22.5 …….. $\beta_{D7} \geq 1.5$ N/mm^2 CEM 32.5N …… $\beta_{D7} \geq 1.5$ N/mm^2 CEM 32.5R ..... $\beta_{D7} \geq 1.0$ N/mm^2 [5])	SRPS U.B1.030 or EN 13286-41	1.000 m^2
(Dry density [Kg/m^3] i Degree of compactness [%])	*(For each test point ≥ 97%, for the test section ≥ 100% of the reference dry density on average)* [2]) and [3])	SRPS U.B1.038 or EN 13286 - 2	500 m^2
(Course thickness [cm])	*(Deviation from the design thickness)* ± 15mm	*(Geodetic surveys and if*	On each profile

		necessary, core drilling or excavation of test pits)	
(Flatness (4.0m long level) [mm])	*(From 0 mm to 15mm)*	*(To be measured by 4.0 m long level)*	On each profile
(Elevation)	*(Allowable deviation from the design elevation)* ± 15mm	Surveying *(Geodetic surveying)*	On each profile

(Mean value of 3 or 2 individual values)

[2]) *(For a calibrated sand method or ballon, testing may start no earlier than 4 hours after the compaction or immediately after the cement has hardened. The tests must be completed before 24 hours have elapsed since the end of the compaction.)*

[3]) T *(The stabilised soil-material base course can be considered homogeneous, if the coefficient of variation KV of one series of measurements of the degree of compaction of the installed stabilized course is:)*

KV < 3%

(*Coefficient of variation is to be calculated using the following equation:)*

$$KV = \frac{\sigma}{\bar{x}}, \qquad \sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

(whereas:)

x_i – *(results of on-site compactness measurements)*

x –*(arithmetic means of all compactness measurements on the tested sections of the installed stabilised course)*

n – t *(number of compactness measurements on the test section of the stabilised course)*

σ- *(standard deviation)*

[4])

(Reference density of fresh mixture samples taken on the route according to Item 7.1.4.1.3 Optimum moisture. For 10 or 15 cm diameter Proctor samples, aggregate grains> 22mm or 32mm are to removed by hand, without re-mixing the material)

(Reference density for determining the degree of compaction is to be calculated using the following equation:)

$$\rho = \left(1 - \frac{ü}{100}\right)\rho_P + 0{,}9 \cdot \rho_k \cdot \frac{ü}{100},$$

ρ - (kg/m³) *(reference density for relevant compaction)*

ρ_p - (Kg/m³) *(Proctor or reference density without oversized grains)*

ρ_k - (kg/m³) *(maximum density of stone aggregate)*

ü - (M-%) *(oversized grain content - mass)*

[5]) *((Samples shall be taken from the fresh mixture at least at two places during one working day (according to point 7.1.4.1.4. Samples) and shall be stored and subsequently tested. Samples can be transported fresh, but when hardened they can only be transported after 24 hours.)*

Calculation of works

Measurement:

Measurements are to be performed in cubic meters (m3) of the installed course measured and approved at the construction site by the Supervisor after its testing.

Payment:

The quantity, determined as described above, will be paid at the unit price contracted for a unit of measure, and this payment represents the total compensation for all work, equipment, tools and everything else necessary for the performance of works described above in these Technical Requirements.

5.03' CONSTRUCTION OF 3.0 cm THICK ASPHALT CONCRETE COURSE AB 8 (for the path parts under the bridges)

ITEM DESCRIPTION

The item includes procurement of materials, mixing, spreading, installation and compaction of a hot mix asphalt of mineral materials and polymer modified bitumen (PmB 45/80-65) in one layer of design thickness of t = 3.0 cm according to the elevations and dimensions given in the construction design.

MATERIALS

Wearing course building materials:
- carbonate stone filler,
- crushed carbonate or silicate stone material 0 - 4 mm,
Crushed eruptive stone aggregate 4/8
- Binder BIT 45/80-65

QUALITY OF MATERIALS

Filler

The filler must in all ascpects meet the criteria defined for the 1st quality class under SRPS B.B3.045.

Particle size distrbution (% sive passage)	for the 1st quality class	SRPS B.B8.105
Plasticity index % (m/m)	max.4.0	SRPS B.B1.020
Moisture content % (m/m)	-	SRPS U.B1.012
particle size distribution for particles less than 0.063 mm %	-	SRPS U.B1.018
Bitumen hardening index	1.80 - 2.40	SRPS B.B8.104
Rigden voids in % v/v	-	SRPS B.B8.102

Sand

Crushed stone must in all aspects meet the quality requirements shown in the table below:

Particle size distrbution (% sive passage)	according to U.E4.014/90	SRPS B.B8.029
content of particles less than 0.09 mm (% sieve passage)	max. 10	SRPS B.B8.036
Content of clay balls % (m/m)	max. 0.5	SRPS B.B8.038
Content of organic impurities % (m/m)	max. 0.3	SRPS U.B1.024
Sand equivalent, %	min. 60	SRPS U.B1.040
Fineness modulus	1.95 - 3.0	SRPS U.E4.014
density (kg/m3)	-	SRPS B.B8.031

Stone chippings

Stone chippings are to be obtained by crushing eruptive rocks Rocks should have the following properties:

mean compressive strength in the dry state	min. 140 MPa	SRPS B.B8.012
Water absorption:	max. 0.75 % m/m	SRPS B.B8.010
wear by grinding	max. 18 cm3/50cm2	SRPS B.B8.015
resistance to freezing	max. 5 % m/m	SRPS B.B8.002

Stone chippings fractins should meet the following quality requirements:

Abrasion resistance and resistance to wear according to Los Angeles (%m/m)	max. 18% m/m	SRPS B.B8.045
polishing value, VPK units	min. 48 VPK	SRPS B.B8.120
resistance to freezing Na2SO4, loss after 5 cycles	max. 3 % m/m	SRPS B.B8.044
percentage of the total area of all grains covered with bitumen (%)	min. 100/90 %/%	SRPS U.M8.096
water absorption for 4/8 mm fraction	max. 1.6 % m/m	SRPS B.B8.031
grain content in fractions above 4 mm where the ratio of the largest to the smallest dimension is> 3: 1	max. 20 % m/m	SRPS B.B8.048
Fraction of friable partciles larger than 4mm	max. 3 % m/m	SRPS B.B8.037
clay lumps in fractions	max. 0.25 % m/m	SRPS B.B8.038
heat resistance	resistant	-

The particle size distribution of fractions shall be tested for any stone chippings fraction according to SRPS B.B8.029, while the content of particles less than 0.09 mm shall be tested according to SRPS B.B8.036.

Bitumen

Polymer modified bitumen PmB 45 / 80-65 is used which meets the ONORM B 3613 crteria given in the following table:

Testing type:	PmB 45/80-65	Testing methods:
Penetration at 25°C (1/10mm), (100g/5s)	45 – 80	SRPS B.H8.612
Softening point- ring and ball method, (°C)	> 65	SRPS B.H8.613
Fraass breaking point, (°C)	< - 19	SRPS B.H8.616
Ductility, (cm) at 25°C	> 50	SRPS B.H8.615
Clevelend flash point, (°C)	> 250	DIN ISO 2592
Recovery at 25°C, (%)	> 80	ONORM S 9219
Homogeneity during storage, Δ PK, (oC)	< 2.0	TL PmB tAIL 1 (1991) Tuba Test
After RTFOT according to ASTM D 2872		
Weight loss, %(m/m)	< 0.5	–
Penetration change at 25 °C, % decrease increase	 < 40 < 10	SRPS B.H8.612
Recovery at 25°C, %	> 80	ONORM S 9219

PRELIMINARY TESTING OF APSPHALT MIXTURE

Prior to commencement of works, the Contractor shall prepare a preliminary asphalt mixture design in an authorized laboratory in accordance with these technical requirements.

Asphalt mixture can be produced only after the Contractor has provided the preliminary mixture to the Supervisor for approval. The certificates of basic materials and preliminary mixture must not be older than 6 months. If there are any changes in the basic materials or changes in the choice of materials, the Contractor shall provide the Supervisor with a written proposal for the change of the adopted asphalt mixture or proposal for a new preliminary mixture for approval before using these materials.

