ANIMAL PASSAGES OVER THE A2 MOTORWAY, NOWY TOMYSL - SWIECKO SECTION, IN POLAND

Arkadiusz MADAJ*, Barbara BEDNAREK**
*) PhD C Eng., Poznan University of Technology, Poznań, Poland
**) MSc. C Eng., ViaCon Polska Sp. z o.o., Rydzyna, Poland

Abstract

Dynamic economic development of Poland is directly connected with the development of the road network which can have a negative influence on the environment. Suitable actions that minimize unfavorable impact of roads will be decisive for maintaining the population of rare species.

Building of animal passages is the most important and common method of minimizing influence of roads on wild fauna. Effective minimization calls for the construction of suitable number of animal passages with adequate parameters.

A2 Motorway, Nowy Tomyśl – Świecko section, is one the example where corrugated steel plate structures have been used for building animal overpasses. Over this 106 km long section as many as 13 animal overpasses were built.

Key words: corrugated steel plate structure (CSPS), animal overpass

1. INTRODUCTION

Development of ecological awareness causes the increase of expenditure of environmental investments required when transportation routes are built. Animal overpasses located over newly built motorways are one of the elements connected with environmental protection. When motorways cross an important area from the point of view of nature, the number of ecological structures can be considerable. It can generate high expenses. In order to decrease this cost one tends to built the cheapest structures on condition that all functional and technical requirements are retained. Economic analysis shows that with the assumption that optimization criterion is the cost of construction and maintenance, these conditions are fulfilled by teh use of corrugated steel plate structures. Important aspect of suitability assessment of this kind of structures as animal overpasses is their looks [1].

Corrugated steel plate structures blends into the landscape in a natural way, as the shape of the structure resembles natural element of landscape and soil
over the structure is not only of an important structural function, but also an essential element for plants, that have to be planted there.

The paper presents an example of using corrugated steel plate structures to build 13 animal overpasses over a 100 km stretch of motorway. Authors present options of using this kind of structure for realization of such a big project in short time, with preserving all requirements of investor concerning utility and durability.

2. DESCRIPTION OF THE PROJECT

On December 1st, 2011 the A2 Motorway Nowy Tomyśl – Świecko section was opened to public traffic. This section counts among the most strategic parts of the motorway construction plan in Poland. By direct connection with the German motorways network it became the key transport route between Poland and Western Europe. The newly opened section connecting the A12 German motorway (Berlin – Frankfurt am Main) in Świecko forms a part of the strategic European transport route on the Berlin – Warsaw – Minsk – Moscow line.

As 85% of the section crosses forest areas, including sites protected under the Natura 2000 programme, the technological challenge consisted in performing the project with utmost care for the natural environment. Thanks to the fact that, already in the design phase, all European environmental standards have been adopted, the new section counts among the most environmentally-friendly infrastructural projects in Europe. The expenses related to the environmental protection constituted 25% of the total project costs. Along the 106 kilometres section almost 200 crossings and culverts for large and small animals were built [2].

13 animal overpasses were built with the use of flexible structures. 11 of them have two spans (Fig. 1), one has three spans and one four spans.

![Fig. 1. Side view of two-span animal overpass](image)

Corrugated steel plate structures SuperCor and MultiPlate MP200 were used to build animal passages. SuperCor structures have the shape of an arch with a span of 17,67 m and rise of 5,50 m and are placed on concrete footings. These structures are intended to cross motorway lines. SuperCor structures are made of deep corrugated structural plates with a 381 x 140 mm corrugation. They are
reinforced by means of special rib plates added to main barrel sheets. Plate thickness is 7.0 mm for main barrel and 5.5 mm for rib plates (Fig. 2). Bottom length of SuperCor structures varies from 39.70 m to 75.51 m [3].

Fig. 2. Corrugation profile of SuperCor and MultiPlate MP200 structures

Due to the fact that the distance between two adjacent SuperCor structures is very small, the space between structures was filled with concrete. A very important task, especially for multiple installation, is to ensure proper drainage between adjacent structures (Fig. 3).

Fig. 3. Drainage between adjacent structures
MultiPlate MP200 structures used as technological roads in two animal overpasses have a closed shape with the span of 8.66 m and rise of 7.54 m. Corrugation profile is 200 x 55 mm (Fig. 2) and plate thickness is 7.0 mm. Length of these structures varies from 40 m to 55 m. MultiPlate structures were placed on a soil bedding.

Width of the overpasses measured in the axis of motorway between fences varies from around 38 m to over 63 m, and reaches 120 m in the base of embankment. Corrugated steel plate structures were designed with square ends (10 overpasses) and with step beveled ends where slope inclination is 1:1.5 (3 overpasses).

