**Traffic Management and Safety**

ST RK 1412-2017 “Traffic management facilities. Application rules”, ST RK 1124-2003 “Traffic Management Facilities. Road marking. Technical specifications”, ST RK 1125-2002 “Road signs. General technical specifications”, ST RK 1125-2002 “Road signs. General technical specifications” regulate the road and pedestrian traffic management along the projected street.

The project provides for using “cold plastic” marking with increased abrasion resistance for main marking lines.

The project provides for road sign installations for traffic management, safety and en route driver information purposes in compliance with ST RK 1125-2002 “Road signs. General technical specifications”.

The road signs shall be made of enclosed metal panels mounted on galvanised posts in compliance with the standard project 3.503.9-80 “Road sign posts on highways”. It shall be SKM type post with F1 and F2 foundation with the post concreting.

Road signs shall be mounted on galvanised posts at the distance of 0.6 m from the front surface of the border stone; and on the traffic lights posts at road intersections. Road sign panels shall be made of enclosed galvanised metal with light-reflecting coating and colourless varnish finish on the front side.

The project provides for road illumination all the way down the street.

The project provides for safety barriers at dangerous road sections and where the road changes its direction. It also provides for pedestrian guide rails at pedestrian crossings. Both measures are regulated by ST RK 1412-2017.

**6.2.2 Engineering structures**

**Bridge, overpasses and pedestrian crossings**

The feasibility study of “The reconstruction of Kabanbai Batyr Avenue section from Saltanat Saraiy to Nursultan Nazarbayev International Airport and the construction of an interchange on Kabanbai Batyr Avenue all the way to Turan Avenue” stipulates five construction stages including: six left U-turn ramps; G-4.5 underground pedestrian crossings at three road intersections; two G-40 underground pedestrian crossings; a bridge; a G-80 overground pedestrian crossing with retaining walls of which:

Engineering structures of The Second Stage:

* a G-40 underground pedestrian crossing near Astana Arena;
* a G-40 underground pedestrian crossing near Barys Arena;
* a G-4.5 underground pedestrian crossing at the Kabanbai Batyr Ave. and Dostyk St. intersection.

Engineering structures of The Third Stage:

* two left U-turn ramps on Uly Dala St.

Engineering structures of The Fourth Stage:

* a bridge over Nura-Ishim canal.

Engineering structures of The Fifth Stage:

* four left U-turn ramps on Uly Dala St.;
* a G-4.5 underground pedestrian crossing at the Kabanbai Batyr Ave. and Korgalzhyn hwy. intersection;
* a G-4.5 underground pedestrian crossing at the Kabanbai Batyr Ave. and Turan Ave. intersection;
* a G-80 overground pedestrian crossing across the Korgalzhyn hwy.

The projected engineering structures comply with ST RK 3.03-112-2013 “Bridges and pipes”, ST RK 1380-2005 “Bridge structures and culverts on roads. Loads and actions”; ST RK 1379-2012 “Clearance diagrams for structures”; ST RK 1684-2007 “Bridge structures and culverts on roads. General design requirements”; ST RK 1858-2008 “Bridge structures and culverts on roads. Design requirements for concrete and ferro-concrete structures”.

Bearing structures and bridge foundations, culverts shall be designed for constant loads and adverse combinations of temporary loads specified in ST RK 1380-2005 (A14 vehicle load, NK-120 and NK-180 heavy single wheel-load, and pedestrian load of 400 kg/m2.

**The Second Stage**

Pedestrian crossings near Astana Arena and Barys Arena

Pedestrian crossings are made on two levels. There is an overpass for vehicles above the pedestrian crossing. The overpass is located in the plan on a straight line. It has 15 + 15 + 15 m scheme.

The length of the overpass is 45.8 m if measuring from the rear edge of the pier caps. The width of the overpass carriageway is 34.3 m and 41.85 m. The projected pedestrian crossing is 40.0 m wide and 127.1 m and 134.69 m long. The entrance to the crossing is a ramp with a 6% slope. The pedestrian part is made of 60 cm thick ferro-concrete slab on a pile base.

*Superstructures*

The superstructure consists of 15.0 m long hollow P-15-А14, that comply with the model project developed by Kazdorproekt LLP, Almaty, 2008, order No. 01-08.

*Piers*

The end piers have a pile base. The pier is a ferro-concrete monolithic solid wall. The pile cap is supported by 20.0 m long bored pile with 1.0 m diameter.

