CONSTRUCTION OF BRIDGES IN POLAND IN THE YEARS 1995 – 2005

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BẢN TÓM TẮT

Bài báo trình bày những thành tựu trong kỹ thuật xây dựng cầu của Ba Lan trong thập kỷ qua và những xu hướng chính trong quá trình phát triển cầu. Thời điểm xây dựng những cây cầu lớn và những yếu tố đặc trưng trong kỹ thuật cầu của Ba Lan được diễn tả và bàn luận trong bài báo này.

ABSTRACT

The paper presents the achievements of the Polish bridge construction engineering during the last decade and the main trends in its development. The largest bridges built during that period are described and the specific features of Polish bridge engineering are discussed.

1. Introduction

A sharp rise in the intensity of road traffic has been observed in Poland during the recent fifteen years. This is the result of social and economic transformations that were initiated in the nineties. The Polish Government was forced to work out a strategy of road network development, with particular stress placed on motorways and expressways. It is planned that by 2015 about 1600 kms of motorways and 400 kms of expressways will be built [17]. The layout of planned road system is shown in Fig. 1. As of January 2004, the national road network comprised about 18,000 kms of roads. That included only 480 kms of motorways and 220 kms of expressways.

In addition to construction of new roads of higher standard, it is also essential to upgrade the existing roads to the 11.5 tons axle load required by the European Union. Many years of negligence in the development of local infrastructure brought about the need to construct many by-pass roads around cities and towns. A number of studies indicate that construction of new roads will also involve the erection of about 1500 new bridges and upgrading of 5000 existing bridges. This is an enormous effort which requires substantial funding. Part of the funds will be provided by the European Union, which Poland joined in 2004.

2. Standard solutions

Construction of a series of bridges along motorways enables their optimisation in terms of cost and durability [10]. Bridge superstructures are most often made of reinforced or prestressed concrete and are of short to medium span of up to 40 m. Slabs are preferred with shorter spans, while for longer spans slabs and beams are used with two or three sturdy beams of trapezoidal cross section. Spans made of prefabricated beams, avoided recently for historical reasons, are now receiving more interest.

Piers in such typical structures are of columnar design, whereas abutments have a massive form. Usually the supports rest on spread foundation, and in the case of bridges over watercourses, large-diameter piles a few to a dozen or so metres long are used. A typical bridge over a motorway is shown in Fig. 2.

Fig. 1. Planned road network In Poland [17]

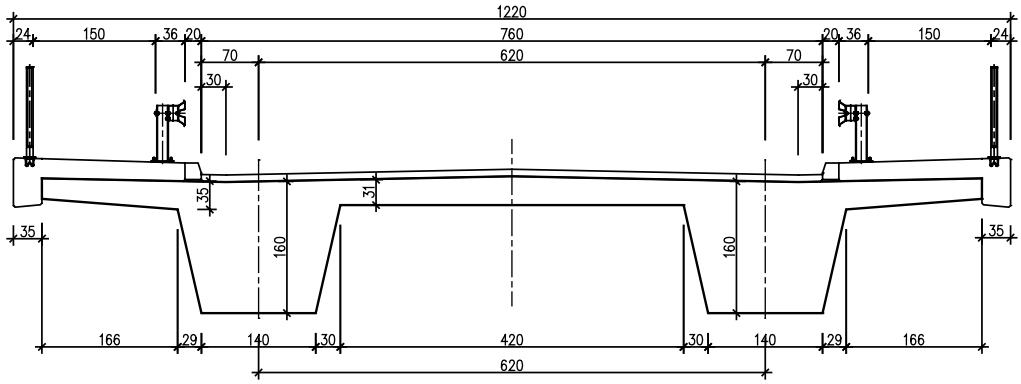

Fig. 2. Cross section of typical bridge over a motorway

3. Large bridges

Progress in technology and design that was made during the recent ten years enabled the implementation in Poland of virtually all modern technologies of bridge construction applied in the world. Records in span length are beaten again and again [4]. The largest bridges erected (or under construction) in Poland are listed in Table 1.

One of the notable achievements was the construction of the first cable stayed bridges. These include the Swietokrzyski Bridge (Fig. 3) [7] and Siekierkowski Bridge (Fig. 4) [5] in Warsaw, John Paul II Bridge in Gdansk (Fig. 5) [3] and Millennium Bridge in Wroclaw (Fig. 6) [13]. Construction of a bridge across Vistula River in Plock (Fig. 7), with a record span of 375 m, is near its completion [8].

