DESIGN AND BUILD SYSTEM IN POLISH PUBLIC SECTOR – CASE STUDY

Michał Juszczyk[1], Agnieszka Leśniak[1]*, Krzysztof Zima[1]

[1] Institute of Building and Transport Management, Faculty of Civil Engineering, Cracow University of Technology, Warszawska Str. 24, Kraków 31-155, Poland

Abstract

One of the possible systems of project delivery is Design & Build, which is widely used in many countries. In this system, the client concludes a contract agreement with only one company, the contractor, to carry out both design and construction of works. Deciding on this form of delivery of a public project, the client is obliged to conduct a single proceeding aiming to selection of the contractor. This paper presents the current situation related to the use of D&B on the public procurement market in Poland. Attention is drawn to the regulations on this procurement method, used modes and selecting criteria. The case study of Design & Build project is analysed. Benefits and problems of practical implementation of this system are briefly discussed.

Key words

Design & Build; functional-utility programme; polish construction market; public procurement

To cite this paper: *Juszczyk, M., Leśniak, A., Zima, K. (2014). Design and Build system in polish public sector – case study, In conference proceedings of People, Buildings and Environment 2014, an international scientific conference, Kroměříž, Czech Republic, pp. 221-231, ISSN: 1805-6784.*

*Corresponding author: Tel.: +48-12-628-23-93, Fax: +48-12-628-23-29
E-mail address: alesniak@izwbit.pk.edu.pl

1 INTRODUCTION

The realization of a construction project in Poland under public procurement procedures is limited by the Public Procurement Law Act of 29 January 2004, as amended, in two ways. It can take place in the so-called conventional method, in which the ordering party separates the performance of design work from the order for performance of construction work (Design-Bid-Build) or in the Design & Build system, in which one contractor is entrusted with the performance of both design and construction work. Article 2 of the Public Procurement Law Act defines an order for construction work as the performance or design and performance of construction work (specified in regulations issued pursuant to the Ordinance on specification of construction work) or of a building, as well as the completion of a building by means of any means, according to the requirements specified by the ordering party.

The Design &Build system has appeared in the Polish law governing public procurement market only recently, in 2004 but is has a much longer history in Western Europe and in the USA. It was discovered by contractors in the early 1960's when a number of building contractors began to offer the package deal [1]. In this system a single contractor is entrusted both design works and implementation. Depending on the type of project, the scope of work ordered from the contractor in the Design & Build system may vary slightly. The primary tasks of the contractor most often include [2].

- the conduct of pre-design studies,
- development of construction and detailed designs,
- obtainment of the permits required by law (e.g. construction permit), confirmations, approvals, opinions, and expert opinions (e.g. environmental opinions),
- development of cost assessments
- complete realization of the construction of an ordered building by means of own or outside resources (subcontractors' resources),
- delivery and assembly of devices necessary for the building's equipment (e.g. passenger elevators in buildings),
- possible training and technical start-up,
- development of as-built documentation,
- obtainment of a permit for exploitation of the building.

The main aim of the paper is the case study of Design & Build project. Benefits and problems of practical implementation of this system are analysed and briefly discussed. The indirect aim of the paper is the presentation of current situation in Poland related to the use of D&B on the public procurement market. Attention is drawn to the regulations on this procurement method, used modes and selecting criteria.

2 PROCUREMENTS OF DESIGN&BUILD CONTRACTS ON PUBLIC BUILDING MARKET

The share of orders for construction work in the Design & Build system in all granted orders for construction work has been presented on figure 1 (based on data from the Public Procurement Office). It is worth emphasizing that in successive analysed years, this share was equal to 0,98%, 1,23%, 1,19%, 1,24%, of all granted orders, respectively. This results from the fact that public ordering parties are using this system more and more often, although the increase in the realization of orders in the D&B system is very slow.