The intermediate piers have a pile base. The pier is ferro-concrete monolithic columns. The pile cap is supported by 20.0 m long bored pile with 1.0 m diameter.

1.3 m to 5.3 m high angular abutment have variable thickness of 0.35 m to 0.55 m.

There are additional 4.5 m wide stairways at the ramp edges of custom design.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **Table 2** |  |
| No. |  | Address |  |  | Title |  |  | Dimensions |  |  | Scheme |  |  | Length in m |  |  | Area in m2 |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  |  |
| 1 |  | Kabanbai Batyr |  |  | Underground crossing |  |  | G-2х15,25 |  |  | 3х15 |  |  | 45.8 |  |  | 1570.9 |  |  |
|  | Ave. |  |  | near Astana Arena |  |  | +2х0.75 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  | Turan Ave. |  |  | Underground crossing |  |  | G-2х(16+6+16) |  |  | 3х15 |  |  | 45.8 |  |  | 1916.7 |  |  |
|  |  |  | near Barys Arena |  |  | +2х0.75 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

*The analogue for the pedestrian crossings near Astana Arena and Barys Arena* is the working project on “The construction of the underground pedestrian crossing under Turan Ave. to Khan Shatyr shopping centre in Astana" dated May 6, 2014 No. 02-0342/14.

**Underground crossings at intersections**

The project provides for underground pedestrian crossings at the Kabanbai Batyr Ave. and Dostyk St. intersection - one 97 m long L-shaped crossing.

Underground pedestrian crossings consist of a tunnel part (underground crossing) and entry elements (staircases and ramps).

The tunnel part of the underground crossing shall be 4.5 m wide. It shall have a monolithic closed structure with a 400 mm thick wall and a 600 mm thick floor slab. The project provides for 4 mm thick Flexigum waterproofing for the entire surface of the tunnel with a geomembrane and a protective screed.

The project provides for a staircase and a ramp for each side of the tunnel. The staircases and ramps shall be 3 m and 2 m wide respectively.

The analogue for the underground crossings is the working project on "The construction of the arterial road, passing through 12,14, Ugolnaya and Sh. Beisekova St; section No. 5 - Sh. Beisekova St. on the section from Constitution to Sarayshyk St.; section No. 6 - Sarayshyk St. on the section from Sh. Beisekova St. to Turan Avenue”. Second stage: section No. 5 - Sh. Beisekova St. from Sarayshyk St. to Korgalzhyn hwy. dated September 28, 2012 No. 01-566/12.

**The Third Stage**

U-turn exit ramp

A left turning exit at the intersection with Ula Dala Ave. The left turning road exits are made in the form of ramps with retaining walls. The ramp is shown in the plan with 30 m radius curvature.

The full width of the exit is 12.8 mm.

**Table 3**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Address | Title | Dimensions | Scheme | Length | Length |  |
| , in  | of SS, in m |  |
|  |  |  |  |  |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |  |
| 1 | Kabanbai Batyr Ave. and | U-turn 1 | G-11,2 | 19.7+20.0+20.03+21.08+2х26.05+21. | 218.96 | 221.4 |  |
| 08+20.03+20.0+19.7 |  |
|  | Uly Dala |  |  |  |  |  |
|  |  |  | 19.7+20.0+20.03+21.08+2х26.05+21. |  |  |  |
| 2 | intersection | U-turn 2. | G-11,2 | 218.96 | 178.7 |  |
| 08+20.03+20.0+19.7 |  |
|  |  |  |  |  |  |  |

*Superstructures*

The superstructure consists of monolithic ferro-concrete of individual design. Ferro-concrete monolithic slabs of hat section have a constant height of 1.2 m along the axis.

*Piers*

The end piers are monolithic ferro-concrete piers based on the bored piles foundation with cabinet walls of individual construction.

A massive body of end piers No. 1, 11 has 0.4 m thick cabinet walls. The body is based on pile cap. The foundation is supported by two rows of the 14 m long bored piles with 1.5 m diameter.

The intermediate piers are made of monolithic ferro-concrete of custom design. The pier body has a variable width of 4.0 m at the bottom and 6.5 m at the upper part. The pier column is based on monolithic pile cap. The foundation is supported by two rows of the 25 m long bored piles with 1.5 m diameter.

*Abutment of the exiting ramps*

0.4 m thick angular abutment has 1.76 m to 6.62 m hight including foundation.

The foundation for the abutment has a bore pile base. A 0.4 m x 0.4 m stopping block is placed on the outer side.

