**Republic of Serbia**



**Annex to Terms of Reference**

for preparing

**Final Design for Heavy Maintenance of IB-15 state road**

**In the zone of Kikinda and on the section Kikinda – Nakovo,**

Section 01516: Kikinda (Nakovo) – Kikinda (Mokrin), length 3.879 km

Section 01517: Kikinda (Mokrin) - Kikinda (VojvodaStepa), length 2.068 km

Section 01518: Kikinda (VojvodaStepa) - border SRB/ROM (Nakovo), length 8.214 km

Chainage: from KM 159+489 to KM 173+650

Length: 14.161 km

Belgrade, September 2017

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# Basis

Road network of the AP Vojvodina consists of the developed network of state roads whose basis is the pan European corridors E-75 border with Hungary - Novi Sad – Belgrade and E-70 border with Croatia – Belgrade – Vršac – border with Romania. The main role of these corridors on the sections through Vojvodina is the provision of large capacity and high level of service for the expected traffic flows. Beside the stated corridors, developed network of state roads enables the functioning and future development of Vojvodina. One of highly significant lateral links in this network consists of IB category state road No. 15, which is one of the most significant road routes in Vojvodina. This road route connects significant industrial regions and several urban centers in the country, such as Sombor, Vrbas, Bečej and Kikinda. At the same time, this road route connects the Republic of Serbia with the countries in the region, i.e. it is the shortest road link between Croatia and Romania.



**Figure 1‑1**Position of the road IB-15 (blue) and sections covered with this Terms of Reference (pink) in the road network of the AP Vojvodina

In the zone of Kikinda two border crossings are located, namely SrpskaCrnja and Nakovo. Link between Kikinda and the border crossing SrpskaCrnja is established through IIA category state road No. 104 and IB category state road No. 12 in the length of about 31km, while the link with the border crossing Nakovo is established through IB category state road No. 15 in the length of about 10km, which is the shortest road connection between Kikinda and Romania.

Municipality of Kikinda, in cooperation with the relevant ministries and Customs Administration, plans the reconstruction and increase of the capacities of Nakovo border crossing for the purpose of more intensified trade as well as the development of tourism, primarily cycling tourism, taking into consideration the significant number of cyclists on the section between Kikinda and Nakovo as well as the position of the European cycling route Euro Velo 13 which passes through the territory of the municipality and the City of Kikinda, where it is placed along IB category state road No. 15 on one section. This cycling route, also known as Iron Curtain Trail, follows an exceptional idea to offer the cyclists the driving along the border of the former Eastern and Western Bloc. From Nordkapp in Norway to the Black Sea, in the total length of about 8000km, passengers can not only pedal and pass through various sceneries, but they can also move through the living history of our continent, getting introduced with the artefacts of its former ominous division as well as with the value of the present European cooperation and removal of borders between peoples and countries. Length of the route EuroVelo 13 is about 900km through Serbia and the route passes along the border of the former Yugoslavia and Eastern Bloc: from Subotica via Kikinda to Vršac and BelaCrkva (on this stretch it passes through the territory of Romania, while the alternative route is in Serbia), through the Djerdap gorge to Kladovo and Negotin, followed by Zaječar, Knjaževac and Pirot, and finally via the mountain Staraplanina to Dimitrovgrad and where it exits to Bulgaria. In the Project of Sustainable Mobility in South East Europe assisted and coordinated by the CF, Slovakia, Slovenia, Hungary, Croatia, Serbia, Romania and Bulgaria jointly worked on the production of all required documents and studies needed for the practical development of this route in 2014. Among other things, the following was produced for our country:

* National status report, which (after detailed field work) defined the final route alignment and foresaw the condition of roads along which it guided;
* National action plan – list of required measures for the elimination of the noticed lacks in infrastructure, organization and tourist offers
* Feasibility study, which precisely defines technical measures and the required financial funds for the upgrade of infrastructure, public transport of cyclists, sustainable tourist offers, etc.
* National marketing plan – set of measures and activities for promoting the route in the country and abroad.

These documents are the basis for further development of the route EuroVelo 13 in Serbia. Additionally, owing to financial support by the Ministry of Trade, Tourism and Telecommunications, the Design of Road Signage was also prepared for the route EV13 in Serbia.

In order to upgrade and create the conditions for safe traffic on the section of IB-15 state road in the zone of Kikinda, connect the participants in traffic travelling along this road route, as well as in Kikinda with Romania, and in order to develop cycling tourism on the territory of the Republic of Serbia, PE “Roads of Serbia” in cooperation with the Municipality of Kikinda and the Regional Agency for Socio-Economic Development – Banat submitted the joint application for participating in the IPA Program for Cross Border Cooperation Romania – Serbia (IPA CBC RU - SRB) in order to receive funds for the implementation of the planned activities. In order to submit the application, PE “Roads of Serbia” prepared the Feasibility Study in February 2016 for road rehabilitation and construction of the cycling path on the state road IB-15 in the zone of Kikinda and on the section Kikinda – Nakovo.

After the adoption of the final decision by the IPA Program for Cross Border Cooperation Romania – Serbia (IPA CBC RU - SRB), PE “Roads of Serbia” is approved to receive the funds for preparing technical documents and construction of the cycling path between Kikinda and Nakovo.

In this implementation phase of the project, it is necessary to produce the Final Design for Heavy Maintenance. Pursuant to the modern principles of safe road design and based on the article 156 of the Law on Traffic Safety, PE “Roads of Serbia” will timely engage a Road Safety Auditor. The task of the Road Safety Audit is to check the design solutions from the aspect of traffic safety requirements pursuant to the physical situation on site and performed Final Design, as well as to mark the adequacy of the applied measures and the recommendations for solving the noticed safety problems. For the measures for which it is noticed that they are applicable and economically feasible, Designer shall receive from the Client the instructions for incorporation in the Final Design. Additionally, PE “Roads of Serbia” will engage a technical controller, whose task will be to check the wholeness and validity of the design, fulfilment of the requirements from the Terms of Reference and obeying of the legal and technical regulations.

## Scope and coverage

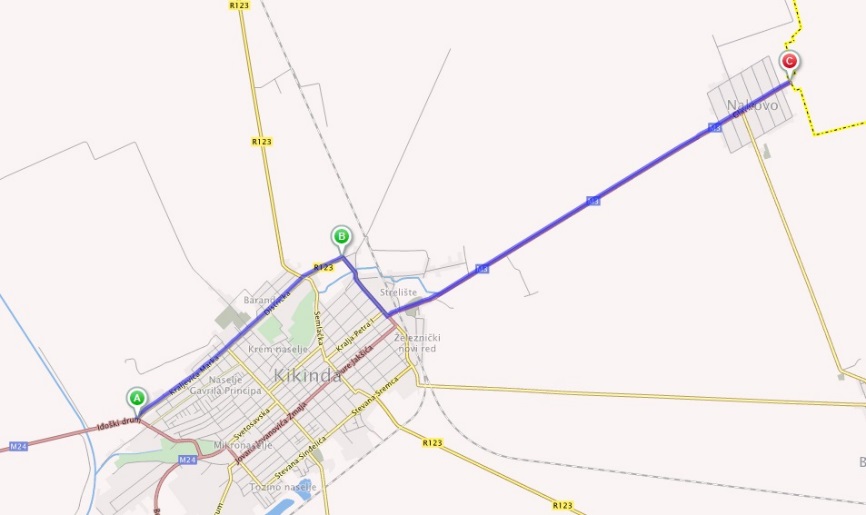
IB category state road No. 15 begins on the border crossing BačkiBreg (state border with Hungary) and continues along Bezdan – Sombor – Kula – Vrbas – Srbobran – Bečej – Novi Bečej – Kikinda – border crossing Nakovo (state border with Romania). Initial chainage of km 0+000 is on the border crossing BačkiBreg, while end chainage of km 173+650 is on the border crossing Nakovo.

This Terms of Reference sets the area which should be covered in the Final Design for Heavy Maintenance, involving the following sections of IB-15 state road:

* Section 01516: Kikinda (Nakovo) – Kikinda (Mokrin), length 3.879 km
* Section 01517: Kikinda (Mokrin) - Kikinda (VojvodaStepa), length 2.068 km
* Section 01518: Kikinda (VojvodaStepa) - border SRB/ROM (Nakovo), length 8.214 km

Pursuant to the valid Reference System for the State Road Network in the Republic of Serbia, initial point covered in this study is node 1307 at the chainage km 159+442 and final point is node 1516 at the chainage km 173+603, which means that the total length of the road covered with feasibility study is 14.161km. Design should also cover the intersection of state roads IB-15 and IB-13 so that the exact beginning and end of interventions will be defined in the design. At the end of the section, the design should fit in the plateau of the border crossing whose solution is not the subject of this design.

