VOLUME 3

TECHNICAL SPECIFICATIONS

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

Ref.no. VI-84/1

VOLUME 3.1

TECHNICAL SPECIFICATIONS

Dual-use lane along Begej canal Section I Žitište and Facilities

TECHNICAL DESCRIPTION

The building permit design for a dual-purpose lane along the Begej Canal from the Romania-Serbia border to the hydro complex Klek - in the territory of Žitište municipality

INVESTOR:	PWMC VODE VOJVODINE Novi Sad, Bulevar Mihajla Pupina No. 25
DESIGN ORGANISATION:	AD "VOJVODINAPROJEKT" Bulevar Kralja Petra I No. 17, Novi Sad
RESPONSIBLE DESIGNER:	Aleksandar B. Marković, M.Sc.C.E. 315 I724 10

INTRODUCTION

The scope of design is the construction of a dual-purpose lane from the Serbia-Romania state border to the settlement Klek, i.e. to fit into the existing bike lane on Sava Kovačević Street.

The lane is planned to be used for smaller vehicles when reviewing or inspecting this section, as well as for machinery whose axle load does not exceed 5t. This lane will also be used for cycling purposes.

This design documentation deals with the section on the territory of Žitište municipality, in the length of 26164.71 m. The lane is located along the crown of the Begej river protective embankment. The start of the lane is on the right bank of the Begej river (continuation of the lane from Romania). At the intersection with state road IIA class road No. 104, through the settlement of Srpski Itebej, the lane descends towards Begej and passes under the bridge on the said road. Returning to the crown of the protective embankment, the lane intersects with a bridge on a local road, where, across the bridge, it crosses to the left bank of the Begej. Maintaining its position on the left bank of the Begei it intersects in the settlement of Torak with the state road IIA class road No. 118 and in Žitište with the state road of the IB class road No. 12. At the intersections, the lane "descend" below the existing bridges.

Design Bases
Location requirements No. ROP-ZIT-18550-LOC-1/2019 dated 13 July 2019
Investor's Terms of Reference
Updated geodetic bases-integrated KTP
Arrangements with Investor's representatives

DESCRIPTION OF FUNCTIONAL AND TECHNICAL SOLUTIONS

Terms of Reference envisage the construction of a dual-purpose lane from the Serbia-Romania state border to the settlement Klek, i.e. to fit into the existing bike lane on Sava Kovačević Street.

This design documentation defines the part located in the territory of Žitište municipality in the length of 26 164.74 m.

The dual-purpose lane is 2.0 meters wide with a reinforced stone shoulder on the higher side of the lane. At points where the stone shoulder is higher than the existing terrain, it shall be 0.5 meters wide, whereas in the lane cuts it shall be less wide due to the planned material of the embankment crown, which takes over and covers the eventual need for traffic.

The preliminary solution considered the possibility of constructing a rest area along the route. The small width of the embankment crown does not allow for the construction of a rest area, i.e. it requires interventions on the construction of the embankment extension and potentially construction of special structures. Under the given conditions, this is not realistic.

-Route of the future lane along the embankment -

The cross slope of the lane is 2% and directed towards the unprotected area.

At a chainage of approximately 5+590 km, the lane "descends" under the existing bridge on state road II A class road No. 104.

At a chainage of approximately 8+360 km, the lane “ascends” to the existing local road and crosses to the other side-left, of the embankment.

At a chainage of approximately 16+140 km, the lane "descends" under the existing bridge on state road II A class road No. 118.

At a chainage of approximately 21+300 km, the lane "descends" under the existing bridge on state road I BA class road No. 12.

The descents below the bridges are presented and enclosed in this documentation.

Securing a bike lane at points of passage under bridges

The newly designed bike lane, in the area of bridges near Srpski Itebej on the road to Međa, in the settlements of Torak and Žitište, descends from the crown of the embankment, down the embankment, to the banke of the Begej river and runs along the existing lane under the bridges. The existing lane below the bridges is made of earthen material and 2.5 to 3 meters wide. The slope of the lane in the bridge area is secured by a stone lining under 1:1 steep slope, laid from the bottom of the Begej to the crown of the lane. The stone lining is overgrown with grass and shrubbery, and in some places it has collapsed, mostly at the very top. In the settlement of Žitište, the stone lining has collapsed along the entire width of the bridge, and is secured by concrete and concrete steps.