The particle size distribution curve of the design mineral mixture must meet limit conditions provided under SRPS U.E4.014/90 for asphalt concrete AB 11s, which are given in the table below:

sieve mesh (mm)	0.09	0.25	0.71	2.00	4.00	8.00
passage (%)	3-11	8-18	16-30	31-48	49-65	75-100

The building materials and quality of preliminary asphalt mixture shall be tested according to SRPS U.E4.014/90 and should meet AB 8 quality requirements.

The designer's approval for a composition of preliminary asphalt mixture is mandatory.

CONSTRUCTION TECHNOLOGY

ASPHALT MIXTURE PREPARATION AND TRANSPORT

The asphalt mixture is to be mechanically produced in an asphalt mixing plant.
A continuous asphalt mixing plant may be used if satisfactory performance is demonstrated by the quality of asphalt mixture produced by this procedure.
The bitumen temperature in asphalt tank trailers is 150 °C, while the maximum temperature is 165 °C. The aggregate temperature must not exceed the bitumen temperature by more than 15°C, while the temperature of the asphalt mixture when leaving the mixer is optimally 165 ± 10 °Cand not more than 175°C.
The asphalt mixture is to be transported to the point of installation immediately after its mixing.

SUBSTRATE PREPARATION

Prior to casting asphalt course, the Supervisor shall survey the substrate level and flatness. In the parts where the substrate layer is higher than the design elevations, the Contractor shall repair the substrate in line with the design requirements.

Laying of the asphalt mixture on the asphalt substrate may start only when the substrate is cleaned of bonded and unbound material, dry and sprayed with PmB KN-50 or PmB KN-60 polymer-modified bitumen emulsion in an amount of 0.2 kg/m2. Spraying must begin at least 2-3 hours before laying the asphalt in order to allow water to evaporate and bitumen binding to the substrate. Laying of the asphalt course may begin only when the substrate (asphalt course) has cooled to air temperature.

INSTALLATION OF ASPHALT MIXTURE

Asphalt mixture is to be installed only in favourable weather conditions. The temperature of the substrate and air must be higher than +10^{o}C. In special weather conditions such as strong winds, the Supervisor may suspend the works even at temperatures higher than the aforementioned, if it is suspected that under these conditions the quality of works will be compromised. The asphalt mixture temperature at the point of installation must not be lower than150^{o}C and higher than 175^{o}C.
The asphalt mixture is to be mechanically laid and immediately afterwards an adequate rolling regime must be provided to ensure the required compaction of the asphalt course.
Other construction technology details for this item are given in the applicable standard SRPS U.E4.014/90 and other applicable SRPS standards.

PERIOD OF EXECUTION OF WORKS

The asphalt can be installed in the period when the air temperatures are higher than 10^{o}C without wind or at least 15^{o}C with wind. Asphalt mixture must not be installed in misty and rainy weather conditions. The substrate temperature must not be lower than +10^{o}C.

QUALITY CONTROL

TESTING

Ongoing testing shall be performed by the Contractor in order to have at all times the best insight into the quality of the building materials as well as the asphalt mixtures produced and installed, in order to intervene in the production process if necessary and to ensure the continued production of the prescribed quality.

The Contractor shall influence the process of production and installation of the asphalt mixture based on the results of the ongoing tests in a way that ensures the uniform and technically compliant quality of the produced asphalt course.
The Contractor shall keep a written record of the results of the tests carried out as part of ongoing tests, which must be made available to the Supervisor.
When casting asphalt concrete surfacing, the ongoing testing shall include:
- ongoing testing of building materials
- ongoing testing of asphalt mixture
- ongoing testing of installed asphalt mixture

All tests to be conducted as part of ongoing testing need to be carried out to the extent and in the manner prescribed by the applicable Yugoslav standards SRPS U.E4.014/90.

CONTROL TESTS

The control tests are to be performed by the Investor or by a quality control company at the Investor’s expense. Based on the test results, the Investor or the Supervisor shall make a final assessment of the quality of installed asphalt courses.
Control tests include:

- control tests of building materials
- control tests of produced asphalt mixture
- control tests of installed asphalt mixture

Control tests of materials

Control tests shall be performed on samples taken on an asphalt base.
One sample is to be taken from each type of material per quantity of material required to produce 5000 tonnes of asphalt mixture. The required quantities of material are to be calculated on the basis of the working composition of the asphalt mixture.

Filler
The following tests shall be carried out:

Particle size distribution of filler	SRPS B.B8.105
Void fraction in dry compacted state - Ridgen voids	SRPS B.B8.102

Sand

The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Sand equivalent	SRPS U.B1.040
Content of partciles less than 0.09 mm	SRPS B.B8.036

Stone chippings

The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Content of partciles less than 0.09 mm	SRPS B.B8.036
Grain shape	
Friable particles	SRPS B.B8.037

Bitumen

The following propertes must be tested:

penetration at 25°C	SRPS B.H8.612
Softening point ring and Softening point- ring and ball method	SRPS B.H8.613
Fraass breaking point	SRPS B.H8.616
Ductility at 25°C	SRPS B.H8.615
Penetration index	SRPS B.H8.614

Bitumen properties are to be tested for every 10000 t of the produced asphalt mixture according to SRPS U.M3.010.

Control tests of produced asphalt mixture

Asphalt mixture samples for control tests shall be taken at the point of installation of asphalt mixture.
The composition and physical and mechanical properties of the asphalt mixture are to be checked by testing one sample for every 350 tonnes of installed mixture.

The following properties are to be tested:

Bitumen content	SRPS U.M8.090
Particle size distribution	SRPS U.M8.090
Stability at 60 °C	SRPS U.M8.090
stability and deformation at 60 °C	SRPS U.M8.090
Void volume fraction	SRPS U.M8.090
bitumen filled voids	SRPS U.M8.090

Changes in the type of extracted binder shall be tested for every 5000 tonnes of produced asphalt mixtures by determining:

penetration at 25°C	SRPS B.H8.612
Softening point ring and Softening point- ring and ball method	SRPS B.H8.613

Fraass breaking point	SRPS B.H8.616

Control tests of produced asphalt course

The physical and mechanical properties and thickness of the produced course shall be tested on samples extracted at least every 200 m of the produced course.
Sampling according to SRPS U.M3.090.

The following properties are to be tested:

Void volume fraction	SRPS U.M8.090
Degree of compactness	SRPS U.M8.090
Course thickness	-
Course flatness	-
Roughness and skid resistance	-
Adhesion	-

The height, transverse slope and position of the produced course shall be inspected by appropriate instruments, at least 20% of the data recorded by the Contractor during the ongoing testing of the course production and installation.

CRITERIA FOR THE CALCULATION OF EXECUTED WORKS

Course flatness and crossfall
The Contractor shall make measurements on cross section profiles, provided that spacing does not exceed 30 m. Measurements are to be performed using a 4 m long screed (left, right, middle). The measurements results shall be provided to the Supervisor for review. The criteria are as follows:

Fatness deviations ranging between 0 to 4 mm	shall be deemed satisfactory
Fatness deviations ranging between 4 to 10 mm	not satisfactory and 5-25% of the surface flatness value will be deducted
flatness deviations exceeding 10 mm	shall be deemed unsatisfactory and 100% of the value of this flat area shall be deducted.

The maximum deviation of the transverse slope of the asphalt concrete course from the design transverse slope is ± 0.4%.

Deviation of the course surface from the design elevation of the level finish

The maximum permissible height deviation of the surface of the constructed wearing course from the design height is ± 5mm.

Horizontal deviation of the edge of the installed course

The maximum permissible deviation of the position of the right and left edge from the design position is± 25 mm.

Deviation in the thickness of the installed course

All deviations of the installed course thicknesses from the design course thickness, provided that the Contractor assesses that the installed course may remain in the pavement structure, shall be the subject to the quality assessment of the executed of works.
The measurements shall be performed on each profile and the criteria are as follows:

For a course thickness deviation of 6 -8 mm	10-25% of the value of this surface shall be deducted.
For a course thickness deviation of 8 -10 mm	26-50% of the value of this surface shall be deducted.

For a course thickness deviation exceeding 10 mm,	the executed works shall not be accepted.

The deduction value in percentages shall be determined by the Supervisor based on the number of measurements and percentage of results that deviate more than -10% of the design course thickness.

Particle size distribution of mineral mixture

If the particle size distribution of the extracted mineral mixture deviates from the boundary curve compared to the required granulometric curve, i.e. exceeds the standard tolerances, the Contractor shall reduce the value of the works of the wearing course works by 5.0% for the area covered by the tested sample.
If deviations exceed the standard tolerances in all three components of the asphalt mixture, in the granulometric curve, filler and bitumen fraction, the asphalt course cannot be accepted.

