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AS FAST AS POSSIBLE
An example of a quick reconstruction of a bridge in difficult atmospheric conditions

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SUMMARY

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.

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Fig. 1. An overview of the bridge before the reconstruction

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.

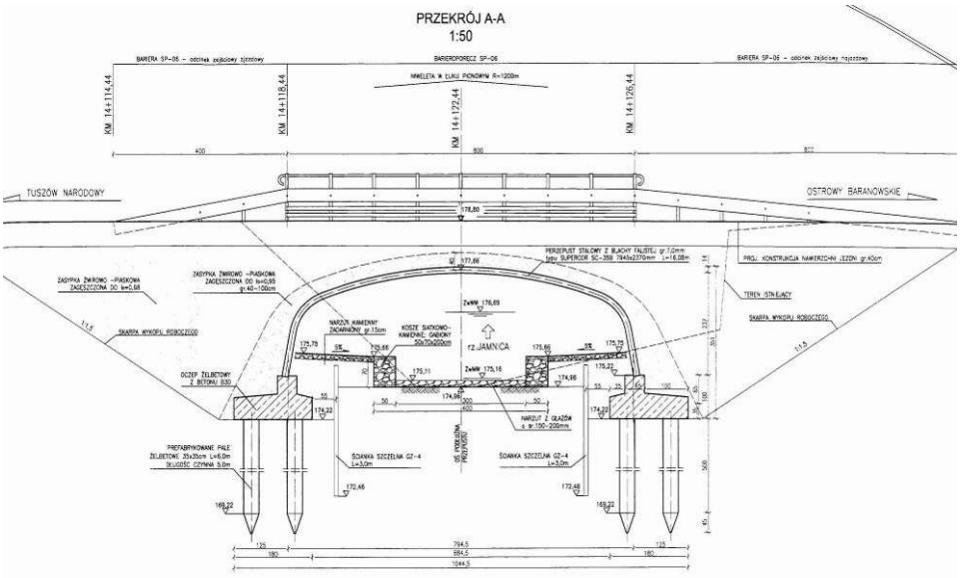

Fig. 2. Longitudinal section

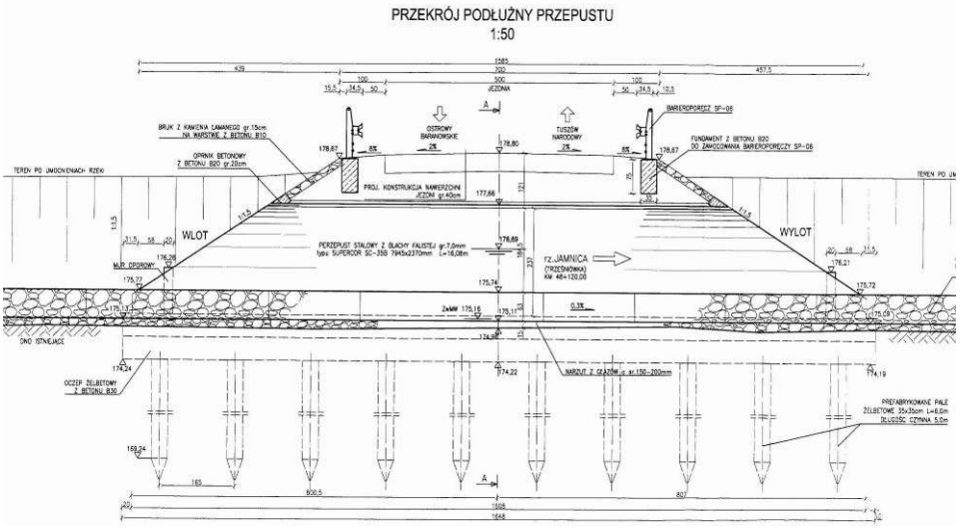

Fig. 3. Cross section

During the reconstruction, the contractor introduced a change to the design by replacing of 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

Fig. 4. Driving of 30x30x700cm prefabricated piles

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																																	
DR	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

Explanations: DK/DR – calendar/working days, RR – disassembly work, IP – piles installation, IS – sheet piles installation, WO – piles cups construction, MK – steel structure assembling, WZ – backfill formation, RK – river bed regulation, RD – road works, MW – equipment assembling, PP – finish-off works.

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.

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

No.	Description	Percentage share in costs	
		Contractor	Investor
1	Adjustment costs	1,8%	1,5%
2	Disassembly works	2,8%	2,3%
3	Excavation	2,3%	1,9%
4	**Installation of piles**	**5,9%**	**4,8%**
5	Installation of sheet pile walls	9,7%	8,0%
6	Piles cups	7,4%	6,1%
7	**Purchase and assembling of the steel structure**	**32,7%**	**26,8%**
8	Backfill forming	4,7%	3,8%
9	Finish-off works and equipment assembling	3,4%	2,8%
10	Road works	8,9%	7,3%
11	River bed regulation	10,3%	8,5%
12	Profit	10,0%	8,2%
13	22%VAT	-	18,0%

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.

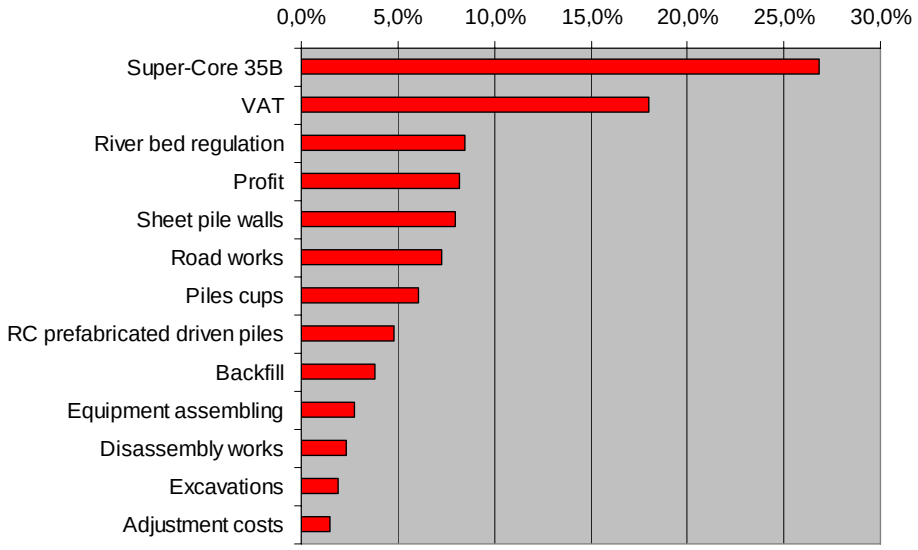

Fig. 8. Share of particular cost items in the investor's expenses

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

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