The securing of the right edge of the pavement structure of the pedestrian lane, towards the river Begej, is provided by a reinforced concrete structure composed of a retaining 60 cm high wall and by a base plate t = 15 cm extending over the entire width of the lane. The reinforced concrete structure is made of MB30 concrete, and is reinforced with ribbed and mesh reinforcement. The lengths of concrete structures below the bridges are:

the Bridge Novi Itebej, km 5 + 580, length of the structure with fence Lk=44.05 m

the Bridge Begejci, km 16+140, length of the structure with fence Lk=43.91 m

the Bridge Žitište, km 21+300, length of the structure with fence Lk=41.88 m

Total Lku=129.84 m^1

An embankment made of crushed stone material 0/31.5 mm will be constructed over the slab, and than a pavement structure of asphalt layers shall be provided over it. A fence for cyclists is foreseen on the retaining wall in accordance with SRPS U.S4.112

The area between the existing stone lining and the retaining wall is closed by a stone lining filled with cement mortar 1:3, and the connection between the existing and new lining is by means of a concrete beam.

- passage under the bridge -

At the chainage km 21+338.76 to chainage km 22+182.80 (844.04 m), the line overlaps with the existing lane made of interlock pavers in use. This solution was a forced one due to geometric constraints, that is, the inhabitants of Žitište use this area as a public beach.

- existing footpath in Žitište -

CROSSING WITH INSTALLATIONS

According to the data from the competent cadastral institution, there are no crossings with underground installations at the heights of the works range, on this section. The route intersects with PTT installations at the crossing points below the bridges, but the installations are placed on the bridge structure, i.e. not in the level of the lane. Water management facilities along the route are at a greater depth and are not in conflict with the works on the construction of the lane.

At the chainage of km 0+200 an observation post was registered in the embankment crown. At the chainage of km 2+110, an anti-hail protection station was registered, which will be relocated to a new location. Relocation studies are not included in this documentation.

On the route, lateral traffic connections for various purposes (in the function of ship lock, anti-hail protection station, etc.) were recorded. For each connection, a standard barrier is foreseen, which is defined and accounted for in the design section related to traffic.

GEOMECHANICAL PROPERTIES OF MATERIALS ON THE LANE ROUTE

Field exploration and laboratory analysis of samples were performed, based on which the Geomechanical Study was prepared (enclosed). Twenty-eight (28) drilling pits were constructed and subsequently additional explorations were made by shallow excavations (up to 0.4m), all in 2019. The test results are presented in tables, and here are highlighted indications that influence the selection of pavement structure and the manner of defining the elevations of surfacing (finished level).

The Study has found that the humus layer thickness is 0.2 m. Below the humus layer there is sandy-clay dust material of yellowish-brown colour, up to the depth of exploration (body of the embankment).

Groundwater has not been registered.

Such results, according to the calcu.ated structure thickness of 33 cm, require the placement of a finished level at such elevation spot that the bedding layer is NOT on the humus layer. Pursuant to the requirements for the correct geometric shape of the level, there is an inevitable need to enter the body of the embankment for more than 20 cm in places where humus layer is of a greater thickness. Also, in places where there is a need for filling under the bedding layer, it is foreseen to first remove the humus layer and then to backfill it with selected material from the excavation. In this way, the embankment crown is brought to the geometrically required shape for laying the lane, without compromising the basic function of the embankment.

According to the results of the Geomechanical Study, the requirements of the Terms of Reference, and the general consideration of the problem, there is a need to ban the use of vehicles and machines with a load greater than 5 (five) tons per axle. During the execution of works, 50% higher loads than the one mentioned above may be allowed.

WATER REGIME OF THE NAVIGABLE BEGEJ RIVER

Begej belongs to the Danube basin, the Tisza sub-basin and the Danube river basin district.

Two water regimes on the Begej Canal are characteristic:

since 20 March to 20 December

For Section I:	maximum water level	77.70 m a.s.l.
	minimum water level	74.10 m a.s.l.

since 20 December to 20 March

For Section I:	maximum water level	77.20 m a.s.l.
	minimum water level	74.20 m a.s.l.
	operating water level	74.70 – 77.70 m a.s.l.
	operating water level	74.40 – 74.60 m a.s.l.