On the stated area, depending on its section and stretch, rehabilitation measures are foreseen as well as heavy maintenance of pavement, construction of bicycle lane and upgrade of the geometry of the existing intersections. All measures and interventions foreseen in the design are performed in the lot of IB-15 state road which is government owned, thus property issues are clearly defined, while the procedure for design implementation is simplified based on the Law on Public Roads while obeying the Law on Planning and Construction of the Republic of Serbia.



**Figure 1‑2**IB-15 road sections (blue) covered in this Terms of Reference

# Objective

PE “Roads of Serbia” was founded based on the Law on Public Roads of the Republic of Serbia and based on the Government decision it is in charge of the management of state roads. Pursuant to the available financial resources, PE “Roads of Serbia” invests in the construction and maintenance of the state road network. Taking into consideration the opening and arrangement of the border crossing Nakovo for the municipality of Kikinda and the Republic of Serbia, PE “Roads of Serbia” will plan the funds for investment maintenance of the road network in the zone of Kikinda in the upcoming period in order to create the conditions for functional and safe traffic. Owing to the increasing number of cyclists moving along the state roads in this area, primarily on the section of IB-15 state road between Kikinda and Nakovo and owing to the fact that a part of the European Cycling Route Euro Velo 13 matches IB-15 state road, PE “Roads of Serbia” plans to invest in the construction of bicycle lanes in the road reserve of IB-15 state road, which will create the conditions for better passability of vehicles and increase the safety level for all participants in traffic.

Pursuant to the above mentioned, the objective of the proposed Terms of Reference is to prepare technical documents in the form of Final Design for Heavy Maintenance which will provide: increase of the value in use and road durability, improvement of traffic safety through the application of adequate design solutions, as well as for the upgrade of pedestrian and cyclist communication, accompanied by the inclusion of local community requirements (social aspect) in maximum possible measure under the given conditions of spatial limitations (section context) and limitations originating from the type of allowed construction and traffic interventions (legal basis).

# Scope of service and tasks

## General requirements

When preparing the relevant technical documents, the Designer shall be in charge of the following:

* To abide by the valid laws and regulations, standards and quality norms for this type of structures,
* Through the design of heavy maintenance, to renew the bearing capacity and the required road durability through the correction of the pavement structure in order to prolong the usability of the road. Required design period is 10 years,
* To collect the existing planning documents and analyse its impact on the design solution and to report the Client on the conclusions prior to the beginning of the preparation of technical documents,
* To prepare the required bases for the preparation of design solutions (geodetic, geotechnical, hydrologic, etc.). Designer shall prepare geodetic bases on the cadastre plan sealed by an authorized institution (geodetic organization);
* To perform geodetic surveys, exploratory works and laboratory tests required for establishing the bases,
* When designing, to identify, describe and estimate from the traffic safety aspect all traffic conflicts between all participants in traffic with special overview for vulnerable users,
* To collect and process the data on traffic accidents with fatalities and injuries on the stated section for the previous period of at least 10 years,
* In the phase of Road Safety Audit, to submit to the Client all documents required for the Audit, to declare about the findings of the independent Road Safety Audit and to amend design parts pursuant to the Client’s order and
* To act pursuant to the remarks of the Technical Control in the manner and within the deadlines defined in this Terms of Reference and Contract.

## Bases for designing

### Traffic volume

Traffic volume necessary for the process of road design refers to time series in the future, thus the defined planning period is 10 years.

In the following table, traffic volume is given for the period 2016[[1]](#footnote-2) on the section between Kikinda and Nakovo, on which automatic traffic counter No. 2043 is placed:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **PC** | **BUS** | **LT** | **MT** | **HT** | **TT** | **AADT** |
| 2016 | 1094 | 18 | 13 | 8 | 10 | 8 | 1152 |

Designer will perform control counting of vehicles on the sections for which there are no data pursuant to the structure stated in the previous table, i.e. pursuant to the need as well as additional traffic counting (pedestrian, cyclist, motor vehicles) on all critical locations. Special attention shall be paid to the selection of locations for control traffic counting. Plan and program of control counting shall be submitted to the Client for approval prior to the implementation of the control counting. Based on the analysis of available data and control traffic counting, Designer will define the valid traffic volume. Analysis of the obtained results shall be submitted to the Client for consideration prior to the design process.

Recommended forecasts of traffic increase rate in the planned period are given in the following table (adopt moderate scenario for traffic increase rate):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **Traffic increase rates (%)** | | | | | | |
| 2015 | 2016 | 2017 | 2018 | 2019 | 2020-2025 | 2025-2030 |
| Pessimistic | 0.5 | 1.0 | 1.5 | 3.0 | 3.0 | 3.5 | 3.0 |
| **Moderate** | **1.0** | **1.5** | **2.0** | **3.5** | **3.5** | **4.0** | **3.5** |
| Optimistic | 1.5 | 2.0 | 2.5 | 4.0 | 4.0 | 4.5 | 4.0 |

Designer will analyse influential parameters (traffic counting, regional macro-economic and development indicators, etc.) and occasionally propose the corrected forecasts of traffic increase rates.

Maximum allowed load bearing capacity relevant for dimensioning of the pavement structure shall be adopted pursuant to the "Rulebook on the division of motor vehicles and trailers and on technical conditions for vehicles in road traffic" (“Official Gazette of the RS”, No. 40/12).

### Final Design of Geodetic Works

When preparing the Final Design of Geodetic Works, Designer shall fulfil the requirements of the Law on State Bill of Quantities and Cadastre ("Official Gazette of the RS ", No. 72/2009, 18/2010, 65/2013, 15/2015 – decision of CC and 96/2015), Chapter XII Geodetic Works in engineering technical fields.

Positional basis for determining the coordinates of traverse points shall consist of the trigonometric points of the state network. On the layered map R=1:25000 it is necessary to insert all points of the grids of all lines (trigonometric and levelling) in the wider zone of the structure on which the traverse points for structure and field surveying might be potentially connected. When preparing the traverse, “Instructions for preparing and maintenance of the geodetic basis for surveying details” No. 951-83/96 dated 13.01.1997 shall be followed, set by the Republic Geodetic Authority.

Traverse points shall be designed continuously, possibly along one side of the structure, laterally with maximum distance of 50m outside the road reserve. Design of the operating traverse shall include all points of the existing trigonometric and levelling network in the vicinity of the structure. Designer shall provide from the relevant Republic Geodetic Authority the list of the coordinates of the existing points and the list of the bench mark heights, and shall annex to the list the RGA’s document on the submission/takeover of the stated data. Traverse points shall not be placed on such locations on which they would be destroyed with the execution of the designed works. They shall also be outside the catchment zone of the machinery and construction roads, or, if it is not possible, they have to be provided against damages.

All traverse points shall be stabilized with the adopted cairn type pursuant to the “Rulebook for the main geodetic works”. Stabilization of points shall be made 7-10 days prior to the geodetic measurements.

Points shall be numbered continuously from 1 to n (regardless of the CM borders) with the initial letter of the cadastre municipality accompanied by the number. For each point, description of the position shall be performed in the Trigonometric Form No. 27.

Heights of the traverse points shall be determined with general levelling. Height accuracy shall be determined pursuant to the allowed deviations for front-back levelling Δ ≤ 4,0\*m0\*√d mm, with m0=4mm/km, and d-length of road in km.

Traverse shall be sealed by an authorized company (geodetic organization). Designer shall give for approval all documents containing technical report, measured and processed data, list of traverse points with coordinates, altitudes, description of positions (TO 27) and traverse sketch in analogue and digital form (DWG form) with the points of state trigonometry network in wider zone. When preparing the documents in digital form, please follow the provisions set in the “Decree on digital geodetic plan” ("Official Gazette of the RS", No. 15/03, 18/03 and 85/08).

Existing situation of the road both horizontally and vertically shall be performed from the network of operative traverse for the needs of producing updated topographic map with the scale 1:1000, which will be used as the design basis. For the needs of discussing possible interventions on intersections and structure, topographic plan in the scale 1:500 shall be performed.

Official scanned and georeferenced copy of the cadastre plan shall be acquired from the Republic Geodetic Authority containing all data required for marking the road reserve limits.

Width of the surveyed scope shall be such (minimum 20 m to the left and to the right from road axis) to provide the preparation of the digital model of pavement surface and complex preparation of all contents in the intersection zone (elements of pavement and road base drainage system, pedestrian sidewalks, retaining walls, access roads, accesses to the structures, etc.).

Cross profiles shall be surveyed on adequate distances (maximum 20 m) pursuant to the situation on site and on characteristic locations (elements of pavement and road base drainage system, pedestrian sidewalks, retaining walls, access roads, accesses to the structures, etc.). Designer’s obligation shall be to define each characteristic point with coordinates too.

Special attention shall be paid to the surveying of the existing installations and other facilities in the road reserve (overhead and underground), which can represent a physical limitation for executing the stated works. Recorded lines and structures shall be drawn on the topographic plan as required for the registration in the cadastre of lines and real estate.

