AS FAST AS POSSIBLE
– AN EXAMPLE OF A QUICK RECONSTRUCTION
OF A BRIDGE IN DIFFICULT ATMOSPHERIC CONDITIONS

Andrzej ZACHWIEJA*, Arkadiusz BUREK*, Dariusz SOBALA**
*) MSc, Eng., Stalmost Sp. z o.o., 1-go Sierpnia 12, 37-450 Stalowa Wola, Poland
**) D.Sc. Eng., Rzeszow University of Technology, W. Pola 2, 35-959 Rzeszow, Poland
and Aarsleff Sp. z o.o., Lambady 6, 02-830 Warszawa, Poland

Abstract

The paper shows an example of a quick reconstruction of a small road bridge with the use of a compilation of two technologies using prefabricates: prefabricated reinforced concrete driven piles and a Super-Core span structure type 35B. Combination of these two technologies allowed the reconstruction of a bridge in Czajkowa, comprising the disassembly of the existing bridge and construction of a new one, within only 33 calendar days. The work was carried out in late fall, from November 4 to December 6 2005, with the working day relatively short and unfavorable weather conditions.

Key words: construction of bridges, flexible corrugated steel structures, prefabricated piles

1. INVESTMENT

As a result of a flood, the bridge located in the area of Mielec Forest Inspectorate, in Czajkowa in the course of a district road joining Tuszów Narodowy and Ostrowy Baranowskie, was damaged (fig. 1).

The District Road Authority in Mielec was the reconstruction investor. The range of the investment comprised the disassembly of the existing bridge and construction of a new one according to a design [1] developed by Kazimierz Pelc and Zbigniew Jajuga, a team of engineers of the INFO-PROJEKT Rzeszów design office.

---

1 stalmost@go3.pl
2 d.sobala@prz.edu.pl
2. THE RECONSTRUCTION PLAN

The reconstruction plan [1] assumed the following activities in the order of their accomplishment:

- disassembly of the existing bridge;
- driving prefabricated piles;
- driving a steel sheet pile wall protecting the foundations;
- reinforcement and concreting piles caps;
- assembly of the bridge span;
- forming of the bridge span backfill;
- assembly of equipment;
- completion of road works and regulation of the river bed.

The designed bridge (fig. 2 and 3) is a structure with the following technical parameters:

- bridge span structure type – Super-Cor 35B;
- span length – 7.945m;
- length of steel structure at the base – 16.20m;
- foundation – 20 concrete prefabricated driven piles (35x35x600cm) + reinforced concrete pile caps (2.0x0.5x16.8m);
- foundation protection – 3.0-meter-long sheet pile walls (GZ-4 profile);
- road on the bridge with a 5.0-meter-wide bitumen surface.
During the reconstruction, the contractor introduced a change to the design by replacing 35x35x600cm prefabricated piles with 30x30x700cm (C40/50) ones according to the Aarsleff catalog [2]. The change was intended to accelerate work completion by using standard piles available in the Contractor’s warehouse.
2. THE RECONSTRUCTION WORKS

The tender for the bridge reconstruction was settled in autumn of 2005. The financial resources not used for the reconstruction could be irrevocably lost at the end of the fiscal year. The investment was to be completed before the end of the year, practically in the first half of December 2005.

Table 1. Abbreviated schedule of activities

| DK | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| RR |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| IP |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| IS |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WO |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| MK |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WZ |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| RK |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| RD |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| MW |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| PP |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |


The schedule of completed work (table 1) shows how this task was practically fulfilled in unfavorable weather conditions from November 4 to December 6 2005. The photographs (fig. 4-7) show key phases of bridge construction.
As fast as possible – an example of a quick reconstruction…

Fig. 5. Steel structure assembling

Fig. 6. Equipment assembling
Fig. 7. Bridge overview after the reconstruction

3. COST ANALYSIS

Table 2. Percentage list of costs of the reconstruction

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Percentage share in costs</th>
<th>Contractor</th>
<th>Investor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adjustment costs</td>
<td></td>
<td>1.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>2</td>
<td>Disassembly works</td>
<td></td>
<td>2.8%</td>
<td>2.3%</td>
</tr>
<tr>
<td>3</td>
<td>Excavation</td>
<td></td>
<td>2.3%</td>
<td>1.9%</td>
</tr>
<tr>
<td>4</td>
<td><strong>Installation of piles</strong></td>
<td></td>
<td><strong>5.9%</strong></td>
<td><strong>4.8%</strong></td>
</tr>
<tr>
<td>5</td>
<td>Installation of sheet pile walls</td>
<td></td>
<td>9.7%</td>
<td>8.0%</td>
</tr>
<tr>
<td>6</td>
<td>Piles cups</td>
<td></td>
<td>7.4%</td>
<td>6.1%</td>
</tr>
<tr>
<td>7</td>
<td><strong>Purchase and assembling of the steel structure</strong></td>
<td></td>
<td><strong>32.7%</strong></td>
<td><strong>26.8%</strong></td>
</tr>
<tr>
<td>8</td>
<td>Backfill forming</td>
<td></td>
<td>4.7%</td>
<td>3.8%</td>
</tr>
<tr>
<td>9</td>
<td>Finish-off works and equipment assembling</td>
<td></td>
<td>3.4%</td>
<td>2.8%</td>
</tr>
<tr>
<td>10</td>
<td>Road works</td>
<td></td>
<td>8.9%</td>
<td>7.3%</td>
</tr>
<tr>
<td>11</td>
<td>River bed regulation</td>
<td></td>
<td>10.3%</td>
<td>8.5%</td>
</tr>
<tr>
<td>12</td>
<td>Profit</td>
<td></td>
<td>10.0%</td>
<td>8.2%</td>
</tr>
<tr>
<td>13</td>
<td>22% VAT</td>
<td></td>
<td>-</td>
<td>18.0%</td>
</tr>
</tbody>
</table>