Overview of bike lane elevations and high water elevation below bridges

	State road	Place	Lane chainage	Spot elevation of bike lane	KVV
Bridge No. 1	II A 104	Novi Itebej	5+587	80.60	80.41
Bridge No. 2	Local road	Srpski Itebej	8+527	Over the bridge	
Bridge No. 3	II A 118	Torak (Begejci)	16+146	78.30	78.71
Bridge No. 4	I B 12	Žitište	21+299	77.30	78.12

The requirements of PWMC VODE VOJVODINE specifically list the water facilities over which the two-purpose lane is running. The facilities are listed according to the chainages of Begej Canal. Water requirements were issued under No. II-1120/2 -19 dated 04/10/2019.

OVERVIEW OF WORK METHOD STATEMENT

The dual-purpose lane is designed along the crown of the Begej Canal protection embankment, on the right side(L=8500 m) and on the left side (L=17 300m). The lane is located approximately in the middle of the embankment crown. Execution of works involves excavation of a humus layer (20cm), construction of a stabilized layer of soil material under the bedding in the thickness of 20 cm, backfilling of crushed stone material with a minimum thickness of 10 cm with rolling up to the required compaction and construction of asphalt layer of BNHS 16 with a thickness of 6 cm.

The stabilization of the existing embankment layer is carried out in the thickness of 20 cm, and more specific description is provided in the Technical Requirements. The Investor may change the means of stabilization while respecting the load bearing and geometry requirements.

Subsequently, a reinforced shoulder on the upper side of the lane will be made (with excavation material) and a grass one on the lower side of the lane. The reinforced part is used for occasional acceptance of passing vehicle wheels and for passing of vehicles during maintenance works. The lower humus shoulder is used to conduct surface water to an unprotected part of the area.

As can be seen, the works can be performed in segments that depend on the Contractor's Plan. Each new segment can only be started after the schedules have been presented and approved by the Supervisor. At the request of the Investor, the works may be suspended in case of an unexpected event, with the obligation to conserve the works in such a way that the traffic can be resumed immediately.

In some places, where it is envisaged to perform stepped cutting into the embankment body in order to extend the embankment crown, the works shall be started based on a special permission of the Supervisor with a precise time schedule for the completion of works. There are only few of such places and they must not be a hindrance to construction and other types of traffic communications.

Note:

Existing Planning documentation in local self-governments, Žitište and Zrenjanin, does not provide for adequate connecting of the newly designed lane with the traffic system of the settlements along the lane (Srpski Itebej, Novi Itebej, Torak, Žitište ..). It is necessary to change the Planning Document in the next period to allow for official incorporation of the lane into the town networks. We find that the interest is obvious and that the technical solutions are very simple. The lanes would be located parallel to the state roads, in their corridor, and thus treated (state committee is not required ..), whereas the intersections with

the state roads would be "executed" at already existing intersections, with the addition of traffic signalization.

It is the obligation of PWMC Vode Vojvodine, as an Investor who regularly maintains the embankment, to provide the contractor with a properly cut and maintained crown of the embankment before commencement of works along the route of the double-purpose lane at a minimum width of 5 m and to maintain the lane during the construction of the lane.

ROAD PAVEMENT STRUCTURE CALCULATIONS

Cycling as well as passenger traffic have no influence on the dimensioning of the pavement structure. However, the calculation related to the road pavement structure are provided. Pursuant to the requirements of the competent institutions, data from the Geomechanical Study and past experience, an attempt was made to optimize the balance between actual needs and available resources.

It is clear that some parameters must be adopted, and primarily an equivalent traffic load in the value of Tu = $4.0x10^4$ - 82 kN/axle, which represents a light traffic load.

PRORAČUN KOLOVOZNE KONSTRUKCIJE

Lokacija: Dvonamenska staza po kruni nasipa kanala Begej

Projekat: Glavni projekat

Ulazni podaci

Ekvivalentno opterećenje st. osovina 82Kn	**Tu= 4.00E+04**
Pouzdanost	**R= 80%**
Standardno norm odstupanje	**Zr= 0.400**
Standardno odstupanje	**So= 0.440**
Početni indeks vozne sposobnosti	**PSI= 4.200**
Pad indeksa na kraju perioda	**PSI1= 2.200**
Rezilijentni modul posteljice	**Mr= 30.000**
Zapreminska težina	**γ(Kn/m^3)= 15.700**
Vlažnost	**W(%)= 13.300**
Indeks mraza -dani stepeni	**Ic= 180**
trajanje mraza (dana)	**t(dana)= 80**
Srednja godišnja temp vazduha	**T^0= 20.00**

