TECHNIKA TRANSPORTU SZYNOWEGO

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SELECTED ISSUES OF BRIDGE CONSTRUCTIONS MANAGEMENT SYSTEM OF FARMING TYPE

Abstract

The paper presents an overview of bridges for the purpose of pathway for people, animals, small rivers, as well as proposes of strengthening of the structure under the oversize load. The author highlighted the importance of management of such facilities and continuing update of its data base.

1. INTRODUCTION

Bridges for the purpose of pathway for people, animals, small rivers (PAR bridges) constitutes an important element in the roads network and also require some investment for construction and maintenance.

The increasing traffic volumes nowadays have led to bridge loads higher than the design ones. As a result, many of these kind of bridges have deficient capacity, lack functional performance, or can only serve restricted vehicle weights. A major reason for bridge deficiencies is the inadequate maintenance.

Bridge management of analysed part of facilities which purpose is to keep links in the area where urbanization degree is not large addresses all activities during the life of a bridge from construction to replacement aiming to ensure safety and functionality.

Existing damages on bridges along with increasing traffic loads and harsh environmental conditions result in rapid deterioration of bridge elements requiring prompt maintenance actions. The large number of bridges in a road network and the high maintenance costs justify the development of sophisticated approaches to bridge maintenance planning and management.

These bridges are often designed as one span frame, box section or arc as a soil-steel structure. The use of PAR bridges allows for smooth transition of animals, small road or river stream under the main road.

All PAR bridges perfectly fulfill their role, regardless of what method they have been built. The main differences taken into account by the investors and general contractors is the cost and time of implementation. The most often the one span frame with reinforced concrete slabs are used. Smooth slab ensures proper drainage of the bridge surface. Most often slab is jointed with abutment wall monolithically which creates rigid connection. Because of the required dimensions of the PAR bridges the foundations widths are not less than 3m and thick not less than 1 m.

Specific requirements are for pathways of large animals traveling under the PAR bridges. Location of the facility is designed nearby forests because of natural migration routes of animals and forest way.

Necessary condition of acceptance the pathway by animals is the properly sized and shaped transition area of the entrance as to resemble as closely as possible the surrounding landscape.

Minimum passage width is 15m and the minimum height is 3,5m. In addition the dimensions must designed to keep the narrowness coefficient defined as width x height/length of at least 1.5. Load for these kind of structures are defined according to Polish standard PN-85/S-10030. From the point of durability the appropriate choice of materials and technology of execution is essential [1,2,3].

2. BEARING STRUCTURES OF PAR BRIDGES

2.1. Typical constructions

Examples of bearing structures of most frequently sections used for PAR bridges are shown in Fig.1. These structures are made as monolithic and prefabricated concrete. Such elements may be any kind of reinforced concrete beams, steel girders, as well as any shells in the case of the ground-steel constructions.

Constructions work as plate, plate together with beam or shell with ground. Implementation of prefabrication structures has a different characteristics. After obtaining the normalized strength of the concrete one can begin to put the beams on the shelf of the outpost. Before installing, the prestressed beams the centimeter layer of high compressive strength mortar need to be placed under the beam.

The beam can be placed after applying the mortar. It have to be kept the edges of the beam do not go beyond the boundary points marked by the surveyors. Some of the beams (ie beams "T") require a temporary support during the installation. System supplied by shuttering companies can be used for this purpose as a separate design taking into account the capacity of individual elements.