After the reconstruction, a cost analysis was carried out. The real share of particular tender’s costs was estimated upon.
The table 2 presents the percentage share of the costs completing particular work activities with reference to the net amount (contractor’s costs) and gross amount (investor’s costs). These costs differ as it is impossible to deduct VAT by local authority units.

The overall investment cost amounts to almost 800,000 PLN. The purchase and assembling of the steel structure of the bridge span was the biggest expense. The next expenses were taxes - 18% of the amount spent by the Investor. The fourth place was the contractor’s profit, which is also taxable. Therefore, apart from the new bridge users, it is the state which is the biggest beneficiary of the investment carried out by local authority. The real share of tax in the investment completion costs exceeds 20%.

It is noteworthy that the cost of pile foundations made of prefabricated piles constitutes only 4.8% of the investment gross value, and is nearly twice as low as the cost of the sheet pile walls, and 50% lower than the cost of the piles cups. Given that the installation procedure took only one day, the result is a very attractive way of foundation for this type of structure.

![Fig. 8. Share of particular cost items in the investor’s expenses](image-url)
5. SUMMARY

The correct selection of foundation type and bridge span structure in the design allows the contractor to be practically independent from the unfavorable weather conditions. This permitted completing the investment within 33 calendar days (26 working days), with relatively short work shifts (due to short autumn days) and limited number of employees (five laborers and one engineer, on average). The index economical analysis carried out in the paper shows that:

• the highest cost in an investment of this type is the steel structure cost (26.8%);
• taxes (ca. 20% of the investment value) are a significant economic barrier for local authority;
• prefabricated piles are an economical (4.6% of the investment value) and fast way of foundation for buried flexible frame and arch steel structures.

The example presented in the paper can be successfully used in planning and constructing of small bridges by all investors forced to work quickly and to reduce costs.

REFERENCES


TAK SZYBKO JAK TO TYLKO MOŻLIWE – PRZYKŁAD SZYBKIEJ REKONSTRUKCJI MOSTU W TRUDNYCH WARUNKACH ATMOSFERYCZNYCH

Streszczenie

Referat prezentuje przykład szybkiej rekonstrukcji malego mostu drogowego z zastosowaniem połączenia dwóch technologii wykorzystujących prefabrykaty: prefabrykowane, żelbetowe pale wbijane oraz konstrukcja Super-Cor typu 35B. Kombinacja tych dwóch technologii umożliwiła rekonstrukcję mostu w miejscowości Czajkowa, na którą złożyły się: rozbiórkę dotychczasowego mostu i montaż nowego w ciągu zaledwie 33 dni. Prace zostały wykonane półmiesiąc przed 4 listopada do 6 grudnia 2005 roku przy relatywnie krótkich dniach pracy i niesprzyjających warunkach pogodowych.

Słowa kluczowe: montaż mostów, konstrukcje podatne z blachy falistej, prefabrykowane pale
Buduj z najlepszymi

Oddział Budownictwa Ogólnego w Lesznie
ul. Chociszewskiego 2 a
64-400 Leszno
tel. +48 65 529 28 01
fax. +48 65 529 39 57
e-mail: budownictwo.leszno@skanska.pl
www.skanska.pl
1992 THE FIRST IN ROMANIA

TUBO-TRADE

tel. (+40722) 362-976
fax. (+40259) 431-555
eng. Teodor SAVA  E-mail: tubotrade@yahoo.com
ViaCon Polska Sp. z o.o.
ul. Przemysłowa 6, 64-130 Rydzyna,
tel. +48 65 525 45 45, fax +48 65 525 45 55
www.viacon.pl

Oferuje:

- rury i konstrukcje podatne do budowy oraz naprawy:
  - przepustów drogowych i kolejowych,
  - mostów, wiaduktów, tuneli,
  - przejazdów gospodarczych,
  - przejść dla zwierząt,

- system kanalizacji deszczowej

- geosyntetyki:
  - geowłókien i geotkaniny do drenażu, separacji i wzmocnienia gruntu,
  - geosiatki do zbrojenia gruntu,
  - słieki do wzmocnienia nawierzchni bitumicznych,

- papę termozgrzewalną do izolacji betonowych
  i stalowych płyt pomostowych