Debljina asfaltnih slojeva **Das=** 5.532 cm

Kalifornijski indeks nosivosti **CBR(%)=** **3.50**

Debljina tuc. slojeva dijagram → 10.000 cm

zamena STABIL. **20.00**

Novi CBR(%)= **15.00**

debljina tuc slojeva dijagram → 10.000

Potreban strukturni broj **Snpot= 5.532 x 0.38 + 30.000 x 0.11 = 5.402**

Usvojena kolovozna konstrukcija:

AB 11	**0.00** x 0.42 =	0.00	
BNHS 16	**6.00** x 0.35 =	2.10	
0/31.5	**10.00** x 0.14 =	1.40	
STAB	**20.00** x0.14=	2.40	
ukupno:	**36.00**	Sn=	6.3

Snpot= 5.402 < Sn= 6.3

PROVERA DUBINE ZAMRZAVANJA

ULAZNI PODACI

Zapreminska masa tla u postel	gd=	0.00157	kg/cm3
Prirodna vlažnost	w=	13.3	%
Indeks smrzavanja	F=	180	dana-stepeni
Trajanje mraza	t=	80	dana
Srednja godišnja temp. vazduh	T=	20	0 C

kapacitet zagrevanja	1.409 do	C=	1.6	J/cm3 0C **ASFALT BETON**
kapacitet zagrevanja	1.879 do	C=	2	J/cm3 0C **CEMENT BETON**

Za smrzavanje litra vode **3335.25** J

Kapacitet zagrevanja po jedinici zapremine za nesmrznuto tlo		Cn=	1.992	J/cm3 0C
Kapacitet zagrevanja po jedinici zapremine za smrznuto tlo		Cn=	1.554	J/cm3 0C
	Srednja vrednost	C=	1.773	J/cm3 0C
Latentna zapreminska toplota J/cm3		L=	69.643	J/cm3
Termička provodljivost za LES sa 15% vlage	k= 0.41 W/cm 0C			
Koeficijent korekcije		a=	8.89	
Koeficijent topljenja		m=	0.17	
	IZ DIJAGRAMA	L=	0.5	
Dubina prodiranja mraza u uniformnu sredinu (LES)		Z(cm)=	51.470	

DEBLJINE SLOJEVA KONSTRUKCIJE

Habajući sloj	h1=	0.00 cm	gd=	0.02357	kg/cm3
Vezni sloj	h2=	6.00 cm	gd=	0.02247	kg/cm3
Gornja podloga	h3=	10.00 cm	gd=	0.02168	kg/cm3
Donja podloga	h4=	20.00 cm	gd=	0.01964	kg/cm3
	UKUPNO	36 cm			

KOEFICIJENTI TERMIČKE PROVODLJIVOSTI

Habajući sloj	k1=	2.28 W/cm 0C	W=	1 %
Vezni sloj	k2=	2.28 W/cm 0C	W=	1.5 %
Gornja podloga	k3=	2.47 W/cm 0C	W=	12 %
Donja podloga	k4=	2.47 W/cm 0C	W=	14 %

LATENTNE ZAPREMINSKE TOPLOTE

Habajući sloj	L1=	78.61 J/cm3
Vezni sloj	L2=	112.41 J/cm3
Gornja podloga	L3=	1084.62 J/cm3
Donja podloga	L4=	1263.59 J/cm3
	L/K=	186.680

DUBINA PRODIRANJA MRAZA Z'= 49.10 cm

Z'= 49.10 <Z= 51.47

Compaction rate:

Stabilized layer		Ms≥40-50 MPa
Crushed stone aggregate 0/31.5	tmin=10 cm	Ms≥50 MPa
Bituminous bearing layer BNHS 16	t=6 cm	compaction rate 96%

Pavement structure

	BNHS 16	t=6 cm	96%	
	DKM 0/31,5	tmin=10 cm	Ms≥50 MPa	
	STABILISATION	t=20 cm	Ms≥40-50 MPa	
Total		tmin=36 cm		

Pavement structure on the part below the bridges

	AB 8	t=3 cm	96%	
	BNHS 16	t=5 cm	95%	
	DKM 0/31.5	t=25 cm	Ms≥50 MPa	
	Subsoil		Ms≥20 MPa	
Total		t=33 cm		