*The analogue for U-turn ramp* is the working project on "The construction of the interchange at the Raimbek Ave. and Auezov St. intersection in Kalkaman" dated March 15, 2013 No. 02-0189/13.

**The Fourth Stage**

PK 14+83 bridge over Nura-Ishim canal

There is a three hole and 22.9 m long culvert with 2.0x2.0 dimensions on the place of the projected bridge.

The bridge over the Nura-Ishim canal consists of two single-span ferro-concrete bridges standing next to each other for oncoming directions. The bridge lies on a straight line in the plan. The carriageway on the bridge is fenced by a metal barrier fence.

Bridge scheme is 1x21, the length is 21.9 m,

The dimensions of the structure are 2x (G-13.25) + 3.0 + 7.5, the canal capacity is 12.3 m3 / sec, the width of the canal by the edge line is 18.63 m.

The superstructures are made of 21 m long girders by the standard project of Kazdorproekt LLP order No. 01-07 for A14 NK-120, NK-120 and NK-180 loads, with a 15 cm thick reinforcement plate.

The abutment of the bridge has a pile base without pile cap. 9 m long ferro-concrete piles of SM9-35T7 grade with a section of 35x35 cm comply with the model project series 3.500.1-1.93 “Ferro-concrete driven piles of solid square section for piers”.

At the top the piles are joined by a 50 cm high concrete cap of B30 F300 W6 grade. There are bed stones of different heights on top of the cap. The bed stones form cross slope of the superstructure.

Protective works. The bridge cones act as slopes of the canal. They are protected with 15 cm thick monolithic concrete and PUM 150.75.15 concrete slabs placed on top of 10 cm thick layer of crushed stone. The boundary of the protection is ladled with red lines.

The analogue for the PK 14+83 bridge across the Nura-Ishim canal is the working project on "The construction of Orynbor St. section from 27 St. to the airport road" in Astana. Expert report dated 19 November 2009 No. 01-582/09.

**The Fifth Stage**

U-turn exit ramp

A left turning exit at the intersection with Ula Dala Ave. The left turning road exits are made in the form of:

* an overpass with ramp walls - U-turn ramp 1;
* ramps with abutment - U-turn ramp 2, 3, 4 .

**Table 4**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. |  | Address |  |  | Title |  |  | Dimensions |  |  | Scheme |  |  | Length |  | Length |  |
|  |  |  |  |  |  |  |  |  |  | of ES, in m |  |  of SS, in m |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  |
| 1 | Kabanbai BatyrAve. and | - |  | U-turn ramp |  |  | G-11.2 |  |  | 1х24 |  |  | 35.2 |  | 483.4 |  |
|  | 1 |  |  |  |  |  |  |  |  |
|  |  | Korgalzhyn hwy. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | U-turn ramp |  |  |  |  |  | 19.7+20.0+20.03+21.08+2х26.05+21. |  |  |  |  |  |  |
| 2 |  | intersection |  |  |  |  | G-11.2 |  |  |  |  | 218.96 |  | 316.0 |  |
|  |  |  | 2 |  |  |  |  | 08+20.03+20.0+19.7 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  | Kabanbai BatyrAve. and |  |  | U-turn ramp |  |  | G-11.2 |  |  | 19.7+20.0+20.03+21.08+31.6+27.4+2 |  |  | 227.78 |  | 248.0 |  |
|  |  |  | 1 |  |  |  |  | 3.0+20.03+20.0+19.7 |  |  |  |  |
|  |  | Korgalzhyn hwy. |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | U-turn ramp |  |  |  |  |  | 19.7+20.0+20.03+21.08+2х26.05+21. |  |  |  |  |  |  |
| 4 |  | intersection |  |  |  |  | G-11.2 |  |  |  |  | 218.96 |  | 267.0 |  |
|  |  |  | 2 |  |  |  |  | 08+20.03+20.0+19.7 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

The overpass with ramp walls (pipe type) - U-turn ramp 1

The tunnel overpass is shown in the plan with 30 m radius curvature, and in the profile with 1000 m radius inverted curvature.

The road approaches are paired with the tunnel overpass by passages in the ramp part.

The length of the exit with the ramp is 518.88 m.

The overpass length is 24.95 m, the width - 33.4 m. The length is estimated based on the 30 m curve on the section under the bridge dimension. The width of the tunnel overpass is estimated based on two 3.5 m wide traffic lanes, 1.0 m safety lanes, 1.5 m widening for each lane and widening for 9 m curvature.

Superstructures of VTK-24 ferro-concrete girders are set up at a distance of 1.4 meters between the girders.