Compaction degree of installed course

The criterion for the acceptance of works is the degree of compaction achieved, which must be a minimum of 98%. If more than 10% of the tested samples show a compaction degree less than 98%, the works will be rejected.

Roughness and skid resistance

The wearing course surface must be rough and skid resistant. These properties are to be tested according to SRPS U.C4.018.

MEASUREMENT AND PAYMENT

Costs shall be calculated per 1 m^2 of executed works that comply with the quality requirements prescribed hereunder and tolerance limits.

5.03'' STONE CLADDING - CRUSHED STOEN (PART UNDER BRIDGES)

The stone cladding is to be made of crushed stone on gravel capping, t=20 cm. The size of the crushed stone material to be used for cladding is 15-25 cm. The crushed stone material shall originate from solid and hard rock material resistant to freezing. The gravel for making the capping layer should be of the petrographic composition in accordance with the requirements for this type of work.
The costs of executed works shall be calculated per a square metre of the cladding, including all works and material.

6. OTHER WORKS

6.01 CONSTRUCTION OF BENCHES

Standard U-shaped elements are to be incorporated into the foundation made of compacted MB 20 concrete. The dimensions of these elements are 40/40/50/8 cm. Seats of 9 cm wide 4 pine laths t= 1-1/2, 9 cm wide are to be placed over the U-shaped elements. The laths are impregnated and painted in burgundy tone with lacquer, and fixed to the concrete elements by anchors and screws. Bench length is 2.5m.
The costs of executed works shall be calculated per piece, and the price shall include the procurement of materials and installation.

6.02 INSTALLATION OF PROTECTIVE METAL BARRIERS

The 60 mm diameter protective metal poles are to be installed between the carriageway and plateau for benches. The pole height shall be 80 cm. The poles are to be 30 cm installed in MB 15 concrete footings, and 50 cm above the plateau and carriageway. The poles shall be spaced 1 m and shall be painted in zebra red and white.
The costs of executed works shall be calculated per a running metre of the installed poles and the price includes the procurement of materials, installation and painting of poles.

6.03 CONSTRUCTION OF TUBULAR CULVERT

A tubular culvert is to constructed using prefabricated concrete tube with a heat at the inlet and outlet according to the design details and type. The centrifuged prefabricated concrete tube are to be used for the

tube body and laid on a concrete pad. All materials installed must comply with the SRPS standards applicable to this type of work. When performing works, observe the environmental conditions and, in the case of excavation, apply the appropriate method of underlaying the foundation pit.
The costs of executed works are to be calculated per a running meter of the culvert constructed in accordance with the design details The price includes costs of works and procurement of materials.

VOLUME 3.4

TECHNICAL REQUIREMENTS
FOR WORKS

DUAL-USE PATH ALONG BEGEJ CANAL
SECTION II - ZRENJANIN

1. PREPARATORY WORKS

1.02 STAKING AND SETTING OUT OF THE ROUTE AND BUILDING

Description of works

Road axis setting out shall include all measurements in order to transfer design data onto the land as well as securing, demarking and maintaining points established on the ground throughout the construction period, i.e until works are handed over to the Investor.

Road axis handover and acceptance

The Contractor shall hand over the Investor the operational polygon and permanent survey points (markers) with all necessary data in the form of drawings, layouts, tables, etc. The data on operational polygon and permanent survey points shall be delivered and received in writing.

Inspection during construction

The Contractor shall regularly inspect the set out road axis, road profiles, permanent survey points (markers) and polygon points. The Contractor shall repair any destroyed or damaged marker at its own expense. The Supervisor shall inspect the accuracy of the restored road axis, road profiles, permanent survey points (markers) and polygon points.

Handover and acceptance upon completion

The Contractor shall restore the road axis, chainage, polygon points and permanent survey points at the Investor's request and hand over them to the Investor upon completion of road works and prior to technical acceptance. The acceptance/handover record should be in writing.

Measurements and payment

Calculation and payment in square meters (m^2) and the unit price shall be a fee for setting out the road route.

1.02 DEMOLITION OF VEHICULAR ACCESSES CONSTRUCTED OF DIFFERENT MATERIALS

Demolish sidewalks and bike paths that need to be removed according to design. The average substrate thickness is 20-30 cm and is composed of different materials. If the sidewalks is paved with slabs, remove these slabs manually, clean and load them into a vehicle. The demolition waste is to be loaded into the vehicle, transported to the landfill determined by the Supervisor, unloaded and graded.

Costs shall be calculated per a square meter of demolished sidewalks and bike paths, including all works, materials and transport as described above.

1. 05 PREPARATION OF THE AS-BUILT DESIGN

Description of works

Upon completion of road construction works, the Investor and Contractor shall prepare an as-built design provided that there were major changes in relation to the conceptual design.

Execution of works

The as-built design shall include all building changes in relation to the conceptual design and all other elements prescribed by the Regulation on the Contents, Manner and Procedure of Producing Technical Documents and their Inspection according to the Structure Class and Intended Use.

Measurements and payment

Executed works shall be calculated and paid at an aggregate price for the entire as-built design.

2. EARTHWORKS

2.01 EARTH EXCAVATION

Description of works

The works involve open cut surface earth excavation along the route, in the borrow pit and below embankments in a design thickness, transport or mechanical pushing of excavated material to the roadside landfill and storage of excavated material. Average thickness of excavated earth material is 20 cm. The actual thickness to be removed shall be determined on site.

All works to be carried out must conform to the design and these technical requirements.

Execution of works

All excavated material should be deposited along the route outside the subsoil area so as to allow its undisturbed subsequent use and access. Excavated material is to be carefully transported or pushed to the landfill so as to preserve the quality of excavated material for subsequent use when making slopes and landscaping green areas and to prevent mixing of this material with other non-humus material.
Transport of any excess humus materials is also included in the scope of works for this item and is to be performed in order to preserve the embankment geometry.

Measurements and payment

Measurement and payment shall be made per a cubic metre (m^3) of excavated humus material deposited along the road or transported to the landfill, including all necessary works and materials.

2.02 GRADING OF AREAS NEXT TO PAVEMENT STRUCTURE

Description of works

Works include: formation works in the carriageway widening by cuts and fills, including coarse and fine grading, repair of individual non-homogenous points, soil wetting and drying. The described works are to be executed to the design elevations along the design formation width observing these technical requirements.

Execution of works

In case that compacted formation is exposed to adverse weather conditions or otherwise damaged, the Contractor shall bring it back to the condition required by these technical requirements.

Formation quality requirements

Flatness

The surface of the wearing course (formation) must be levelled so as allow maximum deviations from the measuring plane of -30mm. Flatness shall be measured by crosses or ropes on each profile and in all directions (perpendicular, longitudinal and diagonal).

Surface elevations

The elevations of the formation wearing course at any point may deviate from the design elevations by -30 mm maximum.

The elevations of individual measuring points shall be determined by a level, where the points will be determined by the Supervisor at its own choice and mandatorily on each cross-section.

The transverse and longitudinal slopes of the formations must be constructed in line with the design. The formation bellow shall be filled at the expense of the Contractor using base course materials. The formation above must be removed to the design elevation.

Acceptance of works

The formation shall be accepted by the Supervisor immediately prior to the next stage of works.

Measurements and payment

Measurements shall be made per a square meter (m^2) of the road formation based on design quantities.

2.03 CONSTRUCTION OF SHOULDERS USING EXCAVATED MATERIALS

Description of works

The slopes of cuts and fills shall be prepared for a humus layer and the shoulder base course shall be brought to a design elevation and then overlaid with a humus layer of a design thickness, graded and compacted on shoulder.

Execution of works

Humus layers are to be applied immediately after the asphalt works.
Prior to applying humus layers, the following requirements need to met in order to achieve stability:
• The surface water of the catchment area must be accepted and drained in a controlled manner.

The deviations of constructed shoulder elevations shall be ±□1 cm compared to design elevations shown in the design drawings. Crushed materials from borrow pits is to be used to fill humus material. Active humus materials that guarantees vegetation sustainability shall be used.

Measurements and payment

Measurements shall be performed per a square metre (m2) of the surface covered with humus of design thickness.