Cost of works

Quantities per position are established based on software program capabilities

VOLUME 3.2

TECHNICAL SPECIFICATIONS

Dual-use lane along Begej canal Section II Zrenjanin

TECHNICAL DESCRIPTION

The building permit design for a dual-purpose lane along the Begej Canal from the Romania-Serbia border to the hydro complex Klek - in the territory of Zrenjanin municipality

INVESTOR:	PWMC Vode Vojvodine Novi Sad, Bulevar Mihajla Pupina No. 25
DESIGN ORGANISATION:	AD "VOJVODINAPROJEKT" Bulevar Kralja Petra I No. 17, Novi Sad
RESPONSIBLE DESIGNER:	Aleksandar B. Marković, M.Sc.C.E. 315 I724 10

INTRODUCTION

The scope of design is the construction of a dual-purpose lane from the Serbia-Romania state border to the settlement Klek, i.e. to fit into the existing bike lane on Sava Kovačević Street.

The lane is planned to be used for smaller vehicles when reviewing or inspecting this section, as well as for machinery whose axle load does not exceed 5t. This lane will also be used for cycling purposes.

This design documentation deals with Section II on the territory of Zrenjanin municipality, in the length of 6 763.07 m. The start of the lane is on the border between the municipalities of Žitište and Zrenjanin. Practically, this is a continuation of the lane after Section I. It ends in the settlement of Klek, on the already existing bicycle-pedestrian lane that is in use.

Design Bases

Location requirements No. ROP-ZRE-18642-LOCH-2/2019 dated 14 October 2019
Investor's Terms of Reference
Updated geodetic bases-integrated KTP
Arrangements with Investor's representatives

DESCRIPTION OF FUNCTIONAL AND TECHNICAL SOLUTIONS

Terms of Reference envisage the construction of a dual-purpose lane from the Serbia-Romania state border to the settlement Klek, i.e. to fit into the existing bike lane on Sava Kovačević Street.

This design documentation defines the part located in the territory of Zrenjanin municipality in the length of 6 763.07 m (from km 26+164.71 to km 32+927.78).

The dual-purpose lane is 2.0 meters wide with a reinforced stone shoulder on the higher side of the lane. At points where the stone shoulder is higher than the existing terrain, it shall be 0.5 meters wide, whereas in the lane cuts it shall be less wide due to the planned material of the embankment crown, which takes over and covers the eventual need for traffic.

The cross slope of the lane is 2% and directed towards the unprotected area.

CROSSING WITH INSTALLATIONS

According to the data from the competent cadastral institution, there are no crossings with underground installations at the heights of the works range, on this section. The route intersects with PTT installations on the section of route from 26+170 to km 30+015. In this part of the route, the lane occasionally intersects with the existing fibre optic cable, so the position of the cable needs to be marked

in the field beforehand and occasionally identified by cutting grooves. These works shall only be performed in the presence of the installation owner.

On the route, lateral traffic connections for various purposes (in the function of house, field and other sorts of access) were recorded. For each connection, a standard barrier is foreseen, which is defined and accounted for in the design section related to traffic, whereas in a settlement, the construction of existing connections is also foreseen.

GEOMECHANICAL PROPERTIES OF MATERIALS ON THE LANE ROUTE

Field exploration and laboratory analysis of samples were performed, based on which the Geomechanical Study was prepared (enclosed). Twenty-eight (28) drilling pits were constructed and subsequently additional explorations were made by shallow excavations (up to 0.4m), all in 2019. The test results are presented in tables, and here are highlighted indications that influence the selection of pavement structure and the manner of defining the elevations of surfacing (finished level).

The Study has found that the humus layer thickness is 0.2 m. Below the humus layer there is sandy-clay dust material of yellowish-brown colour, up to the depth of exploration (body of the embankment).

Groundwater has not been registered.

Such results, according to the structure thickness of at least 16 cm plus 20 cm of stabilized layers, require the placement of a finished level at such elevation spot that the bedding layer is NOT on the humus layer. Pursuant to the requirements for the correct geometric shape of the level, there is an inevitable need to enter the body of the embankment for more than 20 cm. Also, in places where there is a need for filling under the bedding layer, it is foreseen to first remove the humus layer and then to backfill it with selected material from the excavation. In this way, the embankment crown is brought to the geometrically required shape for laying the lane, without compromising the basic function of the embankment.