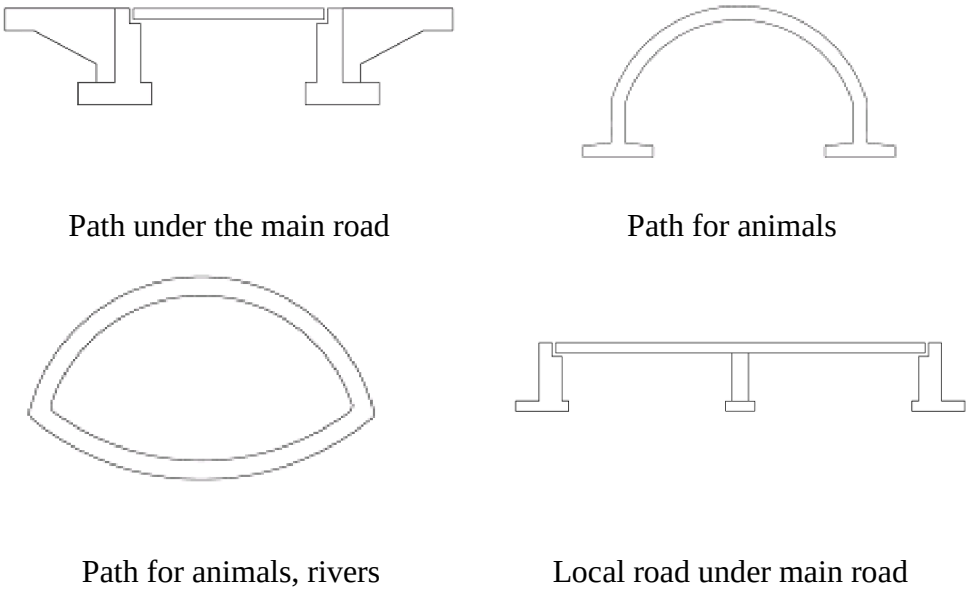

Fig. 1. Shape of general PAR bridges

2.2. Bearing structures of ground steel constructions

Ground steel constructions (Fig.2) are designed to be used as objects to carry outengineering watercourses or pedestrian, road and rail, installation equipment (pipelines, conveyors) and cables for road and railway embankments. They can be used for all load classes of roads and rail - in the case of railways to the speed of train V <200 km / h.

Construction of box-section and arch are mounted on a foundation designed taking into account individual class load, height of the load on the ground level and soil and water conditions.

Construction should be placed on the contoured, uniform and dense subsoil. The ground should not be too rigid. It is unacceptable to stack this construction directly on the rocky ground.

Due to the ease of adapting its shape to the distribution of ground forces these ground bridges can be used wherever movement of the ground is expected, such as ground