2.05 CONSTRUCTION OF EMBANKMENTS USING SELECTED EARTH MATERIAL

Description of works

The works include filling, spreading and coarse and fine grading, drying or wettings and compaction of embankment filling materials according to the sizes defined under the design.
This embankment or earth material filler shall be installed up to the humus level.

Material

Inorganic material of the prescribed quality will be used to construct the embankment.
No material can be incorporated into the embankment which, over time, could change its physical and mechanical properties due to biochemical effects.
The embankment material may be obtained from cuts on the route or from borrow pits provided that it is not sensitive to the presence of water.
When testing the suitability of earth materials for embankment construction, test materials from each cut and borrow pit as well as at any material change. Tests should be performed on at least two samples for each type of material.

Transportation and filling

Transportation and filling of material on prepared foundation soil or pre-constructed embankment capping layer may start only after the base courses are taken by the Supervisor.
Each individual course must be horizontally spread in a longitudinal direction or at most, in slope equal to design longitudinal slope. In the transverse sense, each individual course must have a two-sided or single-sided slope of 2 - 5% to drain storm water.
Each individual course must be filled according to the design cross section profile. When spreading materials, the vehicles must be as evenly distributed as possible along the entire formation width.
The height of each course must be consistent with the compaction effect on the depth of the compaction tool used, type of material filled and segregation phenomena, but must not be higher than 30 cm in loose state.
These materials are to be compacted by vibrating rollers (self-propelled or towed), vibrating plates and compactors depending on the materials used.
Each type of material to be installed in the embankment is to be tested on the test section and the machinery to be used is to be adopted according to the given procedure.

Compaction

Each embankment layer must be compacted in full width by a suitable mechanical means, with compaction generally being carried out from the edge towards the centre.
All inaccessible places for machinery or places at which the use of heavy duty machinery would be inappropriate (embankment behind the building, retaining walls, etc.) should be compacted using other suitable means or methods that will be approved by the Supervisor.
If the predominantly coherent material is used for embankment and weather prevents its use, it is permitted to apply other embankment construction procedures such as stabilisation, processing/treatment or replacement of materials that will be requested or approved by the Supervisor, provided that these costs will be borne by the Contractor.
When there is a risk of rain, the Supervisor will, if necessary, order the suspension of further embankment works, without an obligation to compensate the costs. The top layer of the embankment composed of coherent material shall be graded and rolled by a light-duty smooth wheel roller (3-5 tons) so as to obtain 2 to 5% sloped smooth surface without any recesses that could collect storm water. Prior to filling another layer, the smoothened surface shall be roughened in order to ensure better bonding between layers. This also applies to other prolonged suspension of embankment construction works (due to the end of construction season, etc.)

Measurements and payment

Measurements shall be made per a cubic metre (m3) of the constructed embankment measured on site without humus, including the shoulder core.

Transport of additional material for embankment construction shall be included in the unit price of the item.

3. CONSTRUCTION OF PAVEMENT STRUCTURE

3.02 CONSTRUCTION OF BASE COURSE USING 0/31.5mm CRUSHED STONE AGGREGATE

DESCRIPTION

The item includes procurement, transport, installation, coarse and fine grading, potential wetting and compacting of the 0/31.5 mm crushed stone base course in thickness defined by the Detailed Design.

CONSTRUCTION

The course is to be constructed in one or two layers depending on the machinery. The material must be graded in a longitudinal direction in a slope equal to slope of the finished level.
In the transverse sense, it must have the same slope as the finish level slope, i.e. slope required to drain storm water.

QUALITY CONTROL OF MATERIALS USED TO CONSTRUCT CRUSHED STONE BASE COURSE

The crushed stone aggregate must be used for the construction of the base course. The quality control during preliminary tests shall be performed in line with the following regulations:
SRPS B.B0.001 - natural aggregate and stone; sampling
SRPS B.B8.012 - natural stone, testing of compressive strength
SRPS B.B8.010 - determination of natural stone water absorption
SRPS B.B8.002 - soundness testing
SRPS B.B8.045 - abrasion resistance testing of natural and crushed aggregate rock by Los Angeles machine
SRPS B.B8.037 - determination of friable particles in coarse-grained aggregate
SRPS B.B8.047 - shape and surface appearance of aggregate particles, definitions
SRPS B.B8.048 - stone aggregate particle shape testing
SRPS U.B1.018 - determination of particle size distribution and determination of particles of 0.08 mm by aerometric methods (or according to SRPS B.B8.036)
SRPS B.B8.036 - determination of particles passing through 0.02 mm sieve mesh(the procedure from this SRPS- applies)
SRPS B.B8.038 - clay balls and silt content
SRPS B.B8.031 –water absorption
SRPS B.B8.030 –aggregate bulk density (in compacted and loose state)
SRPS B.B8.032 stone volume mass (determination of bulk density, density, coefficient of density, and porosity)
SRPS U.B1.012 – determination of moisture content
SRPS U.B1.016 – determination of soil density
SRPS U.B1.038 – determination of optimum water content
SRPS U.B1.042 - determination of the California bearing ratio

Tests are to performed for each material change, i.e. at least once every 1000 m2.

CRITERIA FOR ASSESSING BASE COURSE QUALITY

Crushed stone aggregate must meet the following requirements in terms of:

- physical-and mechanical and minerological and-petrographic properties of rocks and aggregates
- bearing capacity
- content of organic matter and light particles.

Crushed material grains must meet the following requirements:

Physical and-mechanical properties of stone:

Medium compressive strength (MPa) - dry	-	min 120
-Water absorption (% of mass)	-	1.0
Frost resistance (25 freeze-thaw cycles)	-	(Stone shall be considered resistant to freezing if a medium compressive strength after freezing decreases up to 20% compared to the medium compressive strength in dry state).
Minerological and-petrographic content	-	Stone can be of eruptive, sedimentary, metamorphic rock origin. The presence of marls, clay shales, soft and clayey sandstones, conglomerates, decomposed granites and gneisses is not permitted.

Physical and -mechanical properties of crushed stone aggregate:

- Grain shape, content of inadequately shaped grains (3:1)	max 40%
- Water absorption (SRPS B.B8.031)	max 1.6%
- Friable grains	max 7%
- Abrasion resistance according to Los Angeles method	max 40%
Content of silt, clay and organic matter-	max 3%

Note: For unseparated stone materials, the prescribed limit value for the content of adequately shaped grains, friable -poor quality grains, water absorption, loss at Na2SO4 are to be calculated as a percentage of the mass in laboratory separated fractions or a fraction of grains greater than 4mm.

Additional quality criteria

In addition to the above defined criterion, the material must also meet the following requirements:
- resistant to disintegration by weathering
- not prone to degradation due to construction site traffic under different meteorological conditions
- fine fractions content (<80μm) should be < 6%
- plasticity index of fine particles Ip<12
- Uniformity coefficient Cu=15-30
- Californian bearing ≥80% at a degree of compaction of 98% compared to the -Modified Proctor test.
- content of organic matter and light particles must not exceed 3% by weight

The grain size distribution curve of the mixture must be within the limits given in the following table:

Sieve mesh mm	0.09	0.25	0.5	1.0	2.0	4.0	8.0	16.0	31.5	45.0
min %	2.0	5.0	8.0	11.0	15.0	20.0	28.0	46.0	95.0	100
max %	9.0	15.0	21.0	30.0	40.0	50.0	62.0	75.0	100.0	100

The quality of material is to be confirmed by the Report on Material Quality and Usability not older than 6 months, which is issued by an accredited laboratory.

COMPACTION OF BASE COURSE

After coarse grading, compact the base course in a full width using adequate compaction means. All potentially inaccessible places for compaction shall be compacted by suitable compaction means applying specific procedures that must be approved by the Supervisor.

At the beginning of compaction works, moisture content of the base course must be sufficient in order to successfully compact it.
If the base course constructed on 0/31.5mm crushed stone aggregate is compacted much before the construction of base courses, it is necessary to inspect their compaction and readiness for further execution of works prior to continuing construction works.

CONSTRUCTION QUALITY

COMPACTION

The Contractor is required to prove the compaction of a capping layer by the test results.
The base course of DKA 0/31.5 mm must be compacted at least 98% of the maximum dry density obtained by the Modified Proctor Test.
At each measuring point, the compactness of the base course must reach the required values. Insufficiently compacted surfaces of the base course must be compacted by the Contractor to the required density as prescribed by these technical requirements without a right to compensation for this additional work.