Designer shall show the limits of the road reserve on a separate site plan (data to be taken from the real estate cadastre) on which also possible occupation of the road reserve by the third parties will be presented, as well as locations on which the road is on other person’s land with cross profile elements outside the road reserve and state the number of lot and property type (state or private).

Designer shall mark the main points of the centre line (beginning of transitional curve, beginning of curve, middle of curve, end of curve, end of transitional curve), hectometres and to give over the axis and traverse points to the contractor in the presence of the supervisor.

Final Design of Geodetic Works shall contain the following:

1. General data on the subject of the design and accompanying documents;
2. Excerpt from the Terms of Reference for preparing the Final Design;
3. Bases for design preparation;
4. Technical report on the prepared preliminary works;
5. Design solution of the geodetic works;
6. Organization of works;
7. Graphic annexes and tables.

### Survey of engineering geological and geotechnical exploratory works

The survey shall contain all results of the engineering geological and geotechnical exploratory works expressed in the form of tables, graphs and diagrams. In adequate attachments in site plans, all locations and types of performed exploratory works shall be presented.

Activities shall be implemented in three phases: field exploratory works, laboratory tests and processing of the obtained results.

Exploratory works shall be carried out pursuant to the Law on Mining and Geological Exploration ("Official Gazette of the RS ", 101/2015) and the Rulebook on the content of designs for geological exploratory works and surveys on the results of exploratory works ("Official Gazette of the RS", No. 51/96). Prior to accessing the exploratory works, Designer shall overview the previous explorations with critical highlight on the obtained results and the level of research, if such explorations had been performed and the data are available. The data shall be shown in the survey.

Designer shall make a program of exploratory works for which he shall obtain Client’s approval prior to the beginning of exploratory works. When preparing the program of exploratory works, he shall use among other things the data collected during the testing of functional and structural situation of the pavement (chapter 3.2.4). Foreseen scope of research shall be such that the Designer can reliably determine the following:

* Zones with similar characteristics;
* Composition of pavement and characteristics of material in it;
* Composition and quality of materials in the final layer of embankment;
* Conditions for the replacement of materials (if required);
* Conditions for roadbed and quality of material for constructing the embankment;
* Stability of embankment slopes;
* Position of the layer in the sample, layer thickness and type of material;
* Thickness of underlays (if they exist) and type of materials below the subgrade layer.
* Measures for implementing traffic safety during the execution of exploratory works.

During the implementation of exploratory works, Designer shall apply all necessary measures for securing the safety of workers. All responsibility for the security of workers during the execution of exploratory works shall be held by the Designer. During excavation or extracting of the samples, pits shall be properly secured in order to protect against collapsing. During excavations below the level of groundwater and in porous land, water shall be pumped out. In bore pits, visual inspection shall be carried out regarding the layers of soil, soil borders, thickness, colour, etc. On undisturbed samples, taken from bore pits, laboratory test CBR shall be performed.

Bore pits shall be excavated on the pavement in the depth up to 2 m, i.e. to the required depth, with mutual distance of 1000 m on average (as needed, the distance of up to 500 m will be used if it is estimated that field characteristics require it). Additionally, bore pits shall be excavated at the distance of 500 meters next to the pavement on the route of the designed cycling lane in order to determine CBR and pavement of the cycling lane (excavation of these bore pits shall be performed after the determination of the alignment of the cycling lane). Between the bore pits on the pavement, sample material shall be taken from the pavement by kerning. Kerning shall be done on 3 (three) locations on cross profile, one in the axis and two at the distance of 0.5 m from pavement edge from the left and from the right side. Taken samples shall be identified macroscopically with the determination of layer thickness and their connections. In case of coherent soil in the pavement subgrade, dynamic cone penetration test (DCP) shall be performed on the sampling point and CBR shall be calculated. After drilling or excavation, bore pit or pit shall be resealed so that the surface becomes safe for traffic. Position of bore pits and kerns shall be placed by their chainages on the line plan (R=1:2000). Additionally, the following shall be stated:

* Physical condition of the samples of cohesive soil (disintegrating, cracked, tied-compact);
* Total pavement thickness;
* Position of the layer in the sample, sample thickness and material type;
* Thickness of underlays (if they exist) and type of material below the subgrade level.

Photo documents about the performed field exploratory works shall be mandatorily submitted.

Perform hydrotechnical and hydrological investigations on the sector required by the relevant water management company. When preparing the relevant hydrotechnical documents, all necessary climate and hydrological bases shall be used as well as the data on calculated precipitation from the relevant rain gauge in order to reach the precise data about the amounts of precipitation which should be collected from the relevant road.

Results obtained in the research and performed analyses shall be shown with all required comments in order to solve the drainage problem adequately, pursuant to the obtained conditions from the relevant water management company.

It shall be innovated, systematized and determined which data are relevant for the calculation and dimensioning of the structures and elements for road drainage, thus taking into consideration to meet all aspects of environment protection.

In order to determine the geomechanic characteristics of the materials, laboratory tests of the samples taken from bore pits and kerns shall be performed. Minimum scope of these tests shall consist:

* Determination of the granulometric composition of the materials;
* Determination of density and moisture in natural condition;
* Determination of maximum density and optimal moisture pursuant to the standard Proctor test;
* Determination of the limits of material consistency;
* Determination of bearing capacity index (CBR).

Laboratory tests of asphalt samples shall cover the following:

* Determination of the content of asphalt mixture;
* Determination of volume share of the main components.

Survey shall be prepared about the performed explorations, tests and results.

### Evaluation of the situation of the existing pavement

Evaluations of functional characteristics of pavement surface

Evaluation shall be given pursuant to the following:

* Visual inspecting of the pavement surface situation pursuant to the catalogue of damages set and submitted by the Client,
* Measurement of the longitudinal roughness of the pavement, for each traffic lane, with adequate measurement instrument, expressed with IRI index (m/km) to the maximum of 100 m distance,
* Measurement of cross roughness of the pavement on the stretches where the ruts or expressed deformations of the cross profile are noticed. Cross evenness of the pavement shall be measured on each 20 m on such stretches. Measurements shall be performed with adequate measurement device or with straight beam 1.2 m long and pin, pursuant to the AASHTO instructions for measuring ruts or with trans-profilograph.

Determination of the bearing capacity of the existing pavement

Bearing capacity of the existing pavement shall be determined through the measurement of deflections.

Deflections shall be measured for each traffic lane individually, by using a falling weight deflectometer (FWD) on the distances not exceeding 100 m, or with Benkelman beam on the distances not exceeding 50 m. It shall be obligatory to do the correction of the deflection in terms of the temperature and deflection normalization pursuant to the load.

Based on the measured deflections, homogenous stretches shall be found and modules of layer elasticity and residual load-bearing capacity of the pavement shall be determined.

Data and results of the tests shall be presented in the Final Design for Pavement.

Designer shall set the type, level, amount and cause of the damage and perform the graphic distribution in the site plan in the scale R=1:500 – 1:1000. Pursuant to the above mentioned, Designer shall evaluate structural characteristics of the pavement.

### Evaluation of the situation of pavement and road base drainage system

From drainage aspect, functional situation shall be evaluated: shoulders, gutters, drain flumes, kerbs, ditches, drainage culverts and other elements of the drainage system.

Evaluation of the situation shall consist of the collection of state indicators by visual inspection and evaluation of each element of the drainage system pursuant to the OECD methodology from 1990.

Special attention shall be paid to the following:

* Field topography (cut/embankment);
* Slope of pavement and shoulders;
* Geometry and situation of the channels and ditches;
* Geometry and gradient of the cut and embankment slopes, as well as their situation;
* Efficiency of the drainage system.

It is necessary to record the presence of structural damages on the drainage system elements.

From the drainage aspect, capacity of the drainage system shall be checked with hydraulic calculation by using the collected data and results of the hydrologic and hydrotechnical exploratory works.

Hydrologic and hydrotechnical exploratory works shall be performed on the sector required by the authorized water management company. When preparing the relevant hydrotechnical documents, all necessary climate and hydrological bases shall be used as well as the data on calculated precipitation from adequate rain gauge in order to reach the precise data about the amounts of precipitation which should be collected from the relevant road.

Results obtained through research and performed analyses shall be shown with all required comments in order to resolve the drainage problem appropriately, pursuant to the obtained opinion/conditions from the relevant water management company.

It shall be innovated, systematized and determined which data are relevant for the calculation and dimensioning of the structures and elements for road alignment drainage, thus taking into consideration to meet all aspects of environment protection.

Type and level of the impact of the present situation of the drainage system shall be performed in terms of the appearance of the noticed structural and surface damages of the road.

Pursuant to the evaluation of the situation, solutions shall be proposed to upgrade the drainage system.

Designer’s obligation shall be to evaluate the situation of all culverts (box, arched and pipe). It is also necessary to determine the need for constructing new culverts in the embankment base of access roads if they obstruct the drainage along the road.

On the noticed locations with the occurrence of erosion of the surrounding field and (or) bed load in the road base and pavement drainage structures, special measures for watercourse arrangement shall be foreseen.