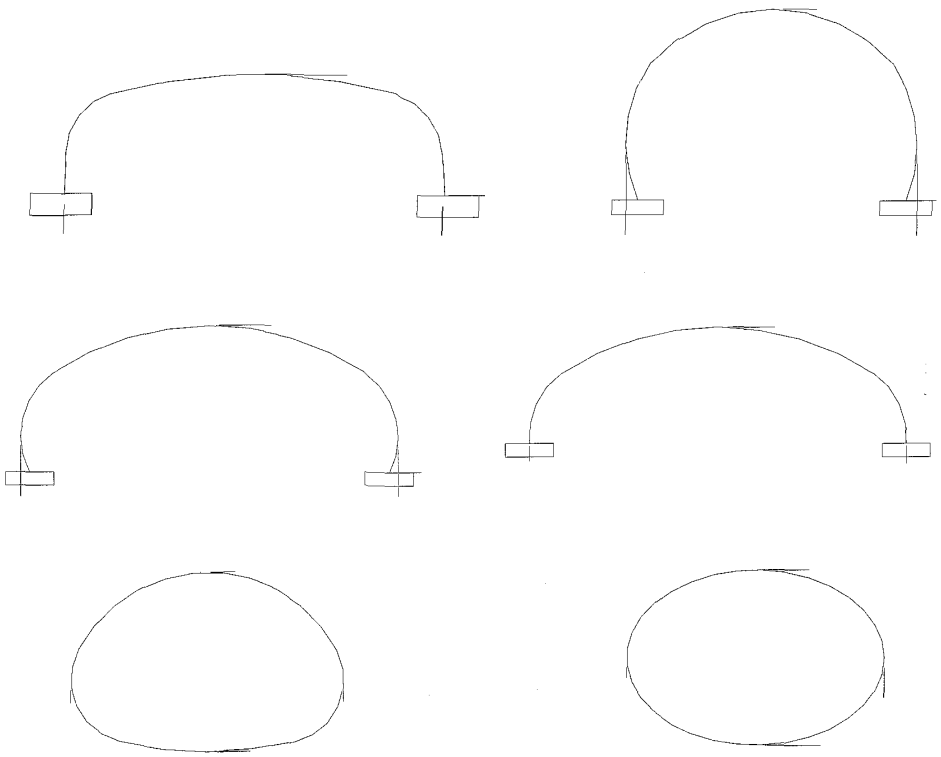

Fig.2. Schemes of types of steel-ground constructions

subsidence, mining damage, seismic, etc. These structures can also be used to strengthening of old, worn out bridges, culverts and tunnels, filled with a mixture of backfill dirt or concrete space between the existing structure and the construction of new construction.

Each use of the construction should be based on the detailed design and load according to PN-S-10030. The project should hydro-geological conditions associated with the location corresponding to the suitable dimensions of the structure presented in the producer's specification.

The special profile is installed to the concrete foundation to allow for mounting the steel shell.

3. MANAGEMENT SYSTEM OF THE PAR BRIDGE INFRASTRUCTURE

Due to the fact that the PAR bridges are among construction of very great importance that failure causing damage and high costs of reparation [4], keeping the current system of management is very important.

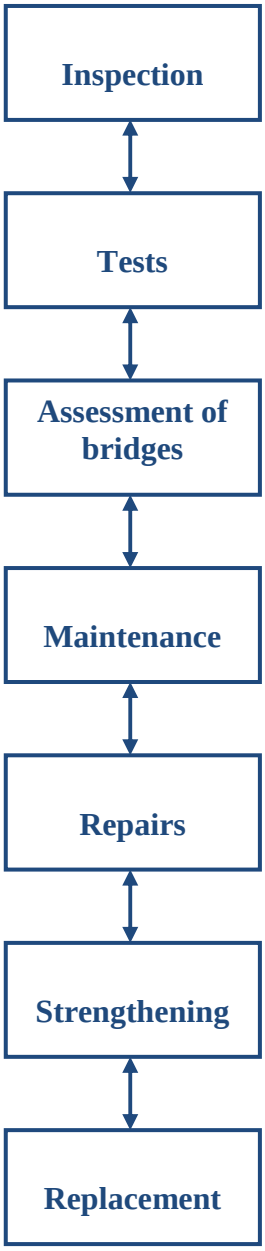

Fig.3. Procedure of bridge management

The condition of the PAR bridge, based on bridge inspection results, information on maintenance work and costs should be recorded [5,6]

Prediction models that take account of indirect costs are not very well developed.

Decisions on maintenance and repair, as well as prioritization, are essentially a matterof engineering judgment.

Management systems should cover all elements, such as location of bridge, type of construction, material description, service and maintenance data and other information that are important from the point of safety and utility [7] (Fig.3).

PAR bridges are usually designed and constructed to achieve a long-life hence it is important to monitor their condition periodically throughout their life in order to ensure that:

- purpose will be achieved,
- the level of deterioration is consistent with achieving the design life,
- there are no defects that affect the safety.

These checks are the purpose of bridge inspection and the results can be used to provide information on the condition of a bridge.

4. TECHNICAL ASSESMENT OF THE PAR BRIDGE AND THE PROPOSAL OF STRENGTHENING

4.1. Researches, testing and assesment

Taking into account principles and procedures of management system presented In sections 3, this part of paper presents the assessment of an individual PAR bridge.

The analysed bridge is the access to private plot, especially farmland. It is a monolithic reinforced concrete structure with a length of 15,0 m (with wings of abutments) and width of 7.40 m. Vertical space is 2.9 m, horizontal one is equal to 3.8 m The wall thickness is 35cm, thickness of walls wing is 32cm, thickness of the slab is 24cm. The angle of intersection of the axis of the PAR bridge to the axis of the road is 90 degrees. Section of the bridge is rectangular with smooth corners between walls bottom and top slabs. PAR bridge was made by split-half method with dilation along the abutments and the slabs. Dilation is filled with asphalt material. The top layer of the slab is covered by bitumen insulation with crushed basalt of 5-l0cm. The whole bridge is covered by soil from nearby fields.