BEARING CAPACITY

The Contractor must prove the achieved capacity bearing of the base course with the test results by measuring Ev2 deformation modulus. (These measurements do not exclude compaction tests).
At any measuring point, the requested deformation modulus values (Ev2) must not be less than 160 MPa.
The Ev1/Ev2 deformation moduli are to be measured by a Φ300mm plate.
The Ev2/Ev1 ration must not exceed 2.5. If the measured value of the deformation modulus Ev1 exceeds 50% of the Ev2 value, the required ratio will not be decisive for the assessment of the bearing capacity of the course.
At each measuring point, the bearing capacity of the base course must meet the set requirements.

BASE COURSE FLATNESS

Base course flatness measured by a 4m long level parallelly laid with the road axis must be at least 1 cm.

HEIGHT POSITION

At the point of measurement, the base course surface must not deviate from the design elevations by more than 1.0 cm.

QUALITY CONTROL

MATERIAL QUALITY CONTROL

Prior to executing these works, the Contractor shall inspect the conformity of the quality of materials with these technical requirements and provide them to the Supervisor for review.

CONSTRUCTION QUALITY INSPECTION

ONGOING AND CONTROL TESTING

Based on the results of the previous tests, the Supervisor will decide on the scope of testing when constructing the base course.

A) The ongoing tests to be performed by the Contractor include:

Testing of materials prior to construction:

Moisture testing
Particle size distribution testing
maximum dry density and optimum moisture testing (Modified Proctor Test)
California bearing ratio testing

Base course testing during and after construction:

moisture content and compaction at 50m,
bearing capacity by deformation modulus at 50m,
flatness at 25 m,
height position at 40 m or on each profile.

B) Control tests that must be performed by the Investor account for 25% of the prescribed scope of ongoing tests.

If, in the course of ongoing testing, the Supervisor observes significant differences from the results of previous tests, it will decide on further work. If necessary, the Supervisor may request to perform the more frequently than prescribed by these technical requirements.

CALCULATION AND PAYMENT

Calculation and payment shall be made per a m3 of the installed and compacted base layer that is accepted by the Supervisor.
The Contractor cannot request any payments for any works that fail to meet these technical requirements or any works that are not instructed by the Supervisor.

3.02 CONSTRUCTION OF STABILISED SHOULDER

Description
This item includes the construction of a shoulder covered with sand gravel or stone chippings of the design thickness and width. The minimum thickness of the course is 10 cm.
Material
On either side of the carriageway, up to the finish level of the base course, the shoulder is to be constructed using the same materials of the same thickness as for the base coarse.
Material that meets the requirements for the material intended for the construction of the embankment base course layer of the embankment according to these technical requirements shall be used for the construction of the shoulder above the finish level of the base course.
The 0/8mm grain size sand or gravel and 0/30 mm stone chippings can be used to construct the embankment finish. However, their quality needs to conform to SRPS U.E9.020.
Performance and quality of works
All works must be carried out according to the detailed drawings enclosed with the design and engineering documentation, unless otherwise specified by these requirements.
Materials used to construct the shoulder finish must be compacted. In principle, the regulations in these technical requirements should be observed.
The surface of the installed course must be transversely and longitudinally sloped according to the design, taking into account the lowering of the finish level (for the thickness of the compacted layer of sand gravel and stone chippings).
The intended materials are to placed over the shoulder in the designed thickness according to the designed profile, with a specific superelevation due to compaction.
Horizontal shoulder edges must be constructed according to the design. Deviations from the design lines are allowed only to avoid visual disturbance.
The permitted elevations of the shoulder finish shall range within 1 cm below the design surface.
The allowed deviations in the thickness of the installed compacted course compared to the design thickness shall range ±1 cm.
The same requirements for the associated items under technical requirements shall apply to flatness, compaction and thickness (embankment capping layer, base course of the pavement structure).
Measurements and payment
Quantities to be for calculation shall be determined in square meters (m2) of the design thickness of the capping layer based on the actual work performed under the design.
The shoulder core above the base course shall be measured as an embankments, while the shoulder core on both sides of the carriageway to the base course elevation shall be measured as part of the quantities used to construct the base course.
Payments shall be made in line with the contract terms - Contract Ref. No.RRSP/ENJ-IIA170RBB/2014-12.

3.03 CONSTRUCTION OF 20 CM THICK CEMENT STABILISED BASE COURSE

Description
The item includes grinding of existing soil, grading, on-site blending with cement and water, necessary transport of materials, installation, compaction and curing of the applied course and application of bitumen emulsion in a design thickness in line with these Technical Requirements and Detailed Design requirements.

Grinding and blending with cement and water will be performed on site with one or two recycler passes. In case of two recycler passes, the first pass will be made to break up the soil into loose soil and grade it, while the second pass will be made for soil stabilisation with binders and blending with additional materials.
The works are to be executed by suitable construction machinery suitable for meeting all the requirements prescribed by these Technical requirements (cement sprayer, water tanks, recycler - stabilizer, roller set, grader, tank with emulsion to protect the installed course, itc.)

Basic materials
Basic materials are:
Local soil,
Cement: Cement CEM 32.5R (or Cement CEM 32.5 N or hydraulic road binder HRB 22.5 E),
Construction water,
Bitumen emulsion to protect the installed course - unstable cationic bitumen emulsion KN 60.

Quality of basic materials

All basic materials used must meet the quality criteria specified in these Technical Requirements.

Binder
The following types of cement according to SRPS EN 197-1 and SRPS B.C1.011 and hydraulic road binders according to EN 13282 may be used as a binder:

- Cement CEM 32.5 N,
- Cement CEM 32.5 R.

HRB 22.5 E can be used as a hydraulic binder for road stabilization. It must fully conform to EN 13282 and its compressive strength after 7 days must not exceed 50% of the compressive strength after 28 days as prescribed by EN 196-1.

Construction water
Construction water suitable for use in construction shall be used as prescribed by EN 1008 and SRPS U.E9.024.
Water that meets the following requirements shall be used:

- pH value higher than 6,
- sulphate content (SO3) less than 2700 mg/l of water,
- chloride (Cl) content less than 300 mg/l of water,
- organic matter indicator expressed as mass of potassium permanganate (KMnO4) consumed in oxidation is less than 200 mg/l of water.
- total amount of salt, expressed as dry residue, is less than 500 mg/l water.

Drinking water or water from the public water supply system can be used without testing.

Bitumen emulsion
Unstable cationic emulsion KN 60 is ro bw used for protection against drying of the installed course according to the requirements of SRPS EN 13808.

The bitumen emulsion must have and identification and prescribed valid certificates and quality reports issued by an accredited laboratory and submitted by the manufacturer. It is to be stored, heated and used in accordance with the manufacturer's instructions and these technical requirements.

Preliminary mixture
Prior to commencement of works, the Contractor shall prepare a preliminary asphalt mixture design in an accredited laboratory and conduct all necessary tests in accordance with these technical requirements and submit it to the Supervisor for approval.

The preliminary mixture for cement stabilisation shall be prepared fully in line with the Austrian technical specifications RVS 08.17.01 / 2009 - Technische Vertragsbedingungen, Betondecken, mit bindemittel stabilisierte tragschichten – Technical contract conditions, Concrete pavements, Base and Sub-Bases stabilized with Binders and RVS 08S.05.13 –Technical contract conditions, Pavement construction (without asphalt construction), Base course, Base course stabilized with Binder for ST-Z cement-based base courses or ST-T hydraulic road binder- stabilised base courses and in accordance with the relevant EN and SRPS standards. Criteria for the preliminary mixture are given in Table 1. Preliminary mixture sampling and control testing shall be performed according to the standard Proctor test in 10 or 15 cm diameter moulds.

The following data must be available for the preliminary mixture for cement stabilisation.

- particle size distribution of local soil,
- binder content (cement),
- water content
- optimum moisture and maximum dry density of the mixture,
- required physical and mechanical properties of the mixture,

In addition to the preliminary (laboratory) composition, the Contractor must submit to the Supervisor appropriate evidence of the selection and suitable quality of all basic materials issued by an accredited laboratory, which will be used in the preparation of the preliminary mixture (recipe). The Contractor shall start the works only after it receives an approval for the preliminary mixture by the Supervisor. For any change in the basic materials (type, origin, major deviation from the particle size distribution, etc.), a new preliminary mixture must be made.