According to the results of the Geomechanical Study, the requirements of the Terms of Reference, and the general consideration of the problem, there is a need to ban the use of vehicles and machines with a load greater than 5 (five) tons per axle. During the execution of works, 50% higher loads than the one mentioned above may be allowed.

WATER REGIME OF THE NAVIGABLE BEGEJ RIVER

Begej belongs to the Danube basin, the Tisza sub-basin and the Danube river basin district.

Two water regimes on the Begej Canal are characteristic:

since 20 March to 20 December

For Section II:	maximum water level	77.70 m a.s.l.
	minimum water level	74.10 m a.s.l.

since 20 December to 20 March

For Section II:	maximum water level	77.20 m a.s.l.
	minimum water level	74.20 m a.s.l.
	operating water level	74.70 – 77.70 m a.s.l.
	operating water level	74.40 – 74.60 m a.s.l.

OVERVIEW OF WORK METHOD STATEMENT

The dual-purpose lane is designed along the crown of the Begej Canal protection embankment, on the left (L~1100m). The lane is located approximately in the middle of the embankment crown. The scope of work involves excavating a layer of humus material (20cm), making a stabilized layer by stabilizing the existing material in the body of the embankment of 20 cm thickness, and then making a layer of crushed material in a minimum thickness of 10 cm. Over that, a 6 cm thick BNHS 16 asphalt layer will be laid.

At chainage of km 27+364.23, the lane "descends" from the embankment and runs by the field roads past the embankment. At chainage of km 30+ 012.31, the lane separates towards Klek by the corridors of the existing service and field roads.

At chainage of km 30 + 222.09, the lane intersects with the access road to the ship lock.

On the part of the lane from km 32 + 192.91 to km 32 + 333.24 (length 140.33 m), because of the property-legal relations, the lane is located on the existing road surface.

Subsequently, a reinforced shoulder on the upper side of the lane will be made of crushed material 0/31.5 mm and a grass one (by excavation material) on the lower side of the lane. The reinforced part is used for occasional acceptance of passing vehicle wheels and for passing of vehicles during maintenance works. The lower humus shoulder is used to conduct surface water to an unprotected part of the area.

As can be seen, the works can be performed in segments that depend on the Contractor's Plan. Each new segment can only be started after the schedules have been presented and approved by the Supervisor. At the request of the Investor, the works may be suspended in case of an unexpected event, with the obligation to conserve the works in such a way that the traffic can be resumed immediately.

In some places, where it is envisaged to perform stepped cutting into the embankment body in order to extend the embankment crown, the works shall be started based on a special permission of the Supervisor with a precise time schedule for the completion of works. There are only few of such places and they must not be a hindrance to construction and other types of traffic communications.

It is the obligation of PWMC Vode Vojvodine, as an Investor who regularly maintains the embankment, to provide the contractor with a properly cut and maintained crown of the embankment before commencement of works along the route of the double-purpose lane at a minimum width of 5 m and to maintain the lane during the construction of the lane.

ROAD PAVEMENT STRUCTURE CALCULATIONS

Cycling as well as passenger traffic have no influence on the dimensioning of the pavement structure. However, the calculation related to the road pavement structure are provided. Pursuant to the requirements of the competent institutions, data from the Geomechanical Study and past experience, an attempt was made to optimize the balance between actual needs and available resources.

It is clear that some parameters must be adopted, and primarily an equivalent traffic load in the value of $Tu = 4.0x10^4$ - 82 kN/axle, which represents a light traffic load.

PRORAČUN KOLOVOZNE KONSTRUKCIJE

Lokacija: Dvonamenska staza po kruni nasipa kanala Begej

Projekat: Glavni projekat

Ulazni podaci

Ekvivalentno opterećenje st. osovina 82Kn	**Tu= 4.00E+04**
Pouzdanost	**R= 80%**
Standardno norm odstupanje	**Zr= 0.400**
Standardno odstupanje	**So= 0.440**
Početni indeks vozne sposobnosti	**PSI= 4.200**
Pad indeksa na kraju perioda	**PSI1= 2.200**
Rezilijentni modul posteljice	**Mr= 30.000**
Zapreminska težina	**γ(Kn/m^3)= 15.700**
Vlažnost	**W(%)= 13.300**
Indeks mraza -dani stepeni	**Ic= 180**
trajanje mraza (dana)	**t(dana)= 80**
Srednja godišnja temp vazduha	**T^0= 20.00**