If overhead and/or ground installations are identified which obstruct the function of drainage system elements by the type or position thus remaining on the location or with the newly designed elements, proposal of the solution for drainage system upgrade shall have the explanation.

### Requirements of social aspect

Designer shall observe all road elements and contents along the road which can impact the quality of local environment life and to contribute to the upgrade of such quality with own design solutions, within the limits of allowed and possible.

Designer’s task shall be to observe the following in this segment of the service:

* Intensity and flows of pedestrian movements with the analysis of the need and options for constructing pedestrian sidewalks, fences, footbridges, etc.;
* Need for constructing cycling lanes;
* Need for arranging parking areas, i.e. approaches to certain commercial facilities;
* Need for the arrangement, i.e. construction of new bus stops;
* Need for the relocation of installations, i.e. lighting of certain segments on the section;
* Need for arranging public areas along the road reserve;
* Need for the arrangement of access to agricultural fields with the analysis of constructing the trackout pad;
* All other details which can be useful for the local community pursuant to the Designer’s opinion.

When analysing the data, Designer’s obligation is to contact the following interested parties:

* Local self-government(s) of the territory on which the section is located,
* Local bus transporter (bus transporters, taxis, car-transporting organizations, etc.)
* Local relevant utility companies and discuss their opinion regarding the stated issues.

After the analysis of the expressed needs and requirements, the Designer shall:

* In consultations with the Client, implement the requirements of the local community in the design solution in rational and possible volume.
* Discuss about the reasons why it is not possible to implement certain requirements of the local community.

Designer shall make the Report on Social Aspects in which he will show the requirements, proposals and decisions related with the requests of the local community.

### Analysis of traffic safety

When analysing traffic safety, Designer shall implement:

* Analysis of traffic accidents on the observed road and the relevant section,
* Analysis of the opinion of officials (representatives of the MI, supervisors on routine maintenance of roads, inspection, etc.) and road users about the problems regarding traffic safety on the relevant section,
* Check of the elements of the existing road from the aspect of traffic safety pursuant to the principles of safe road design and
* Identification of dangerous locations based on the comparative analysis of objective and subjective risk, i.e. based on the analysis of accidents and opinion on traffic safety and potential measures for improving traffic safety on these dangerous locations.

In the form of the Report on Traffic Safety Analysis and in addition to the existing situation according to the above stated requirements, Designer shall propose the measures which should be applied for risk mitigation regarding the occurrence of traffic accidents related with the previously identified possible measures, together with the analysis of the feasibility of applying the proposed measures (economic evaluation of the feasibility of each individual measure, as well as all measures as a whole). For the needs of economic estimation of measure justification, prices of various types of injuries in traffic accidents shall be used as given in the "Cost Benefit Analysis Manual[[2]](#footnote-3)" which is the product of the project “Assistance to Serbia regarding the Road Infrastructure Planning and Programming” (G2G09/SB/5/2) as a part of the G2G initiative.

Designer shall submit the Report on Traffic Safety Analysis to the Client for approval. The Designer shall incorporate the approved measures for increasing traffic safety in his design solution.

Analysis of traffic accidents shall contain:

* Analysis of the total number and structure of traffic accidents, pursuant to the historical data for the previous 10 years,
* Analysis of the total number and structure of casualties in traffic accidents (killed, heavily and slightly injured), pursuant to the historical data for the previous 10 years,
* Analysis of the trend and forecast of accidents for the upcoming 5-year period;
* Spatial analysis of all accidents and their consequences, as well as a map of traffic accidents with the display of location and the main data on each traffic accident with casualties,
* Spatial analysis of accidents and casualties and
* Analysis of time distribution of traffic accidents and casualties in traffic (monthly distribution during a year, weekly distribution during a year, daily distribution during a week, hourly distribution during a week and hourly distribution during a day).

Basis for the analysis of traffic accidents shall consist of the data on traffic accidents obtained from the Traffic Police Administration, i.e. from the authorized departments for traffic safety of the MI of the Republic of Serbia and the road safety inspection on the location.

For the needs of traffic safety analysis, weighted number of traffic accidents (WNTA) shall be used, i.e. weighting factors based on total socio economic consequences of traffic accidents in Serbia shall be applied. The following weighting factors shall be used:

* 99 for accidents with fatalities,
* 13 for accidents with heavily injured and
* 1 for accidents with slightly injured.

### Analysis of the existing situation

As initial activity in the preparation of technical documents, Designer shall analyse the existing situation of the spatial and physical structure of the road in the road reserve based on the archive data and immediately collected data on the field regarding the geometric characteristics of the road, road bed, pavement structure (bearing capacity, friction, pavement condition (level of damages), accompanying elements of the road (shoulders, berms, slopes), drainage (surface, riparian, underground)), road structures, intersections, access control, safety and traffic technical equipment, environment danger, etc.

In the analysis of the existing situation, Designer shall determine the parameters significant for the road situation and safe traffic on the section of the public road, as follows:

* Elements of cross and longitudinal profile of the road,
* Driving dynamic characteristics of the road,
* Available visibility,
* Deflections,
* Pavement roughness,
* Friction capability of the pavement surface,
* Level of pavement damages,
* Condition of the existing road structures (bridges, retaining walls, culverts, etc.),
* Situation of the drainage system,
* Condition of the road bed and
* Type, thickness and condition of the layers in the superstructure.

Also, attention shall be paid to the following:

* Existing connections and access control,
* Presence of the construction along the edge of the road reserve,
* Accompanying contents along the road,
* Requirements of the local community and road neighbours,
* Existing situation regarding environment and
* Other parameters which can be significant for the preparation of technical documents or are required in the Terms of Reference.

Set parameters describing the existing road situation are expressed in the form which enables quantitative and qualitative analysis. Designer shall compare the found parameters with the set values and determine the deviation of certain elements from the set values.

Analysis of the existing situation shall cover the requirements of the local community as well. It is necessary to observe all road elements and contents along the road which can have impact on the local community. Technical solutions in the design shall be used to eliminate all noticed lacks within the limits of technical and economically justified potentials.

Analysis of the existing situation is the constituent part of the technical documents and it is produced as Book 1.4 (Chapter 4.1). Obligatory part of the survey shall be the graphical representation of the obtained results. As this Terms of Reference requires to produce the analysis of traffic safety and analysis of social aspects as separate documents, only conclusions and final results of these two analyses shall be used in the analysis of the existing situation.

## Final Design for Pavement

Based on the implemented investigations, measurements and analyses from chapter 3.2, traffic load, estimation of fatigue and the remaining life, design of the required measures for pavement rehabilitation shall be produced.

Optimal design solution shall be performed pursuant to the following:

* Analysis of the available documents and evaluation of pavement situation based on the performed exploratory works
* Establishment of at least two applicable design solutions
* Analysis of alternative solutions primarily from the aspect of applicable technology, availability of main materials and construction costs

Relevant climate and hydrologic conditions for pavement dimensioning shall be determined pursuant to the results of researching climate and hydrologic characteristics of the field and spatial position of the section.

Due to significant temperature difference during a year, dimensioning and analysis of pavement fatigue shall be performed by applying the methodology which enables analyses through the division into the minimum of three periods during one year (winter, spring/autumn and summer). For each period in the year, relevant values of certain mechanical properties of materials and layers shall be defined which will be used in the designing of optional pavement solutions.

Reference temperatures for each period in one year shall be adopted pursuant to the measured values of air temperatures on the reference weather station for the previous period of at least 10 years.

Dimensioning of the pavement shall be implemented through adequate empirical and/or theoretical procedures. Some of the acknowledged procedures, relevant for the class and significance of the road, i.e. to the traffic volume and explored qualities of material can be selected for dimensioning. Applied methodology shall be described and explained. Entry data shall be defined.

Client can ask the Designer to check the obtained results by using another methodology. In that case, Designer has no right to any remuneration of costs which might arise from the Client’s requirement.

All proposed solutions of the pavement shall be checked regarding the resistance to harmful effect of frost by using one of the valid and acknowledged procedures.

Valid traffic volume for pavement design shall be calculated based on the data from item 3.2.1 of this Terms of Reference.

The design shall define:

* Required preparatory works on the pavement referring to the repairs of damages or demolition and removal of layers,
* Design thickness of new layers and type of materials and mixtures, minimum and maximum technological thickness for preparing joints and levelling,
* Solutions for the new pavement regarding the widening of the existing pavement with the drawings of typical details of the link of the existing pavement and widening and
* Technical conditions for the construction which will treat all positions and specificities of design solutions.

Designer shall prepare general and special technical conditions for the construction/specifications in the manner described in chapter 3.4.3.

## Final Construction Design

### General requirements

In accordance with the “Methods for road reconstruction design” the geometric optical and driving-dynamic analyses shall be performed. Homogeneous stretchesshall be established, planning and profile elements for preparation of construction design shall be defined, and background for elaboration of traffic signage and equipment design shall be prepared.