Preliminary mixture design

It is necessary to determine the quality and usability of the base materials and their content in the mixture, in particular the dry density, proportion of binders and water, as well as all parameters that need to be kept constant during the execution of works.

Number of preliminary mixtures and sample size

It is necessary to check whether the local soil and basic mineral materials of uniform quality will be available throughout the. If necessary, the section under construction can be divided into separate homogeneous sections and treated separately as such.

Optimum moisture content

For cement-stabilised or hydraulic binder-stabilised sub-base and base courses, the optimum binder content and standard Proctor density of the mixture is to be determined based on the planned binder content. When using a Proctor mould with a diameter of 10 cm, grains of aggregates larger than 22mm are to be replaced by 4/22mm fractionated material, while when using moulds with a diameter of 15cm, grains larger than 32mm are to be replaced by 4/32 mm fractionated material in the same proportion.
The basic material, binders and water are to be mixed by hand or by a mixer until the mixture has a uniform colour. If the aggregate grains are crushed by Proctor hammer, it is necessary to prepare a new sample for each test separately and these activities need to be recorded and presented in the report. Standard Proctor density is a reference value for the execution of works and control tests.

Sample preparation for testing

The cylindrical samples with optimum water content are prepared and compacted to a reference density with a minimum of 2 different binder contents.
For cement-stabilised or hydraulic binder-stabilised base courses, the samples shall be prepared in 10 or 15 cm diameter Proctor moulds according to EN 13286-2 or SRPS U.B1.038. Prior to applying the next course, the course substrate needs to be roughened. The prepared sample is to be levelled and grinded and then immediately left for 7 days in air with a minimum of 95% of relative humidity at a temperature of 20 °C.

Mechanical characteristics

For cement or hydraulic binder stabilised base courses: samples are to be prepared with a minimum of 2 different binder contents and for each binder 3 seven-day old samples are to be placed in water at 20 ° C for 4 hours to test uniaxial compressive strength according to standard SRPS U.B1 .030 or EN 13286-41 and indirect tensile strength according to EN 13286-42. To execute works at temperatures below + 10 ° C, at least one binder of the preliminary mixture needs to be tested for uniaxial compressive strength after 28 days.

Work technology

The basic material is to be blended with water and binders and then compacted using suitable blending equipment (grinder, stabilizer, recycler).
Cement stabilised and hydraulic road binder-stabilised base courses are to be constructed in a design thickness. In exceptional cases, the total thickness of the course may be up to 40 cm, but it will be installed in two layers.

Machinery, plants and equipment

The appropriate construction machinery and equipment shall be used to achieve sufficient precision and uniformity of binder dosing and blending/installation homogeneity.

It must be selected and used appropriately to guarantee achievement all the required properties.

It is necessary to use devices that can measure and evenly distribute the amount of binders and water to be added to the mineral mixture.

The cement spreader and dispenser must have a cement doser to dose the cement taking into account the length or distance travelled by the machine. The blending equipment (grinder, stabilizer, recycler) must have a device for the controlled dosing of pressurized water.

Requirements

The execution of works may start immediately after obtaining an approval for the preliminary mixture by the Supervisor.
The cement or hydraulic binder stabilised base course construction works may be executed only at air temperatures higher than +5 C°. Materials to be stabilised and/or course below the stabilised course must not be frozen.

Installation

For on-site cement or hydraulic binder stabilised base courses, the required amount of binder in kg/m² to be added is to calculated based on the optimum binder content value in the preliminary mixture in kg/m³ increased by 1.10 coefficient factor and multiplied by a nominal course thickness. After defining the technology for performing the works on a test section and performing all the necessary control tests, at a later stage of the works, if the results of the control tests prove an acceptable level of uniaxial compressive strength achieved, the coefficient is to be reduced to 1.05.

Immediately after spreading the binder, it is necessary to blend it together evenly adding the required amount of water to achieve the required moisture.

If compaction begins half an hour later, the fresh mixture must be re-mixed. Works must be stopped in case of unacceptable weather conditions such as strong winds.

Compaction is to be done as evenly as possible using vibrating rollers or rubber rollers to achieve the required compactness and provide a compacted and smooth surface of the course.

The compaction process must be completed before the mixture begins to hardens and enters a state when compaction is no longer possible. Light rain does not interfere with installation, but installation must be stopped during heavy rainfall.

Transverse and longitudinal connection joints

The stabilisation procedure and on-site blending require a longitudinal overlap of an adequate width to be made in order to prevent formation of longitudinal joints.

The longitudinal connection joints are to be made with vertical edges. The compacted mixture on the joint must be of the same thickness as the stabilisation layer.

When executing works on the transverse joint, care must be taken to avoid damage to the already formed course when compacting the fresh mixture.

Curing and protection of courses

The cement or hydraulic binder stabilised base courses must be sprayed or protected with coatings that prevent their drying. Protection against drying is to ensured by using bitumen emulsion with an effective content of 0.6 kg/m² of residual bitumen (spraying min. 1.0 l / m2 of unstable bituminous emulsion KN 60).

If the cement stabilised course finish is dry, it is necessary to spray it with water prior to applying the required amount of bitumen emulsion.

Stabilized courses may be exposed to traffic loads only if it is demonstrated that no visible damage due to their impact will be caused.

Stabilized courses must be protected against negative freezing effects (i.e. by appropriate textile coats).

Prior to the first application of road defrosting salt, the stabilized courses must be fully protected with subsequent asphalt courses of the pavement.

Materials and requirements for the execution of works

All basic materials used must be compatible with each other and must not have any adverse effect on subsequent courses (courses above the stabilised course) in the pavement structure.
For base courses stabilized with hydraulic binders or cement, the Contractor, through its hired accredited laboratory, must demonstrate before the start of the work that satisfactory efficiency of the working mixture can be achieved with the designed preliminary mixture of the same basic materials. To this end, a sufficient quantity of fresh mixture will be sampled at ten test points on the test section in order to prepare two samples for each test point (see Item 7.1.4.1.4. Samples). One sample is to prepared without re-mixing while the other sample is to prepared by re-mixing, with a minimum of five minutes of continuous mixing (in a laboratory mixer or manually). One-axial compressive strength test after 7 days is to be performed on the samples prepared in this manner, while the result of the test, i.e. the efficiency value of the mixture, shall be expressed in% based on the ratio of the average strength value of the non-re-mixed samples multiplied by 100 and the strength of the re-mixed samples.

The efficiency of the working mixture must be at least 85%. If it is necessary to improve the efficiency of the working mixture, the mixing time is to be adjusted (or the speed of the stabilizing machine).

Criteria for the produced and installed cement stabilised mixture

The ongoing tests during the stabilisation of recycled pavement and crushed stone aggregate with cement or hydraulic binder include:

- preliminary tests,
- control tests.

Preliminary tests involve:

- Performing all preliminary tests of component materials and preparing the preliminary mixture in laboratory conditions,
- Transferring the preliminary mixture to the machinery for stabilisation and determining the required composition of the working mixture to be used for construction on the test section.
- Determination and adoption of construction technology on the test section with all necessary tests defined in Table 2,

Submission of the results of all tests and construction technology proposals to the Supervisor for approval.

When transferring the produced preliminary mixture - recipe to the construction site machinery, the exact weight ratios for dosing the individual component materials are to be established. The existing moisture content of the basic material shall also be taken into account and only the difference in the amount of water required to achieve prescribed moisture content level is to be added.

From the test production, samples of the fresh mixture shall be taken to test the test section in order to confirm the required stabilization properties. At least three samples of the mixture shall be tested by controlling all the properties defined in Table 2.

If the results of the tests carried out ensure that the results are consistent with the laboratory findings and design requirements, stabilization may be initiated subject to the approval of the Supervisor.

In the event that the results are inconsistent, the necessary adjustments shall be made before commencement of works. It is the obligation of the Contractor to maintain the approved working composition during the execution of works at the construction site.
The test section area should be at least 600 m2.

If the tests show that the quality achieved corresponds to that obtained in the laboratory conditions and these Technical Requirements, the works may be continued, otherwise the work will be suspended and a new test section shall be prepared.

The following table shows the on-going testing that, as a minimum of construction testing, is to performed by the Contractor as part of its quality assurance program. Control tests to performed by the an accredited testing laboratory hired by the Supervisor (Investor) in the account for 25% of total amount of Ongoing Tests.

