STEEL – CONCRETE COMPOSITE FLYOVER

MASTER THESIS

PART B: TECHNICAL REPORT

Bc. SAMAL GUBASHEVA

PRAGUE 2019
Content

1. Bridge Identification data .................................................................................................................. 3
2. Geometry of the bridge ......................................................................................................................... 3
3. Technical solution of the construction ................................................................................................. 4
   3.1. Description of the bridge structure ............................................................................................... 4
       3.1.1. Substructure .......................................................................................................................... 4
       3.1.2. Superstructure ...................................................................................................................... 5
   3.2. Carriageway, bridge equipment ..................................................................................................... 7
       3.2.1. Substructure .......................................................................................................................... 7
       3.2.2. Sidewalk ledge ....................................................................................................................... 7
       3.2.3. Traffic barrier, railings .......................................................................................................... 7
4. Construction process ............................................................................................................................. 8
   4.1. Location of cranes .......................................................................................................................... 10
   4.2. The suitable crane ......................................................................................................................... 11
1. Bridge Identification data

Structure: Road bridge above the Highway D11

Name of the object: Flyover above the Highway D11 at the 52km

Place of construction: Czech Republic, Středočeský kraj

Reason for construction: Replacement of the old bridge

Minimum clearance under the bridge: 5,0 m

Angle of inclination of the bridge: 90°

2. Geometry of the bridge

Clearance: 46 m

Length of the span: 47,6 m

Total length of the bridge: 49,2 m

Width of the bridge: 12,6 m

Width between sidewalk: 9,5 m

Width of the deck: 12,1 m

Clearance under the bridge: 5,7 m

Traffic passing height: 5 m

Construction height: 8 m

Area of the superstructure: 619,92 m²
3. Technical solution of the construction

3.1. Description of the bridge structure

3.1.1. Substructure

The substructure consists from the abutment, foundation piles, approach slab and parallel wings embedded in the base. The abutment casts above foundation piles. The substructure is monolithically connected to the superstructure and designed as a rigid support. The working joints assumed to be above the piles and abutment stem. All substructure will be cast-in-place.

Width of abutment 1,6 m
Total height of the abutment 8 m
Length of transition slab 6 m
Angle of inclination of transition slab 10%
Diameter of the foundation pile 1,1 m
Distance between piles 3 m
Length of the pile 6 m
Depth of concrete plate 0,1 m

Materials:

- Abutment, wingwalls C35/45 – XC2 + XD1 + XF2
- Foundation piles C25/30 – XA1 + XC2
- Transition slab C25/30 – XA1
- Concrete plate C12/15 – XA1
- Reinforcement B500B
3.1.2. Superstructure

The superstructure consists from four prefabricated composite girders, which are simultaneously make up formwork for the deck from in-situ concrete. This Prefabricated Composite Construction Method mostly applied in Germany (Figure. 1). Close to support steel beam creates haunches. They are used for higher bending stiffness. The detailed dimensions of the steel cross-section are represented in Figure 2.

---

**Figure 1. VTF technology**

- The length of prefabricated girders: 47.6 m
- The width of prefabricated girders: 3.15 m (2.9 on the edge)
- The depth of in-situ concrete slab: 0.22 m
- The depth of prefabricated concrete slab: 0.12 m
- The height of the steel girder in the middle span \( h \): 1.5 m
- The height of the steel girder in support \( h \): 1.9 m
- Distance between girders: 3.15 m
- Width of upper flange \( b_1 \): 0.3 m
- Width of bottom flange \( b_2 \): 0.63 m
depth of upper flange $t_1$ 0,04 m
depth of bottom flange $t_2$ 0,06 m
width of the web $t_w$ 0,02 m

Figure 2. Steel cross-section details

**Materials:**

- **Steel beam** S460N for thickness 63-80cm
- **Prefabricated concrete slab** C50/60 – XC2 + XD1 + XF2
- **In-situ concrete slab** C35/45 – XC2 + XD1 + XF2
- **Reinforcement** B500B
3.2. Carriageway, bridge equipment

3.2.1. Substructure

The total depth of the carriageway is 100 mm and it contains from four layers (Figure 3), which are:

- **Asphalt mixture SMA-11S**: 40 mm
- **Protective insulation**: 45 mm
- **Waterproofing barrier**: 5 mm
- **Adhesive penetrating coating**: - mm

**Total**: 100 mm

The waterproofing layer is covering all deck surface, but protective insulation will be only between sidewalk ledges along the bridge. Drainage of the road surface is ensured with a longitudinal slope of 2% and a transverse slope of 2.5%.

3.2.2. Sidewalk ledge

The sidewalk is designed from monolithic concrete C35/45 – XC2 + XD1 + XF2 and from reinforcement B500B. It is located on both sides of the bridge with dimensions:

- **Width along the bridge**: 1550 mm
- **Depth of sidewalk**: 220 mm
- **Depth of sidewalk cap**: 620 mm
- **Height of the ledge above the carriageway**: 150 mm

The top surface of the ledge is inclined in a transverse direction towards the carriageway at 4% (Figure 3).

3.2.3. Traffic barrier, railings.

The traffic barrier and railings are located on both sides of the bridge and anchored into the ledge. Traffic barrier is designed as high containment barrier in a level H3, type of SZ/H3. The height of railings is 1100 mm. Both structures are made from steel (Figure 3).
4. Construction process

Because of the large span, steel girders will be divided into 3 pieces (10m - 27,7m - 10m) for better transportation. They will be welded and cast with concrete C50/60 in the construction site. After, one by one the composite precast structure will be lifted by cranes and placed on abutments. The construction sequence contains six stages and they are described in the Figure-4.

The maximum weight of one composite beam is 72,54 tons. In our case, we will use two cranes because of the large span of the bridge. Therefore, each crane must be able to hold 36,3 tons.
Figure 4. Construction sequence of the bridge
4.1. Location of cranes

The right side of the highway D11 will be used as a construction site for welding and casting the girders. Figure 5 represents the most suitable location for the cranes for lifting the composite girders. The maximum arm, in this case, is 46.7 m.

*Figure 5. Location of cranes*
4.2. The suitable crane

I am choosing DEMAG Mobile Cranes type CC 2500. They have exceptional lifting capacities with Superlift attachment and with maximum speed 150m/min. From Figure 5, it is visible that we need a crane with the arm length, minimum of 46.7 meters. For this reason, I am choosing SSL crane type of 2721 (Figure 6-7). Which arm is suitable for lifting in 36 – 72m span. From the Table 1, we see that in the radius of 50 meters, the crane can lift a maximum 52 tons, which is even more than 36.7 tons and more safety for this case.

![Figure 6-7. DEMAG Mobile Crane type of SSL 2721](image)

![Table 1. Lifting capacity of the Crane SSL](image)