Based on this Terms of Reference, geodetic works and pavement structure design, the Final construction design of intensified road maintenance should define:

* elements of site plan, longitudaland cross profile (radii of horizontal and vertical curves, deviation angles, grade and crossfall, and the like), which provide prescribed visibility. When determiningthe elements of site plan, spatial and legislative limitations shall be taken into consideration for the planned type of the intervention;
* geometric designed solutions for pavement rehabilitation (repair of damaged pavement surface, correction of the existing forms of pavement surface, application of final layers, road surface processing, milling and application of new layers, and the like) and present them in adequate scale;
* Road elements outside the settlementsshall be designed for overall design speed of 80 km/h, and in the settlement of 50 km/h
* solution for roadway drainage;
* solution for road base drainage;
* solutions for collection and drainage of rain and seepage water from surrounding terrain,
* levelling solutions for service facilities (connection for other roads, bus-bays, petrol stations and parking lots) on the road reserve of designed section;
* solutionfor remedy of existing culverts and solution for construction of new culverts (if needed), along with all the details and calculations necessary for execution of works.

All solutionsshall be given for the existing road reserve without expropriation of new land parcels. Exceptionally, in case that designed measures necessary for elimination of dangerous spots on microlocations of the section in question require expropriation of new land parcels, i.e. exits outside the existing road reserve, before adoption of final solution, it is necessary the prior approval of the Client is provided.

In accordance with the previous requirement, the elements of site plan and cross-sectionshall be adopted in such a manner so that design solutions should not, by applying them, provoke necessity of land acquisition, i.e. lead to significant disturbance of current situation on the site, unless it comes to solutions resulting from requirements for increased traffic safety.

Cross-section elements (traffic lanes, marginal strips, shoulders, flumes and berms) shall be adopted according to applicable regulations and special requirements provided for in this Terms of Reference.

Upon adoption of plan and profile elements the following provision of the Rulebook on conditions which road structures and other elements of public road shouldfulfilfrom the traffic safety aspect shall be taken into consideration: „Established values of separate elements can be deviated from only in case the technical and economic analyses prove adequacy of different solution and the required level of safety, flow and environmental protection is guaranteed, and in case that the consumption of investment funds is coordinated with the designing procedure".

In case the existing watercourse is foreseen for collection of atmospheric waters, and competent water management institution nonetheless prescribes special conditions, road atmospheric waters shall be previously treated by the interceptor for removal of aggregates, oils and other floating materials in accordance with the regulations governing prescribed values of wastewater quality.

Locations and actual needs for usage of the existing registered bus-bays shall be determined in cooperation with the local self-governance and local passenger transportation company. On all existing bus-bays’ locations which are to be retained, the repair of this bus-bays shall be designed in case they fulfil traffic safety requirements in accordance with applicable regulatory norm. If necessary, the new stops are to be designed outside the carriageway. All bus-bays shall be designed uniformly according to the standard model, if possible.

On stretches where the real necessity for movement of pedestrians exists, the pedestrian communications shall be designed in such a manner that undisturbed and safe connection of pedestrians with roadside facilities is ensured, taking care of length and position of communications so the pedestrians are willing to use them. The need for renewal of existing footpaths should be also reconsidered.

All connections to the road concerned shall be identified, and data shall be displayed in a form of table within a specific annex. The following items are necessary to be defined and displayed:

* chainage of communication's centre line
* position of communication in cross-section (left/right)
* type communication (individual/unclassified road/municipal road)
* whether the communication is located in a settlement
* communication width
* angle of communication, left and right radius
* whether the communication is in conflict with designed solution for widening or dewatering
* whether the communication is cased (yes/no)
* type of surfacing on communication (concrete/asphalt/crushed stone or no surfacing)
* evaluation of communication justifiability (is there a possibility of communication elimination, i.e. relocation of communication)

Detailed Bill of Quantities shall be prepared for all communicationswhich are necessary to be recovered after the intervention provided for in the Design.

Prior to drawing up the technical documents, Designer is obliged to obtain necessary opinions and conditions from the competent institutions. The Terms of Reference shall be compatible with the obtained opinions and conditions.

If the intervention provided for in the Terms of Reference falls within the existing dimensions of the structure and road, it is not necessary to obtain new or additional water conditions, but the Designer acquires the opinion from the competent water management institution. This condition is related to the road itself, the structure, and the regulation of river flow in zone of road or structure as well. This point of view is in line with the Conclusion of the Ministry for Construction, Transport and Infrastructure No. 06-00-00126/2016-03 issued on 09 September 2016 after the meeting held with the MCTI, Water Directorate and the PERS.

Designer is obliged to collect data on existing installations on the road reserve and draw up a synchronous plan in the adequate scale. The installations not retainable on the existing locations, i.e. the ones which need to be relocated due to performance of designed works, shall be identified. Designer shall inform the Client on existence of such installations in writing immediately after their identification.

Designer's obligation is to, after the preparation of technical documentation is completed, obtain all approvals necessary for provision of Certificate of receipt of technical documentation /Building permit, i.e. a document by which the competent ministry approves performance of designed works.

As the process of preparation of the Final Design for Heavy Maintenance also enhances implementation of independent traffic safety audit on the section concerned, Designer's obligation is to make available to the Auditor, and upon the Client’s request, all necessary data, backings and documents in addition to the Final Design, and upon receiving and analyzing the Road Safety Audit Report, to make declaration in writing on Auditor's findings in reasoned and substantiated manner.

Upon making a decision on application of additional measures for improvement of traffic safety provided for in the Road Safety Audit Report, which initially were not envisaged by the Design solution, and reception of written notice of the Client, the Designer corrects, at their own cost, designed solution in accordance with the adopted measures and amends all parts the Final Design for Heavy Maintenance which are influenced by the additional measures.

Within the Final construction design, the Designer shall identify the technology for conducting the designed works, as well as all the other aspects typical for safe performance of works and protection of structures and environment during the execution of works.

When determining the requests for quality of materials used in the process, the special care shall be taken of the quality of the final product, but also of the characteristic of the materials found on the domestic market, and of locality as well, wherever possible, under conditions that the quality of designed solution is not discredited.

Particular account should be taken in course of technology selection process of minimal technical criteria necessary for application of specific technology.

In course of selection process of technology for performance of works, the special attention should be paid to the fact that the works are being performed under traffic on the section concerned.

### Special requirements

All the elements of the cross-section should be adopted after detailed analysis of the existing situation.

Defined values of separate elements can be deviated from only if technical and economic analysis proves justifiability of different solution, as provided for in general requirements for preparation of the Final construction design under the item 3.4.1.

Efficient dewatering/drainage of road and road profile elements shall be provided.

Justifiability of construction of new culverts shall be observed within the intergrated consideration of drainage system.

When required, and within the designed measures for improvement of drainage system, it is necessary to define receiving body, as well as solutions for controlled channeling of water to the receiving body.

For the purpose of increasing the safety of vulnerable traffic participants, actual on-site requirements and position of the international cycle route spanning Europe, the cycle lane should be designed along the sections under the Design.

As a level crossing is situated at the exit from Kikinda, the rehabilitation of carriageway in its zone and/or placement of adequate traffic signalization for its marking should be foreseen if necessary, and depending on conditions provided by the Serbian Railways.

Engineering geological exploratory works and geodetic surveys need to cover all the elements (measures) necessary for designing the road rehabilitation and preparation of accompanying designs/studies through:

* rehabilitation of bridges,
* regulation of river beds/channels,
* rehabilitation of the existing culverts and retaining walls,
* construction of new retaining walls,
* rehabilitation of unstable slopes and declensions,
* road dewatering and channeling to the receiving body,
* interchange reconstructions
* construction/reconstruction of cycling paths, and
* construction/reconstruction of sidewalks.

Special requirements from the aspect of geometry:

* In accordance with the regulations, the cycling pathsshall be designed within the road reserve of the state road sections concerned,
* In the designing stage the existing and planned works shall be taken into consideration, as well as existing and planned design documentation, so that all the stages of technical documents’ prodution could be harmonized,
* In case of designing the improvement of geometric road elements (horizontal and vertical geometry) the goal shall be the maximum homogenization of roadway, so that after the rehabilitation more favorable and safer driving conditions are achieved.

Special requirements from the aspect of carriageway:

* Depending of the time of intervention, the pavement surfaces give different impression of degradation, butall types of damaged low-volume roads generally exist. Accordingly, the existing conditions on pavement structure shall be carefully analysed and adequate measures for pavement rehabilitation per homogeneous sections should be foreseen. The final decision on type and scope of intervention on the pavement structure is made by the Client, based on assessment and ranking of designing alternatives.
* Due to small surface of damages which indicate degraded subgrade and road pavement foundation, their rehabilitation shall be foreseen in order to avoid occurrence of cracks reflection in the design period.