(Description of tests for cement or hydraulic road binder stabilised base course Type: ST-Z or ST-T)	*(Requirements for the cement or hydraulic road binder stabilised base course) Type: ST-Z or ST-T)*	(Testing method)	*(Testing frequency)*
(Preliminary mixture performance)	≥ 85%	*(Technical requirements)* and RVS 8S.05.13 and RVS 08.17.01	On test section, and subsequentl y in case of doubt
(Particle size distribution)	*(Particle size distribution curve must be within the required boundary)*	SRPS U.B1.018	3.000 m^2
(Binder quality)	*(According to the defined quality in the preliminary mixture: standard consistency, binding time, volume constancy, residues on sieves)*	SRPS EN 196-3, SRPS EN196-6	For every 100 t of binder consumed
(Binder content)	*(Binder content may deviate ± 10% from the preliminary mixture)*	*(Inspection of cement dosing equipment)*	Measureme nt shall be performed every 10,000 m^2 while the total binder consumption is to be controlled on a daily basis.
(Reference dry density [Kg/m^3] and optimum moisture [w_{opt} %])	*(is to be determined in line with)* [4])	SRPS U.B1.038 and/or EN 13286 - 2	5.000 m^2
(Moisture [w %])	*(compared to the optimum moisture content of the preliminary mixture ranges between)* (w_{opt} - 2,0) < w < (w_{opt} + 1,0)	SRPS U.B1.012	500 m^2

(Uniaxial compressive strength after 7 days) β_{D7} [N/mm²] [1])	*(depending on the type of the binder used)* HRB 22.5 ……. $\beta_{D7} \geq 1.5$ N/mm^2 CEM 32.5N …… $\beta_{D7} \geq 1.5$ N/mm^2 CEM 32.5R ..... $\beta_{D7} \geq 1.0$ N/mm^2 [5])	SRPS U.B1.030 and/or EN 13286-41	1.000 m^2
(Dry density [Kg/m^3] i Degree of compactness [%])	*(For each test point ≥ 97%, for the test section ≥ 100% of the reference dry density on average)* 2) and 3)	SRPS U.B1.038 and/or EN 13286 - 2	500 m^2
(Course thickness [cm])	*(Deviation from the design thickness)* ± 15mm	*(Geodetic surveys and if necessary, core drilling or excavation of test pits)*	On each profile
(Flatness (4.0m long level) [mm])	*(From 0 mm to 15mm)*	*(To be measured by 4.0 m long level)*	On each profile
(Elevation)	*(Allowable deviation from the design elevation)* ± 15mm	Surveying *(Geodetic surveying)*	On each profile

(Mean value of 3 or 2 individual values)

[2]) *(For a calibrated sand method or ballon, testing may start no earlier than 4 hours after the compaction or immediately after the cement has hardened. The tests must be completed before 24 hours have elapsed since the end of the compaction.)*

[3]) T *(The stabilised soil-material base course can be considered homogeneous, if the coefficient of variation KV of one series of measurements of the degree of compaction of the installed stabilized course is:)*

KV < 3%

(*Coefficient of variation is to be calculated using the following equation:)*

$$KV = \frac{\sigma}{\bar{x}}, \qquad \sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

(whereas:)

x_i – *(results of on-site compactness measurements)*

x –*(arithmetic means of all compactness measurements on the tested sections of the installed stabilised course)*

n – t *(number of compactness measurements on the test section of the stabilised course)*

σ- *(standard deviation)*

[4])

(Reference density of fresh mixture samples taken on the route according to Item 7.1.4.1.3 Optimum moisture. For 10 or 15 cm diameter Proctor samples, aggregate grains> 22mm or 32mm are to removed by hand, without re-mixing the material)

(Reference density for determining the degree of compaction is to be calculated using the following equation:)

$$\rho = \left(1 - \frac{ü}{100}\right)\rho_P + 0{,}9 \cdot \rho_k \cdot \frac{ü}{100},$$

ρ - (kg/m³) *(reference density for relevant compaction)*

ρ_p - (Kg/m³) *(Proctor or reference density without oversized grains)*

ρ_k - (kg/m³) *(maximum density of stone aggregate)*

ü - (M-%) *(oversized grain content - mass)*

[5]) *((Samples shall be taken from the fresh mixture at least at two places during one working day (according to point 7.1.4.1.4. Samples) and shall be stored and subsequently tested. Samples can be transported fresh, but when hardened they can only be transported after 24 hours.)*

Calculation of works

Measurement:

Measurements are to be performed in cubic meters (m3) of the installed course measured and approved at the construction site by the Supervisor after its testing.

Payment:

The quantity, determined as described above, will be paid at the unit price contracted for a unit of measure, and this payment represents the total compensation for all work, equipment, tools and everything else necessary for the performance of works described above in these Technical Requirements.

3.04 CONSTRUCTION OF BITUMINOUS WEARING COURSE (BNHS 16)

ITEM DESCRIPTION

The item includes procurement of materials, mixing, spreading, installation and compaction of a hot mix asphalt of mineral materials and road bitumen BIT 50/70 in one layer of design thickness of t = 6.0 cm according to the elevations and dimensions given in the construction design.

MATERIALS

Building materials for the construction of the bituminous wearing course:
- carbonate stone filler,
- crushed carbonate stone aggregate 0/4, 4/8, 8/16
- binder BIT 50/70

QUALITY OF MATERIALS

Filler

The filler must in all ascpects meet the criteria defined for the 1st quality class under SRPS B.B3.045.

Particle size distrbution (% sive passage)	for the 1st quality class	SRPS B.B8.105
Plasticity index % (m/m)	max.4.0	SRPS B.B1.020
Moisture content % (m/m)	-	SRPS U.B1.012
particle size distribution for particles less than 0.063 mm %	-	SRPS U.B1.018
Bitumen hardening index	1.80 - 2.40	SRPS B.B8.104
Rigden voids in % v/v	-	SRPS B.B8.102

Sand

Crushed stone must in all aspects meet the quality requirements shown in the table below:

Particle size distrbution (% sive passage)	according to SRPS U.E9.021/86	SRPS B.B8.029
content of particles less than 0.09 mm (% sieve passage)	max. 10	SRPS B.B8.036
Content of clay balls % (m/m)	max. 0.5	SRPS B.B8.038
Content of organic impurities % (m/m)	max. 0.5	SRPS U.B1.024
Sand equivalent, %	min. 60	SRPS U.B1.040
Fineness modulus	-	SRPS U.E4.014
density (kg/m3)	-	SRPS B.B8.031

* the value in parenthesis refers to crushed sand of silicate composition

Stone chippings

Stone chippings fractins should meet the following quality requirements:

Abrasion resistance and resistance to wear according to Los Angeles (%m/m)	max. 30 % m/m	SRPS B.B8.045
resistance to freezing Na2SO4, loss after 5 cycles	max. 5 % m/m	SRPS B.B8.044
percentage of unocovered area of all grains (%)	max. 20%	SRPS U.M8.096
water absorption for 4/8 mm fraction	max. 1.2 % m/m	SRPS B.B8.031
grain content in fractions above 4 mm where the ratio of the largest to the smallest dimension is> 3: 1	max. 20 % m/m	SRPS B.B8.048

clay lumps in fractions	max. 0.25 % m/m	SRPS B.B8.038
density	-	SRPS B.B8.031

The particle size distribution of fractions shall be tested for any stone chippings fraction according to SRPS B.B8.029, while the content of particles less than 0.09 mm shall be tested according to SRPS B.B8.036.

Bitumen

Bitumen BIT 50/70 shall be used and must meet the criteria given in SRPS U.M3.010. for BIT 50/70 in all aspects.

PRELIMINARY TESTING OF APSPHALT MIXTURE

Prior to commencement of works, the Contractor shall prepare a preliminary asphalt mixture design in an authorized laboratory in accordance with these technical requirements.

Asphalt mixture can be produced only after the Contractor has provided the preliminary mixture to the Supervisor for approval. The certificates of basic materials and preliminary mixture must not be older than 6 months. If there are any changes in the basic materials or changes in the choice of materials, the Contractor shall provide the Supervisor with a written proposal for the change of the adopted asphalt mixture or proposal for a new preliminary mixture for approval before using these materials.