Piers. The pier body is solid 0.9 m thick monolithic ferro-concrete. The ramp has a straight part and a curved part with 850 m radius curvature. The base of the tunnel type overpass and the ramp part with pile foundations is located on a straight and partly curved radius of 850 m.

The tunnel overpass and ramp have bored pile foundation with removable casing. The piles have 1.0 m diameter and joined by pile caps. The columns are 10.0 m long.

The analogue for the overpass is “The reconstruction of the A27 national highway “Aktobe-Atyrau-Russian border (on Astrakhan)” at 11-52 km. Section 10. The bridge over Batbakty river 30+200(PK194+51)”, dated April 5, 2017, No. 01-0152/17. The analogue for ramp walls is "The construction of the interchange at the Raimbek Ave. and Auezov St. intersection in Kalkaman village” dated March 15, 2013 No. 02-0189/13.

The overpass with ramp walls (of pipe type) U-turn ramps 2, 3, 4

The overpass is shown in the plan with 30 m radius curvature. The total width of the exit is

12.8 mm.

*Superstructures*

The superstructure consists of monolithic ferro-concrete of individual design. Ferro-concrete monolithic slabs of hat section have a constant height of 1.2 m along the axis.

*Piers*

The end piers are monolithic ferro-concrete piers are based on the bored piles foundation with cabinet walls of individual construction.

A massive body of end piers No. 1, 11 has 0.4 m thick cabinet walls. The body is based on pile cap. The foundation is supported by two rows of the 14 m long bored piles with 1.5 m diameter.

The intermediate piers are made of monolithic ferro-concrete of custom design. The pier body has a variable width of 4.0 m at the bottom and 6.5 m at the upper part. The pier column is based on monolithic pile cap. The foundation is supported by two rows of the 25 m long bored piles with 1.5 m diameter.

*Abutment of the exiting ramps*

0.4 m thick angular abutment of 1.76 m to 6.62 m high including foundation.

The foundation for the abutment has a bore pile base. A 0.4 m x 0.4 m stopping block is placed on the outer side.

The analogue for the overpassis the project on "The construction of the interchange at the Raimbek Ave. and Auezov St. intersection in Kalkaman" dated March 15, 2013 No. 02-0189/13.

Underground crossings at intersections

The project provides for the underground pedestrian crossings at the following intersections:

* Turan Ave. and Korgalzhyn hwy. – 3 crossings of 211 m each;
* Kabanbai Batyr Ave. and Korgalzhyn hwy. - 1 crossing of 302 m.

Underground pedestrian crossings consist of a tunnel part (underground crossing) and entry elements (staircases and ramps).

The tunnel part of the underground crossing shall be 4.5 m wide. I shall have a monolithic closed structure with a 400 mm thick wall and a 600 mm thick floor slab. The project provides for 4 mm thick Flexigum waterproofing for the entire surface of the tunnel with a geomembrane and a protective screed.

The project provides for a staircase and a ramp for each side of the tunnel. The staircases and ramps shall be 3 m and 2 m wide respectively.

The analogue for the underground crossings is the working project on "The construction of the arterial road, passing through 12,14, Ugolnaya and Sh. Beisekova St; section No. 5 - Sh. Beisekova St. on the section from Constitution to Sarayshyk St.; section No. 6 - Sarayshyk St. on the section from Sh. Beisekova St. to Turan Avenue”. The second stage: section No. 5 - Sh. Beisekova St. from Sarayshyk St. to Korgalzhyn hwy. dated September 28, 2012 No. 01-566/12.

The G-80 overground pedestrian crossing across the Korgalzhyn hwy.

The crossing is designed with the following specifications:

* overpass scheme is 2 x 17.0 m
* overpass length is 34.8 m.
* overpass width (tunnel length) is 80 m.
* under the bridge dimension G(12.5+6.0 +12.5)+2x0.75, h=5.5 m.

The overpass has two superstructures covered with 160 hollow-core slabs with individual span of 17.0 m (similar to the P 18-A14 - K7 slabs of 18 m that comply with the standard project order No. 1-08 issue 3. Kazdorproekt LLP, Almaty).

The body of the end pier is a non-buried, 0.9 m thick monolithic solid wall.

The body of intermediate pier is monolithic, cylindrical columns with 1,0 m diameter. The intermediate piers are installed with every 2.5 m.