Special requirements from the aspect of dewatering:

* Due to the low-rise embankment dominating on longer part of the section, rainwater collection canals shall be foreseen along the entire roadway, because the existing ones are mostly aligned with the surrounding terrain.
* At the intersections with the local roads, factory access roads and bus-bays, and because of small finished level gradient and road edges, the technically and economically justified dewatering solution shall be proposed.

### Bill of Quantities

Bill of Quantities should provide all relevant information for observation of the scope of works and to enable efficient and correct constitution of tender for performance of works.

Bill of Quantities is produced in a form of table.

Position of items of works in the BoQ should be organized in such a manner so that the division into specific groups and subgroups of works per location/section is clearly displayed. Form and content of the BoQshall be clear, descriptive and simple.

Every work under the Design shall be included in the items of works of the BoQ.

BoQ shall be given separately for five different phases of performance of works. In the first phase the construction of cycling path on the section no. 01518 shall be anticipated. The second phase shall anticipate the works on carriageway rehabilitation and construction of cycling path on the section no. 01517. The third phase shall anticipate the works on carriageway rehabilitation and construction of cycling path on the section no. 01516. The fourth phase shall anticipate the works on carriageway rehabilitation on the section no. 01518. In the fifth phase the works on rehabilitation of intersection at the starting point of the section shall be anticipated.

## Final Design for Structure

The actual number, type and state of the existing culverts, bridges and retaining walls shall be determined by the Designer.

Based on analysis of state of the existing culverts and bridges and observation of other relevant parameters, the Designer establishes the necessity of interventions on the existing structures (repair, reconstruction, construction of new structure).

For every engineering structure which reflects the necessity of any kind of intervention, the Designer shall prepare specific designed solution containing all necessary details needed for smooth execution of works. The Bill of Quantities shall be enclosedwithin the solution, and every item of works shall be clearly displayed under the Technical conditions.

The Designer is obliged to:

* Perform detailed geodetic survey of the structure and structure zone;
* Prepare the site plan of the location together with the topographic data, longitudal profile and cross-section in adequate proportion. Cross-sections on the structures shall be recorded at the maximum distance of 2 m.
* Record the existence of installations on structures and structures' zone, and plot their positions;
* Perform detailed inspection of the structure and record damages on every bridge element, and provide evaluation of state of elements and bridges based on this inspection.
* Perform sampling from carriageway and concrete, and carry out other investigation works deemed necessary for the purpose of determination the state and bearing capacity of the structure.

Based on results obtaindfrom previous activities, the Designer provides technical solution for interventions on bridges.

The designed solution shall cover the following:

* Repair of structural bridge elements, if necessary;
* Repair of all damaged concrete surfaces, including sand blasting and corrosion inhibiting protection of reinforcement;
* Waterproofing;
* Repair or replacement of existing safety and pedestrian barrier fence;
* Replacement of damaged and placement of new curbs;
* Making of footpaths;
* Technical solution for bridge drainage system;
* All the other measures necessary for efficient and safe functioning of the structure.

Width of carriageway and paths of the bridge (traffic profile) should be aligned with the designed solution for traffic profile of the road section concerned.

In case the bridge is not sufficiently wide, the Designer is obliged to provide preliminary design for bridge widening, accompanied with the adequate Bill of Quantities, economic justifiability of investments, and to submit it to the Client for review so that the Client could decide on necessity of bridge widening. The subject of this Design is not bridge widening.

Geometric characteristics of road on accesses to the bridge shall be in line with the geometry of the designed structure.

Static calculations required by the positive regulations for designed intervention on the bridge shall be performed.

Adequate measures for surface protection of parts of the bridge exposed to atmospheric and other aggressive influencesshall be anticipated.

Within the technical documents, the solution for dewatering which will enable efficient and controlled channeling of atmospheric waters in accordance with the relevant regulations shall be foreseen. In order to acquire a full safety of the existing bridge, inspection of hydraulic capacity according to the criteria stipulated in the Water Management Master Plan (Official Gazette of the RS, No. 11/2002) shall be performed.

In case the existing watercourse is foreseen for collection of atmospheric waters, road atmospheric waters shall be previously treated by the interceptor for removal of aggregates, oils and other floating materials, depending on conditions prescribed by the competent institution. The quality of the atmospheric water released in the existing watercourse shall be in line with the Regulations on watercourse cathegorization and water classification („Official Gazette of the RS, No. 5/68).

The Final Design of the structure shall imperatively include separate Bill of Quantities of all designed works.

Separate Bill of Quantities must be included in the General BoQ.

## Final Design for Traffic Signals and Equipement

### General requirements

Based on inspection of the respective state road section, the actual state of spatial and physical structure of the road reserve shall be established, as well as other elements significant for the traffic safety.

The Designer of traffic signals and equipment shall assume from the Designer of the structure completed backings and performe review of solutions relating:

* driving-dynamic and visual roadway characteristics,
* maximum speed of vehicles in curves,
* mutual harmonization of the roadway elements and their dynamic homogenity,
* traffic safety for every participant, and
* identification of required stopping sight distance, available and overtaking sight distance, and the like.

Upon designing all interventions foreseen in the construction design, as well as solutions arising form traffic safety analysis, shall be taken into account.

Within preparation of the Final Design for Traffic Signals and Equipment, the Designer shall anticipate and cover all necessary solutions considering road markings and vertical traffic signage (traffic signs, their supporting poles, construction of supportings and foundation calculation) and road equipment.

Installation of rigid elements along the road lacking adequate protection is not allowed. Locations allowing greater speed of vehicles require designing of equipment installed within road reserve, such as lightning poles, structures' poles and other, in accordance with the standard SRPS-EN 12767. In case of limited space on shoulders (inability of installation of guard rail systems), it s necessary to anticipate the usage of barriers with high degree of impact mitigation.

The special emphasize is to be put on the traffic signal elements and equipment, such as: protective-resistant fence for vehicles, signpost, and the like, which shall be designed in compliance with the applicable SRPS-EN standards.

Proposed traffic solution and proposed traffic signals and equipment must be consistent with the rank of the respective road. Dimensions, quality of material and durability of traffic signals and equipment must also be consistent with the rank of the respective road, and based upon the SRPS-EN standards and applicable Rulebook on traffic signage ("Official Gazette of the RS" No. 134/2014).

Proposed solution for traffic management systems and direction-posts systems should enable efficient and safe traffic on the state road with obligatory use of inscription indicating number of international and state road.

In case of proposition of usage of signal and equipment elements not covered by the Serbian standards, the Designer shall substantiate the proposition in writing and identify the relevant legal provisions enabling such usage in order to provide consent of the Client. The usage of these elements shalbe limited and appropriate.

Statical calculation of wind load on traffic sign structure, including calculation of number and type of posts, post supports and foundation,shall be performed for traffic signs, signposts and tourist signs. The statical calculation shall be performed by the person (responsible Designer) qualified for this kind of work.

The layout of traffic signals and equipment given in the Final Design shall be displayed through graphical enclosures including chainage and levels necessary for positioning and placement/installation of signage and equipment in the field.Chainage of the traffic signals, elements and equipment shall be consistent with the Construction part of the Design.

The Final Design on traffic signage and equipment shall not include alternative/different solutions.

End treatments of protective devices shall be designed as oblique endings on both sides. End treatments of protective devices (guardrails) are to be designed laterally turned in relation to the road edge. In locations where such an activity cannot be performed, the protective devices are to be constructed with the adequate end treatments to mitigate as much as possible the consequences of hypothetical vehicle impact. If application of protective devices of different levels of vehicle restraining in continuous sequences is necessary, the adequate transitional structures shall be anticipated.

The Designer shall substantiate specific solutions within the Technical Report. The Technical Report shall include:

* description of location, the most important characteristics and description of proposed traffic solution,
* description of proposed elements of traffic signage and equipment, and
* other data and explanations given by the Designer which are important for considered and proposed traffic solution.

The Final Design for Traffic Signals and Equipment shall include the Bill of Quantities. The items of dismantling of the existing elements of traffic signals and equipment which do not comply with the designed solution and are necessary to be removed shall be displayed separately in the BoQ. The real unit market prices shall be used in preparation of the BoQ.

For the standardized elements of the traffic signals, the designations given in Serbian standards shall be used.

Every description of items shall be referred to in specifications, and clearly defined and compatible with details given in drawings. The same items of works shall not be differently described at different places in the Design, i.e. the data given in the BoQ, specifications and drawings need to be identical.

The contents supporing high-quality and precise installation of proposed signals and equipment shall be displayed within the annex given in the details of the Final Design. Graphic presentations and drawings of details shall be processed as magnifiers, in a proportion adequate for this type of display.

Details of the Final Design shall also include all the elements enabling production of traffic signals for directioning the road user (signpost and tourist’s signals), and on the level of so called shop drawings.

All the relevant technical details and descriptions enabling ordering of signals and equipment shall be displayed in specifications without favoring individual manufacturers and their products.