The largest Polish bridges are steel structures. These mainly include arch bridges: Kotlarski Bridge across Vistula River in Cracow (Fig. 8) with a span of 166 m [9] and across Dzwina River in Wolin (Fig. 9) with a span of 165 m [15]. Construction of a new arch bridge across Vistula River in Pulawy, with a span of 212 m, is to commence soon.

Large bridges are also made of prestressed concrete box girders constructed by the free cantilever method [1][6]. The record holder, with a span of 132 m, is the Zwierzyniecki Bridge across Vistula River in Cracow (Fig. 10) [6]. Stepwise launching and span by span method has been applied at a number of bridge construction sites. The most interesting structures include those of the Czerniakowska interchange in Warsaw (Fig. 11) [14] and a few bridges on the South.

Table 1. List of the 10 largest bridges under construction in Poland

No	City	River	Design	Material	Span [m]	Year of construction
1	Plock	Vistula	cable stayed	steel	375	2005
2	Warsaw (Siekierkowski)	Vistula	cable stayed	steel / concrete	250	2002
3	Gdansk (Jana-Pawla II)	Vistula	cable stayed	steel / concrete	230	2001
4	Pulawy	Vistula	arch	steel	212	project
5	Warsaw (Swietokrzyski)	Vistula	cable stayed	steel / concrete	180	2000
6	Cracow (Kotlarski)	Vistula	arch	steel	166	2001
7	Wolin	Dzwina	arch	steel	165	2003
8	Wroclaw (Milenijny)	Odra	cable stayed	concrete	153	2005
9	Cracow (Zwierzyniecki)	Vistula	beam	concrete	132	2001
10	Torun	Vistula	beam	concrete	130	1998

Fig. 3. Swietokrzyski Bridge over Vistula River in Warsaw

Fig. 4. Siekierkowski Bridge over Vistula River in Warsaw

Fig. 5. Third Millenium John Paul II Bridge in Gdansk

Fig. 6. Millenium Bridge over Odra River in Wroclaw

Fig. 7. New Plock Bridge over Vistula River in Plock

Fig. 8. Kotlarski Bridge over Vistula River in Cracow [18]

Fig. 9. Dziwna Bridge in Wolin

Fig. 10. Zwierzyniecki Bridge over Vistula River in Cracow [18]

Fig. 11. Czerniakowska interchange Bridge in Warsaw

4. Footbridges

Many interesting footbridges have recently been erected in city centres, commercial centres and near sports arenas. Many a time they form distinctive landmarks, have a unique shape or adapt to the surroundings if located within historical area. Worth noting are the footbridges in Wroclaw (Fig. 12) [2] and across the A4 motorway (Fig. 13).

Fig. 12. Lesnica Footbridge in Wroclaw

Fig. 13. Footbridge over A4 motorway in Ruda Slaska

5. Development trends

The main trends observed in the construction of bridges in Poland [12] include:

- increasing length of spans
- application of new materials
- new architectonic forms

- improved durability of structures
- systemic bridge management

Geographical characteristics of Poland – lack of large rivers, straits and islands – do not make the country a contender in beating world records in span lengths. Most of the large bridges in Poland have spans not longer than 300 m. Actual needs are confined to just a few bridges with a span of up to 500 m. Suspension bridges allow for the longest spans. In Poland, where terrain obstacles are relatively small, these types of structures are seldom erected, save for footbridges.

One of the driving forces of bridge engineering is the application of new, unique construction materials. These include new grades of concrete and fibre-reinforced polymers. Several bridges in Poland have been built with the use of concrete grade higher than B60 and light and self-compacting concrete grades [11]. Polymer composites have been used in the construction of only one footbridge in Poland [16]. However, research is under way to expand the applications of these materials.

Pursuit of unique architectonic forms is invariably connected with increased capital costs. However, there is a drive to bestow promotional significance on new bridges. This mainly applies to big and rich cities.

New solutions aimed at improving structure durability are gaining in interest recently. This does not only involve the use of stronger and more corrosion-resistant materials, but also the application of protective means, such as coatings and insulation, as well as advanced bridge furnishings (epoxy deck coating, drainage devices, safety devices, bearings, expansion joints).

An act on bridge management came into force in 2002. After that an inventory was taken of most of the existing bridges and the local owners were forced to take interest in the technical condition of their property. This is just the beginning of the process of implementing systemic management of bridges.

6. Summary

Poland is a small country with a relatively low economic potential. Therefore, construction industry may offer opportunities for the country's promotion abroad. During the recent ten years Polish engineers were able to gain the necessary experience. Now we can say that Polish bridge engineering stands up to European standards in terms of proficiency and methods.

Acknowledgments

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