The reinforcement of soil mass for square ends structures was achieved by laying either welded wire mats or steel strips horizontally in regularly spaced lifts as the soil is being compacted (Fig. 4). The facing material for a wall are precast concrete panels. All wire meshes are hot-dip galvanized with 610 g/m² zinc coating. The precast panel facing was painted. The embankment slope around beveled overpasses was protected with the use of riprap. Concrete ring beams were constructed for all the structures.

A very significant task given by investor was to ensure a durability of the structures of minimum 100 years. In order to meet this requirement steel plates were hot-dip galvanized with average thickness of 105 µm (minimum thickness
of 90 µm) and additionally the plates were painted on the inside. The total thickness of the paint layer was minimum 200 µm and painting was performed in two layers – 120 µm of epoxy and 80 µm of polyurethane paint. Colour of the paint was chosen to match RAL1013 in order to brighten the interior of the passages and improve safety of cars at the same time. Corrosion protection was made in the factory.

Corrugated steel plate structures were backfilled with a sand-gravel mix compacted to 98% standard Proctor density. Depth of cover over SuperCor structures varies from 1.80 to 2.35 m.

Due to the fact that structures are built over a transportation route, it was necessary to provide suitable protection of users against rain water that can infiltrate through backfilling. For that purpose a layer of 1.0 mm HDPE geomembrane enclosed by two layers of 500 g/m² non-woven was placed over the steel structures. For some overpasses this “umbrella” was made with the use of two layers of bentonite mat (geosynthetic clay layer) (Fig. 5)

Fig. 5. Protection of the structures against rain water

3. CONSTRUCTION

An important element that influenced the success of this investment and lowered its realization cost was the use of adequate assembly method and a suitable delivery schedule. Owing to the scale of this project and relatively short realization time, elements were successively produced and delivered to the job site. It required harmonization of the production process with the progress of work on site [4].

Assembly procedure consisted of plate by plate method (Fig. 6 and Fig. 7) combined with component preassembly allow for efficient work [5]. During peak period assembly was performed by five crews. On average one crew consisted of 7 workers. Each crew was assisted by a crane with the capacity of 40 tons and a movable scaffolding. Assembly was organized in the way that no technological traffic under the structure took place. Mean assembly time of one structure was 4 weeks and the whole project was finished during not more than 14 months (from April 2010 until May 2011).
Photos from the construction and of the finished structures are shown in Fig. 6-11.

Fig. 6. Assembly of SuperCor structure using plate-by-plate method

Fig. 7. Assembly of MultiPlate MP200 structure using plate-by-plate method

Fig. 8. Assembled SuperCor structures (source: Autostrada Wielkopolska S.A)

Fig. 9. Three span overpass before backfilling (source: Autostrada Wielkopolska S.A)

Fig. 10. Animal overpass during backfilling process (source: Autostrada Wielkopolska S.A)
4. CONCLUSIONS

A2 Nowy Tomyśl – Świecko project was the biggest project with the use of large span steel plate structures realized within one investment. Presented example indicates a possibility of effective use of corrugated steel plate structures to build a large number of structures in a relatively short time, with the use of small assembly crews. During assembly around 35 persons were working at the same time. It is worth stressing that in the framework of this investment almost 4,300 tons of steel structures were built in. Apart from one crane, no other heavy equipment was used for assembly. Completion of a similar project using traditional technology, e.g. a reinforced concrete bridge, would involve considerably higher amount of work and resources – heavier equipment, more complicated scaffolding, formworks, etc.

Significant novelty in this project applied on such a large scale was the use of precast concrete panels anchored in soil by means of steel mesh or steel strips in the role of headwalls. It allowed bigger effective width of the overpass with smaller length of steel structures, which limited steel consumption.

One can use these conclusions in similar future projects. It mainly concerns a problem of necessity of using reinforcing ribs in this kind of structures. Preliminary analysis and test performed during this project show the possibility of not using ribs, which can significantly facilitate assembly and decrease cost. Further analysis has to be performed.
REFERENCES
2. Autostrada Wielkopolska S.A. http://www.autostrada-a2.pl

PRZEJŚCIA DLA ZWIERZĄT NAD AUTOSTRADĄ A2, ODCINEK NOWY TOMYŚL – ŚWIECKO W POLSCE

Streszczenie
Dynamiczny rozwój ekonomiczny polski jest bezpośrednio powiązany z rozwojem sieci dróg, co może powodować negatywne skutki ekologiczne. Dla zachowania populacji rzadkich gatunków decydują decydująć zostać zminimalizowanie niekorzystnego wpływu dróg.
Najważniejszą i najbardziej popularną metodą zminimalizowania wpływu rozwoju sieci drogowej na faunę jest budowa odpowiedniej liczby przejść dla zwierząt, które będą posiadały wymagane parametry.
Przykładem może być budowa autostrady A2 Nowy Tomyśl – Świecko, gdzie na odcinku o długości 106 km zbudowano trzy naścienny górnych przejść dla zwierząt. Do budowy tych obiektów wykorzystano konstrukcje ze stalowych blach falistych.