### Special requirements

Besides the general requirements, the following special requirements are also applied:

* Measures for improvement of traffic safety shall be defined having regard to the volume and structure of traffic flows on the sections;
* Analyze visibility triangles on intersections and communications which need to be regulated by the Design, and design priority road signs, as well as adequate remaining traffic signals and equipment, accordingly;
* Precisely define boundaries of settlements on the respective section based on spatial, i.e. urban plan of the municipality and the existing designs. Accordingly, traffic signals and equipment in zone of the settlement shall be designed;
* Access and exit zones of horizontal curves and structures (bridges and culverts), in cases where the Designer deems it necessary, shall be treated with the protective devices of appropriate characteristics and lengths, while bearing in mind possibility of glitter ice occurrence in these zones;
* On dangerous spots, identified based on traffic safety analysis, the traffic signs with fluorescent backgrounds shall be designed;
* On sections with slippery pavement, i.e. sections with potential risk from glitter ice formation, the adequate traffic signals and equipment shall be anticipated. The use of variable traffic signage on these sections shall be taken into consideration;
* Visibility of horizontal and vertical curves shall be improved in cases where it is deemed justified and possible;
* Based on actual site situation, the pedestrian communications shall be regulated and footpaths along section shall to be anticipated, especially in the settlements and zones of bus-bays;
* Possibilities and needs shall be considered, and pedestrian islands on locations where pedestrian crossing are foreseen shall be anticipated;
* When preparing the designed solution,the cycling route which represents the subject of the Design shall be elaborated;
* Bus-bays shall be designed out of the carriageway with developed pedestrian communications to and from bus-bay. Functionality of the existing baysshall be inspected, and appropriate measures harmonized with the traffic safety requirements shall be anticipated;
* Structures located at an unsafe distance from road edge (lightning poles, trees, lattice sign supporters, poles with overhead installationsitd.) shall be provided with the protective devices of appropriate protection degree;
* Within the designed solution, proposals for regulation of all communication on the stretch of road classified as hazardous from the aspect of traffic safety shall be given.

## Design for traffic regulation during performance of works

Design for temporary traffic signage and equipment shall anticipate specific organization and traffic regulation on road sections where normal traffic flow is occassionalydisturbed due to execution of works.

Proposed solutions for temporary traffic signals and equipment should be in rank with the road route and provide undisturbed and safe traffic flow on a road section under works, as well as guarantee full safety for all traffic participants and workers in zone of works. Designed solution for traffic regulation during the execution of works shall consider traffic volume and spatial and time distribution of traffic flows on the repectivesection.

The special attention during the preparation of the design for traffic signalswhile the works are being performed shall be paid to vulnerable traffic participants and accessibility of roadside facilities.

Plans concerning traffic regulation shall be made based on scope and significance of works because of which a partial carriageway closure needs to be performed, with special treatments of intersection zones, structures, individual communications and safeguard of pedestrian movements. On locations under partial carriageway closures, where narrowed part dissables introduction of bidirectional movement of vehicles, it is necessary to anticipate the alternate movement of vehicles. On these locations the alternate movement of vehicles shall be anticipated together with traffic light signals (traffic lights), and alternatively, manually with use of flags.

Dimensioning of parameters of signaling planon alternate movement of vehicles regulated by the light signals (traffic lights) shall be performed in accordance with conditions of traffic flow, so that the time losses are acceptable. Several signaling plans shall be defined as per time unevenness of traffic flow on the respective section.

Prepared plan on traffic regulation shall include site plan on traffic signals on the respective road section concerned in the standard form, in appropriate proportion with analysis of impact of works on road permeability and increased travel time due to narrowing or partial closure to traffic. The spatial plan should include the existing traffic signage and method of its treatment in accordance with the designed solution.

On the part where works on widening of the existing pavementare performed and where the difference between the level of excavation and level of the existing asphalt endangers traffic safety, the placement of the adequate equipment (vertical barriers, concrete barriers, and etcetera) shall be anticipated.

The following standard solutions for specific situations in traffic which can be observed and singled out as special are the following:

* On the open road section, with width less than 5.5 m, covered by the traffic lights and, alternatively, manually with use flags;
* In wider zone around intersections, with maximum width of works of 150 m, manually regulated by flags;
* In immediate zone of intersection under works, manually regulated by flags;
* In zone of structure on road under traffic lights; and
* On open road section in the zone of works, more than 5.5 m wide, with partial closure of traffic lane or for works performed beside the carriageway.

In cases where standard solutions for traffic regulation are not applicable or in case of closure of road to traffic, the plan on traffic regulation in these circumstances shall be prepared.

If the technology as such requires traffic closure on the respective road during the performance of works, the Designer shall:

* Anticipate the regime of traffic closure during the performance of works,
* if planned regime of traffic closure requires it, the alternative road routes for vehicle redirection shall be anticipated,
* obtain conditions from the road route manager for the alternative road routes for vehicle redirection,
* prepare the project on traffic management during the peprformance of works, and
* obtain consent on this project from the Client;

In case the alternative road routs need to be defined, the Designer shall use to the fullest extent the state road network for channeling traffic to the adequate destinations.

The special attention shall be paid to placement of road signs for traffic directioning during the execution of works.

Depending on technology of performance of works and proposed designed solution, the adequate quantities of traffic signals and equipment necessary during the execution of works shall be anticipated and designed.

For road works marking, especially by night and under reduced visibility conditions (fog, dust, rain, and the like), yellow blinkers and flashing lightsshall be anticipated. On road parts with temporary lack of road markings due to applied technology (asphalt milling), the adequate temporary road markings necessary for safe channeling of traffic flows shall be anticipated.

The width of traffic lanes shall be anticipated for purposes of speed limiting during the perfomance of works on the section.

The designed solutions shall be prepared in concordance with applicable standards and "Technical manual for marking of zone of maintenance works on the state roads of the Republic of Serbia", Belgrade 2016. Utilization of this source and consultations with the Client do not liberate the Designer from responsibility concerning the quality of designed solutions.

The characteristics of the vertical signalization elements are to be applied in compliance with the applicable SRPS-EN standards. Materials used for manufacturing of traffic signs are to contain retroreflective properties anticipated by the Rulebook on traffic signage ("Official Gazette of the RS" No. 134/2014) relating road rank.

In case the road elements not covered by the Serbian standards are proposed, the Designer shall explain the suggestion in writing and identify relevant legal provisions which enable usage of such elemnts in order to obtain the Client's consent.

For non-standardized traffic signs and signposts the statical calculationof wind load on traffic sign structure, including calculation of number and type of posts, post supports and foundation, shall be performed. The statical calculation shall be performed by the person (responsible Designer) qualified for this kind of work.

The Technical Report, besides description of problem, limitation, description of proposed solution, traffic and technical calculations and expected effects on the section, shall also include locations' descritptions which demand special treatments from the traffic safety aspect (school zones, bus-bays, location with higher intensity of pedestrian flows, etcetera).

Within the enclosures given in Detalsthe elements harmonized with the defined installation methods supporting high-quality and precise installation of proposed signals and equipment shall be displayed. Graphic representations and drawings of details shall be processed as magnifiers, in adequate proportion for such displays.

Witnih the enclosures containg measures for safety at work, the existing and potential risks likely to occur during the perfomance of works on placement of traffic signals and equipment and road usage shall be identified. The adequate measures implemented for purpose of risk identification are to be proposed based on this identification.

# Content, processing and submission of technical documentation

## Content of technical documentation

Design technical documentationshall include all relevant documents and chapters required the applicable legislation.

Content of the Technical Documentation shall be structured in the following manner:

* Book 1: Final construction design on heavy road maintenance
* Volume 1.1: General documentation
* Volume 1.2: Textual documentation
* Volume 1.3: Numerical documentation
* Volume 1.4: Graphic documentation
* Volume 1.5: Analysis of the current situation
* Book 2: Final designfor geodetic works
* Book 3: Study on engineering-geological and geotechnical investigations
* Book 4: Final design for pavement structure
* Book 5: Final design for the structure
* Book 6: Final design for traffic signals and equipment
* Book 7:Report on traffic safety analysis
* Book 8: Design for regulation of traffic during performance of works

In accordance with the applicable legislation, and within each separate book of technical documentation, the mandatory general documentation (licences, declarations, certificates, and the like), terms of reference/excerpt, technical report, study on safety at work complied with the requirements defined in Serbian legislation, numerical documentation (adequate calculations, results of analyses and calculations, schemes, specification of materials), separate and cumulativeBoQ, drawings and details necessary for high-quality performance of works shall be enclosed.

Every drawing, i.e. graphical representation, given in lower right angel, includes table displaying:

1) Employers name;

3) Name of enterpreneur, i.e. legal entity that has prepared the respective design;

4) Indication of type of technical documentation;

5) Indication and name of the part of design;

6) Title of drawing or graphical representation;

7) Scale;

8) First name, last name and number of licence of responsible Designer;

9) Number of drawing;

10) Date of drawing

11) Registry of changes, amendments and revisions of drawings

In addition to usual requirements relating content of certain books of technical documentation, the Designer shall also satisfy specific requests cited in this Terms of Reference.