The analogue for the overground pedestrian crossing is the projects on:

* “The construction of the "South-West Bypass of Astana", section No. 1 PK0+00-PK86+00. The overpass on the interchange at the intersection with Kabanbai Batyr Ave.” PK0+00-PK13+00 No. 01-0317/17 dated June 30, 2017;
* “The construction of Tauelsyzdyk Ave. on the section from A43 St. (project name) to Hussein bin Talal St. with the construction of a bridge across the Yesil river. The Second Stage – the construction of Tauelsyzdyk Ave. on the section from A43 St. (project name) to Hussein bin Talal St." dated July 30, 2018 No. 01-0283/18;
* “The construction of 27 St. on the section from Sh. Beisekova St. to Turan Ave. in Astana” No. 01-0548/17 dated 14.11.2017.

**6.3 Engineering, networks and systems**

**Water supply and waste water disposal**

The feasibility study for reconstruction of water supply and wastewater disposal was performed on the basis of design assignment and technical conditions of “Astana Su Arnasy” Municipal Utility Service No. 3-6/231 dated November 15, 2019 and “Astana Municipal Services Department” State Institution No. 09-09/3913 dated December 21, 2017 in accordance with current regulations.

Section 1: from Saltanat Saraiy to Kunayev St. *External water and sewerage lines*

The feasibility study provides for relocating the existing water supply networks from under the carriageway to ensure continuous water supply to existing consumers. An integrated utility and fire-fighting water supply system is being designed; fire extinguishing is provided for from the designed and existing fire hydrants. The project provides for casing of projected water supply networks through the carriageway. Water supply wells are made of prefabricated ferro-concrete elements that comply with the model project 901-09-11.84 for wet soils. PE100, SDR17 polyethylene pipes to be used for the water supply system construction complaint with GOST 18599-2001.

*Storm-water sewers*

The feasibility study provides for the extension of the main carriageway with the arrangement of additional local passages. The project provides for construction of a main storm-water sewer collector made of ferro-concrete pipes with 800 mm and 500 mm diameter. They shall be connected to the existing collector of 1000 mm diameter along Sarayshyk St. Surface inlets shall be placed in the carriageway grip to collect water from the carriageway according to the plan for grading. Surface inlets shall be connected to the main collector is via pipes with 200 mm diameter.

Lookout wells and storm-water sewers comply with the model project 902-09-46.88.

Section 2: from Dostyk St. to 26 St. (Bukhar Zhyrau St.)

*External water and sewerage lines*

The project provides for the construction of underground pedestrian crossings at the Kabanbai Batyr Ave. and Dostyk St. intersection of and near Astana Arena and Barys Arena.

*Water pipeline*

The feasibility study provides for relocating the existing water supply networks from under the carriageway, taking into account the construction of underground pedestrian crossings and ensuring the switching of existing consumers to newly built networks. The project provides for casing of projected water supply networks through the carriageway. PE100, SDR17 polyethylene pipes shall be used for the water supply system construction complaint with GOST 18599-2001. The manholes are made of round and rectangular prefabricated ferro-concrete elements comply with the model project 901-09-11.84 for wet soils.

*Sewerage networks*

The feasibility study provides for relocating the existing sewerage networks taking into account the construction of underground pedestrian crossings. The project provides for casing of projected sewerage networks through the carriageway. The project provides for using polypropylene corrugated pipes with a socket complaint with GOST R 54475-2011 and PE100, SDR17 polyethylene pipes compliant with GOST 18599-2001 for sewerage networks.

The manholes are made of prefabricated ferro-concrete elements comply with the model project 901-09-11.84 for wet soils.

*Storm-water sewers*

The feasibility study provides for the extension of the main carriageway with the arrangement of additional local passages, the construction of underground pedestrian crossings. The project provides for construction of a main storm-water sewer collector made of polypropylene and ferro-concrete pipes with 300÷1000 mm diameter. It shall be connected to the existing networks. Surface inlets shall be set up to collect water from the carriageway and connected to the main collector via pipes with 200 mm diameter.

The project provides for relocating the existing pumping stations to the lawn part of the projected intersections along Syganak and Dostyk Streets. Lookout wells and storm-water sewers shall comply with the model project 902-09-46.88.Storm water drainage pipes are made of reinforced concrete non-pressure with 500÷800 mm diameter complaint with GOST 6482-88 and polypropylene corrugated pipes with 300÷400 mm diameter socket complaint with.GOST R 54475-2011. Branches of rain collectors are made of polypropylene corrugated pipes of 200 mm diameter. Surface inlets branches are made of polypropylene corrugated pipes with 200 mm diameter.