Particle size distribution of mineral mixture

The particle size distribution curve of the design mineral mixture must meet limit conditions provided under SRPS U.E9.021/86 for bituminous wearing courses BNS 22A, which are given in the table below:

Sieve mesh (mm)	0.09	0.25	0.71	2.00	4.00	8.00	11.2	16.0
passage (%)	4-14	7-37	12-53	21-65	30-74	44-85	54-92	70-100

The building materials and quality of preliminary asphalt mixture shall be tested according to SRPS U.E9.021/86 and should meet BNHS16 quality requirements.

The designer's approval for a composition of preliminary asphalt mixture is mandatory.

CONSTRUCTION TECHNOLOGY

ASPHALT MIXTURE PREPARATION AND TRANSPORT

The asphalt mixture is to be mechanically produced in an asphalt mixing plant. A continuous asphalt mixing plant may be used if satisfactory performance is demonstrated by the quality of asphalt mixture produced by this procedure.
The optimum bitumen temperature in asphalt tank trailers is 150 ^{o}C, while the maximum temperature is 165 ^{o}C. The aggregate temperature must not exceed the bitumen temperature by more than 15^{o}C, while the temperature of the asphalt mixture when leaving the mixer is optimally 160 $\pm$ 10oC and not more than 175^{o}C.
The asphalt mixture is to be transported to the point of installation immediately after its mixing.

SUBSTRATE PREPARATION

Prior to casting asphalt course, the Supervisor shall survey the substrate level and flatness. In the parts where the substrate layer is higher than the design elevations, the Contractor shall repair the substrate in line with the design requirements.
The asphalt mixture can be laid on a substrate composed of mechanically stabilized granular only after the substrate has been tested and accepted by the Supervisor. The time interval between the substrate testing and installation of the asphalt mixture must not be longer than 24 hours and during this time, transportation on the tested substrate should be prohibited.
Prior to installing bituminous wearing course, the substrate must be clean and must not be frozen.

INSTALLATION OF ASPHALT MIXTURE

Asphalt mixture is to be installed only in favourable weather conditions. The temperature of the substrate and air must be higher than +5^{o}C. In special weather conditions such as strong winds, the Supervisor may suspend the works even at temperatures higher than the aforementioned, if it is suspected that under these conditions the quality of works will be compromised. The asphalt mixture temperature at the point of installation must not be lower than140^{o}C and higher than 175^{o}C.
The asphalt mixture is to be mechanically laid and immediately afterwards an adequate rolling regime must be provided to ensure the required compaction of the asphalt course.
Other construction technology details for this item are given in the applicable standard SRPS U.E9.021/86 and other applicable SRPS standards.

PERIOD OF EXECUTION OF WORKS

The asphalt can only be installed in the period when the air temperatures are higher than 5^{o}C without wind or at least 10^{o}C with wind. Asphalt mixture must not be installed in misty and rainy weather conditions. The substrate temperature must not be lower than +5^{o}C.

QUALITY CONTROL

ONGOING TESTS

Ongoing testing shall be performed by the Contractor in order to have at all times the best insight into the quality of the building materials as well as the asphalt mixtures produced and installed, in order to intervene in the production process if necessary and to ensure the continued production of the prescribed quality.
The Contractor shall influence the process of production and installation of the asphalt mixture based on the results of the ongoing tests in a way that ensures the uniform and technically compliant quality of the produced asphalt course.
The Contractor shall keep a written record of the results of the tests carried out as part of ongoing tests, which must be made available to the Supervisor.
The ongoing testing during the construction of the bituminous wearing course includes:

- ongoing testing of building materials
- ongoing testing of asphalt mixture
- ongoing testing of installed asphalt mixture

All tests to be conducted as part of ongoing testing need to be carried out to the extent and in the manner prescribed by the applicable Yugoslav standards SRPS U.E9.021 / 86.

CONTROL TESTS

Control tests are to be carried out by the Contractor as part of its Quality Assurance Program in order to obtain a more realistic picture of the achieved quality of the asphalt course installed according to these Technical Requirements.
Control tests include:

- control tests of building materials
- control tests of produced asphalt mixture
- control tests of installed asphalt mixture

Control tests of materials

Control tests shall be performed on samples taken on an asphalt base.
One sample is to be taken from each type of material per quantity of material required to produce 1000 tonnes of asphalt mixture. The required quantities of material are to be calculated on the basis of the working composition of the asphalt mixture.

Filler
The following tests shall be carried out:

Particle size distribution	SRPS B.B8.105
Void fraction in dry compacted state - Ridgen voids	SRPS B.B8.102

Sand

The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Sand equivalent	SRPS U.B1.040
Content of partciles less than 0.09 mm	SRPS B.B8.036

Stone chippings
The following tests shall be carried out:

Particle size distribution	SRPS B.B8.029
Content of partciles less than 0.09 mm	SRPS B.B8.036
Grain shape	
Friable particles	SRPS B.B8.037

Bitumen

All analyses are to be conducted in line with SRPS U.M3.010.

Control tests of produced asphalt mixture

Asphalt mixture samples for control tests shall be taken at the point of installation of asphalt mixture.
The composition and physical and mechanical properties of the asphalt mixture are to be checked by testing one sample for every 350 tonnes of produced asphalt mixture.

The following properties are to be tested:

Bitumen content	SRPS U.M8.090
Particle size distribution	SRPS U.M8.090
Stability at 60 °C	SRPS U.M8.090
stability and deformation at 60 °C	SRPS U.M8.090
Void volume fraction	SRPS U.M8.090
bitumen filled voids	SRPS U.M8.090

Control tests of produced asphalt course

The physical and mechanical properties and thickness of the produced course shall be tested on samples extracted at least every 200 m of the produced course.
Sampling according to SRPS U.M3.090.

The following properties are to be tested:

Void volume fraction	SRPS U.M8.090
Degree of compactness	SRPS U.M8.090
Course thickness	-

The height, transverse slope and position of the produced course shall be inspected by appropriate instruments, at least 20% of the data recorded by the Contractor during the ongoing testing of the course production and installation.

CRITERIA FOR THE CALCULATION OF EXECUTED WORKS

Course flatness and crossfall

The Contractor shall make measurements on cross section profiles, provided that spacing does not exceed 30 m. Measurements are to be performed using a 4 m long screed (left, right, middle). Criteria are as follows:

Fatness deviations ranging between 0 to 8 mm	shall be deemed satisfactory
Fatness deviations ranging between 8 to 12 mm	shall be deemed unsatisfactory and 5-25% of the value of this flat area shall be deducted.
Flatness deviations exceeding 12 mm	shall be deemed unsatisfactory and 100% of the value of this flat area shall be deducted.

The maximum deviation of the transverse slope of the asphalt concrete course from the design transverse slope is ± 0.4%.

Deviation of the course surface from the design elevation of the level finish

The maximum permissible height deviation of the surface of the constructed bituminous wearing course from the design is ± 10mm.

Horizontal deviation of the edge of the installed course

The maximum permissible deviation of the position of the right and left edge from the design position is± 25 mm.

Deviation in the thickness of the installed course

All deviations of the installed course thicknesses from the design course thickness, provided that the Contractor assesses that the installed course may remain in the pavement structure, shall be the subject to the quality assessment of the executed of works.
The measurements shall be performed on each profile and the criteria are as follows:

For a course thickness deviation of 10 -13 mm	10-25% of the value of this surface shall be deducted.
For a course thickness deviation of 13 -17 mm	26-50% of the value of this surface shall be deducted.
For a course thickness deviation exceeding 17 mm,	the executed works shall not be accepted.

The deduction value in percentages shall be determined by the Supervisor based on the number of measurements and percentage of results that deviate more than -10% of the design course thickness.

Particle size distribution of mineral mixture

If the particle size distribution of the extracted mineral mixture deviates from the boundary curve compared to the required granulometric curve, i.e. exceeds the standard tolerances, the Contractor shall reduce the value of the works of the bituminous wearing course works by 5.0% for the area covered by the tested sample. If deviations exceed the standard tolerances in all three components of the asphalt mixture, in the granulometric curve, filler and bitumen fraction, the asphalt course cannot be accepted.

Compaction degree of installed course

The criterion for the acceptance of works is the degree of compaction achieved, which must be a minimum of 98%. If more than 10% of the tested samples show a compaction degree less than 98%, the works will be rejected.

MEASUREMENT AND PAYMENT

Costs shall be calculated per 1 m2 of executed works that comply with the quality requirements prescribed hereunder and tolerance limits.