Within Volume 1.1, amongst other things, the following is to be enclosed:

* General data on design organization
* Decision on appointment of responsible designers
* Declaration of responsible designers
* Certification of design organization of documentation regularity
* Terms of Reference
* Design conditions and consent of competent enterprises
* Final report on Technical Control of documentation

Within Volume 1.2, amongst other things, the following is to be enclosed:

* Technical report thoroughly explaining the designed solution. The Technical report shall include Excerpts provided by all responsible Designers
* Results of previous investigations
* Consolidated technical conditions for construction/specifications according to items given in Bill of Quantities and group of works
* General Bill of Quantities, covering a summary of all separate Bills of Quantities from each Book
* Individual Bill of Quantities
* Textual enclosures important for construction of structure. i.e. works execution

Within Volume 1.3, amongst other things, the following is to be enclosed:

* List of coordinates of points of operating traverse
* List of coordinates of detailed points of centre line
* Elements for staked centre line

Within Volume 1.4, amongst other things, the following is to be enclosed:

* Descriptive site plan (general map), scale 1:25000
* Site plan with displayed boundaries of road reserve area, scale 1:1000
* Site plan with displayed installations and facilities on road reserve, scale 1:500
* Site plan of newly designed state, scale 1:1000
* Longitudinal profile, scale 1:100/1000
* Standard cross-section, scale 1:50
* Leveling plan for sections in the settlements, scale 1:500
* Details of pavement structure
* Details of cycling path
* Details of elements of plan and profile (curns, flumes, trench drain, etcetera)
* Drainage details
* Utility installation details
* Details of access roads, scale 1:500
* Levelling solution for intersections with access joints cross-section, scale 1:250
* Details of separate access joints
* Type of bus stop
* Levelling solutions for matching of existing purposes with carriageway in the stretch R=1:250.
* Characteristic cross-section, scale 1:100, carriageway 1:100/20

Within Volume 1.5, amongst other things, the following is to be enclosed:

* Graphic representation of road surface distress (PCI)
* Graphic representation of longitudal and cross evenness
* Graphic representation of friction capacity of road surface
* Graphic representation of division into homogeneous sections
* Graphic representation of values of layer elasticity modules of the existing pavement structure

Within Book 2, amongst other things, the following is to be enclosed:

* Disposition of points of operating traverse on maps in suitable scale with marked connections for basic state network, and position of elevation network along the roadway as well
* Spreadsheet with basic positional and elevation network provided by the authorized company (geodetic organization).
* Description of position and operating traverse’s point stabilization mode, as well as given elevation points – bench marks (trigonometric form 27)
* Data on levelling of operating traverse with all data falling within the levelling
* General levelling book with linking to existing elevation network
* Spreadsheet with coordinates and operating traverse levels
* Spreadsheet with data for transfer of design centre line to the field (elementary points of curve, hectometers)
* Situacioniprikaz of road reserve boundaries
* Study on occupancy records

Within Book 4, amongst other things, the following is to be enclosed:

* Results and analysis of the results of inspection conducted on the existing pavement structure
* Description of method applied for dimensioning of pavement structure
* Rationale of choice of method
* Details of pavement structure

Within Book 5 the following shall be enclosed:

* Analysis of the actual state and report on detailed structure inspection and investigation works
* Textual documentation of the bridge rehabilitation project (Technical report, Technical conditions for construction, Bill of Quantities, Description of Technology of works execution, Statical calculation – numerical control of a bearing capacity of the existing bridge structure and necessary calculations for all new elements of span and supporting bridge structure, conclusion on bearing capacity, usability and duration of bridge structure),
* Graphic documentation – disposition of the actual state of the bridge (site plan, bridge base, bridge appearance, standard bridge section, longitudal section, cross-sections, foundation base),
* Graphic documentation – layout drawings with distress displayed, and with elements under intervention with description of bridge rehabilitation works,
* Graphic documentation on design for bridge rehabilitation (site plan, bridge base, bridge appearance, standardcross-section, longitudal section, cross-sections, details of elements under intervention and novelties regarding actual state, rehabilitation details, reinforcing details and bending schedule, material specification)
* Design on watercourse regulation
* Program on inspection of bridge with load test

Within Book 6, besides annex foreseen by the Rulebook on traffic signage, the following shall be enclosed:

* Description of problems
* Limitations
* Description of solution proposed
* Technical calculations
* Necessary detailed drawing.

Within Book 7, amongst other things, the following is to be enclosed:

* Analysis of traffic accident on the respective road,
* Traffic safety check,
* Feasibility study of proposed measures for solving observed problems relating traffic safety (economic evaluation of justifiability of certain measures, i.e measures in whole)

Within Book 8 traffic calculations and analyses and other documentation in accordance with the Rulebook on traffic safety shall be enclosed.

## Processing and submission of technical documentation

The Final Design for Heavy Miantenancecertified by the Technical Control (technical documentation) shall be prepared, packed and submitted to the Client in printed and digital form, containing adequate textual, graphical and numerical enclosures.

The Technical Documentation shall be prepared in Serbian and English.

The Technical Documentation shall be submitted to the Client in 6 (six) copies together with the letter, which besides basic information on the Design and Designer, shall also include contract identification. Copy includes printed version of the Design and digital version written on the CD of adequate capacity.

When processing the technical documentation the following should be adhered to:

* The digital version of the technical documentation shall include all source files (unprotected electronic documents in a format of program used for preparation and processing) and unprotected PDF format. Both electronic forms shall be identical,
* The digital version of the technical documentation shall be fully harmonized with the printed version,
* Text of the technical documentation shall be written in UNICODE font. Use of YUTTF fonts is not allowed,
* For processing of documents (text, graph, vector, raster) widely spread and available commercial programs (such as applications from MS Office package, Auto CAD, and the like) shall be used. Format of these electronic documents shall be compatible with the older versions of these programs,
* In case the Designer uses unconventional programs unavailable to the Client for document processing, they are obliged, by previously reaching an agreement with the Client, to convert documents to formats the Client disposes of before final processing of the technical documentation,
* Electronic documents shall be designated according to design content, logically and in full name or associatively, if the full name requires usage of large number of characters. Title of document shall be written in Latin characters. The title shall not contain special characters or letters specific to Serbian alphabet. It is not allowed to name the document in Cyrillic,
* Documents with content written in English are titled in English language, with content written in Serbian are titled in Serbian language, and bilingual documents are titled in Serbian with unique postfix code SE for bilingualism,
* On the cover of the electronic medium (disc), used for storage of electronic documents, the Designer’s name, name of the technical documentation and date being actually a month in which the certification of the Design was performed by the Technical Control, shall be entered. Text given on the cover is imprinted. Additionally, on the electronic medium (disc) itself the names of the Technical Documents and the Designer shall be legibly printed,
* Textual parts of the Design shall be processed, printed and bound in A4 format,
* Graphical enclosures shall be processed and printed in adequate A1/A3 format, and bound in A4 format, and
* Printed copies shall be put in hardcover, bound, signed and sealed properly.

# Control of preparation of the Final Design for Heavy Miantenance

Preparation ofthe Final Design for Heavy Miantenanceis continually monitored and controlled by the Client via its nominated representative.

The Final Design for Heavy Miantenanceis subjected to the following external controls:

* Traffic Safety Audit,
* Technical Control.

The Traffic Safety Audit is performed in accordance with the Article 156 of the Law on Traffic Safety:

* The Design is subject to audit from the traffic safety aspect. The Traffic Safety Audit is performed after the preparation of the Final Design, and before the Technical Control,
* The Client informs the Designer on nominated Auditor. The Designer is obliged to cooperate with the Auditor,
* The Designer observes the audit report and provides reasoned opinion to all audit findings,
* The Client instructs the Designer to include audit findings in the respective Technical documentation, and
* The Designer is not entitled to compensation in respect of labor costs resulting from Traffic Safety Audit findings, and overall activities relating design amendments made in connection with the Audit will be deemed to be included in a contract price.

In accordance with the Law, the Final Design for Heavy Maintenance is subject to Technical Control. As the Technical Control of the Design will also be performed during the preparation of the Final Design, the Designer is obliged to deliver to the Performer of the technical control at their request all necessary data, backgrounds, information and explanations. The Client informs the Designer on nominated Performer of technical control.

The Technical Documentation including incorporated agreed measures resulting from the Trtaffic Safety Audit is also a subject of (final) technical control of the Design. Final Report of the Technical Control will constitute a part of the Book 1.1.

The Designer is not entitled to the compensation in respect of labor costs resulting from the Technical Control and overall activities relating design amendments made in connection with the Audit will be deemed to be included in a contract price.

1. <http://www.putevi-srbije.rs/index.php/brojanje-saobraćaja> [↑](#footnote-ref-2)
2. http://www.putevi-srbije.rs/images/pdf/strategija/Prirucnik\_za\_analizu\_troskova\_i\_koristi.pdf [↑](#footnote-ref-3)