Debljina asfaltnih slojeva **Das=** 5.532 cm

Kalifornijski indeks nosivosti **CBR(%)=** **3.50**

Debljina tuc. slojeva dijagram → 10.000 cm

zamena STABIL. **20.00**

Novi CBR(%)= **15.00**

debljina tuc slojeva dijagram → 10.000

Potreban strukturni broj **Snpot= 5.532 x 0.38 + 30.000 x 0.11 = 5.402**

Usvojena kolovozna konstrukcija:

AB 11	**0.00** x 0.42 =	0.00	
BNHS 16	**6.00** x 0.35 =	2.10	
0/31.5	**10.00** x 0.14 =	1.40	
STAB	**20.00** x0.14=	2.40	
ukupno:	**36.00**	Sn=	6.3

Snpot= 5.402 < Sn= 6.3

PROVERA DUBINE ZAMRZAVANJA

ULAZNI PODACI

Zapreminska masa tla u postel	gd=	0.00157	kg/cm3
Prirodna vlažnost	w=	13.3	%
Indeks smrzavanja	F=	180	dana-stepeni
Trajanje mraza	t=	80	dana
Srednja godišnja temp. vazduh	T=	20	0 C

kapacitet zagrevanja	1.409 do	C=	1.6	J/cm3 0C **ASFALT BETON**
kapacitet zagrevanja	1.879 do	C=	2	J/cm3 0C **CEMENT BETON**

Za smrzavanje litra vode **3335.25** J

Kapacitet zagrevanja po jedinici zapremine za nesmrznuto tlo		Cn=	1.992	J/cm3 0C
Kapacitet zagrevanja po jedinici zapremine za smrznuto tlo		Cn=	1.554	J/cm3 0C
	Srednja vrednost	C=	1.773	J/cm3 0C
Latentna zapreminska toplota J/cm3		L=	69.643	J/cm3
Termička provodljivost za LES sa 15% vlage	k= 0.41 W/cm 0C			
Koeficijent korekcije		a=	8.89	
Koeficijent topljenja		m=	0.17	
	IZ DIJAGRAMA	L=	0.5	
Dubina prodiranja mraza u uniformnu sredinu (LES)		Z(cm)=	51.470	

DEBLJINE SLOJEVA KONSTRUKCIJE

Habajući sloj	h1=	0.00 cm	gd=	0.02357	kg/cm3
Vezni sloj	h2=	6.00 cm	gd=	0.02247	kg/cm3
Gornja podloga	h3=	10.00 cm	gd=	0.02168	kg/cm3
Donja podloga	h4=	20.00 cm	gd=	0.01964	kg/cm3
	UKUPNO	36 cm			

KOEFICIJENTI TERMIČKE PROVODLJIVOSTI

Habajući sloj	k1=	2.28 W/cm 0C	W=	1 %
Vezni sloj	k2=	2.28 W/cm 0C	W=	1.5 %
Gornja podloga	k3=	2.47 W/cm 0C	W=	12 %
Donja podloga	k4=	2.47 W/cm 0C	W=	14 %

LATENTNE ZAPREMINSKE TOPLOTE

Habajući sloj	L1=	78.61 J/cm3
Vezni sloj	L2=	112.41 J/cm3
Gornja podloga	L3=	1084.62 J/cm3
Donja podloga	L4=	1263.59 J/cm3
	L/K=	186.680

DUBINA PRODIRANJA MRAZA Z'= 49.10 cm

Z'= 49.10 <Z= 51.47

The degrees of compactness should also be emphasized:

By compacting the subsoil the following should be achieved
Ms≥20 MPa

Crushed stone aggregate 0/31.5	t=25 cm	Ms≥50 MPa
BNHS 16 bituminous bearing layer	t=5 cm	compaction rate 96%
Wearing layer AB 8	t=3 cm	compaction rate 96%

Road pavement structure

	BNHS 16	t=6 cm	96%	
	DKM 0/31,5	tmin=10 cm	Mc≥50 MPa	
	STABILISATION	t=20 cm	Mc≥40-50 MPa	
total		tmin=36 cm		

Cost of works

Quantities per position have been established based on software program capabilities.