Slab has the reinforcement of diameter 16mm, spaced at 15-20cm. Secondary reinforcement bars are 12mm. Concrete cover of main reinforcement is from 30 to 40mm, cover of secondary reinforcement is 20mm.

The concrete of bridge is high quality and strength of 50 MPa of walls and 55 MPa of slabs.

The walls of the abutments have local damage caused by excessive moisture and damaging effects of frost. Approximately 2cm depth of surface concrete is defected due to poor choice of concrete mix (the dominance of coarse fraction) and the abnormal compacted. The bottom of the slab shows no damage that could lead to failure of the structure. Wings do not have a scratch, only minor surface mechanical damage, losses due to unfavorable atmospheric and biological conditions (destructive action of moss).

After technical survey and according to new requirements the following assumptions were made: load from the vehicle of 100 kN, steel grade A-III.

Analysis of settlement was performed based on technical standards [7] for the weight of the foundation and soil on: 320 kN, characteristic unit total load is 55 kPa, Thickness of settled ground is 3,7 m.

After analysis the settlement was calculated: primary: s' = 1.37 (cm), total: S = 1.37 (cm) <SDOP = 5.00 cm.

4.2. Technical assesment

The wings are of unknown degree of reinforcement, and thus of unknown capacity and certainly they are not able to withstand the load of lateral earth pressure of ground from a passing oversized vehicle. It is required to impose a vehicle route by geometric object. If one need to get closer to the edge of the culvert route (regardless of which side) soil lateral pressure should be entirely eliminated from the wings, eg through equipment or geogrid.

In order to reduce the vertical load on the conduit and thereby reduce the impact of the load on the ground, use of geogrid strengthening soil. This structure must be composed of several layers of geogrid in spaced every 30 cm. Backfill between geogrid should be compacted to Is> 0.95.

Because of the new load of oversized moving transport the steel stamps under the slab is required when the heavy trucks are moving.

Steel stamps cannot directly touch the ends of the floor and the bottom slabs - use hardwood joists (oak, beech) is necessary. Stamps need to be adjust by screws to a full stop. The side walls need to be prevented by installing wooden or steel struts, which also can not directly touch the walls, the wooden buttresses is necessary to use of the same cross-section as joists.

In the case of wooden buttresses the wedges and for steel elements the adjustment screws can be used. The cross-section of 140x140 mm for compressed wood elements is required.

4. CONCLUSION

In the paper the importance of farm bridge management system that covers also infrastructure was presented. These constructions of bridges are often omitted from the record system because of their small size that makes the efficient and safe use of them and associated facilities impossible. As some needed information is available in hard copy it is therefore necessary to collect all the information in one system and update them. These are mainly the information in the discretion of the management of roads.

The paper underlines the main PAR bridge management activities such as inspections, assessments, testing, maintenance, and replacement.

The types of record should include: measures of the condition of each structural element and component of a bridge, the load carrying capacity of a bridge, the rate of deterioration of elements and components of a bridge, programme of maintenance.

The paper emphasizes that management of analysed bridges requires the prioritisation of maintenance needs, planning the procedures for performing the maintenance, and optimisation of the bridge life-cycle cost.

Bridge management associated with the functions, such as bridge condition assessment, load capacity assessment, deterioration prediction, determination of available treatments and their effectiveness, lifetime, and cost, criteria setting for prioritising maintenance needs, decision making for resource allocation, development of a management information system, requires the global activity covered by the management system or company.

WYBRANE ZAGADNIENIA SYSTEMU ZARZĄDZANIA OBIEKTAMI MOSTOWYMI TYPU PRZEJAZD GOSPODARCZY

Streszczenie

W artykule przedstawiono przegląd obiektów mostowych typu przejazd gospodarczy, propozycję wzmocnienia analizowanego obiektu znajdującego się pod obciążeniem ponadnormatywnym. Zwrócono uwagę na ważność systemu zarządzania obiektami typu przejazd gospodarczy i jego ciągłej aktualizacji.

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