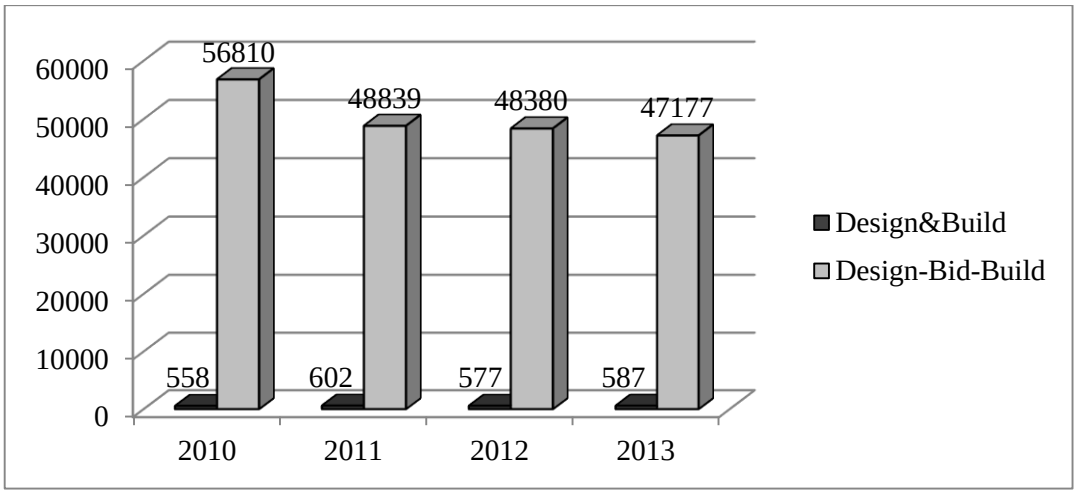

Fig. 1: Share of public procurement procedures for the design and performance of construction work in all orders for construction work.

In 2008, 272 Design & Build orders were granted to realize public investments. In 2013, based on data from the Public Procurement Office, as many as 587 orders were recorded, which is more than twice the number of orders granted in 2008 (Fig. 2). It is worth noting that the rise in the popularity of this system of investment realization is convergent in time with European Union funds being granted for the years 2007-2013.

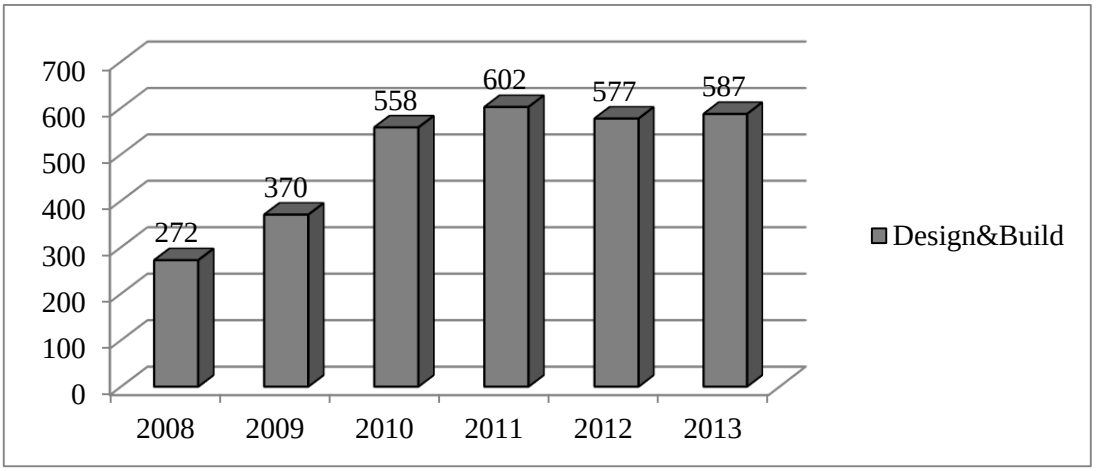

Fig. 2: The number of public procurement procedures for design and performance of construction work.

Based on data from the Public Procurement Bulletin, it was proven that the number of orders obtained by public procurement using the Design & Build system increases from year to year. The Polish Public Procurement Law distinguishes seven different modes of awarding contracts for construction works: open tendering and restricted tendering (the basic procedures), negotiated procedure with publication, competitive dialogue, negotiated procedure without publication, single-source procurement procedure, or by electronic bidding procedure, under the circumstances specified in the PPL. Selection of the procedure depends solely on the prerequisites and limitations specified in the said Law, and these do not address the project delivery system. The Law does not distinguish any special modes for selection of a contractor when the client chooses the Design and Build system. The dominant mode of awarding contracts in the D&B system is open tendering. This is the type of contract awarding, in which, following a public contract notice, all interested contractors may submit

their tenders (Article 39 of the PPL). In 2013 it was applied in about 94% D&B contract (similarly in 2012). In 2011, 82,07% of all orders were open tenders, and in 2012 there were 84,43% of them [Report of the President of the Procurement Office 2013).]. It is worth noticing that this mode is generally the most popular in awarding public contracts for construction works in Poland regardless of the system of the project performance [3].

The selection of the contractor in Poland is usually based on the lowest price criterion as it was mentioned in [4]. The selection of the contractor with the lowest price is not a good solution [5] and a multi-criteria assessment of contractors increases the chances for successful completion of the project [3], [6]. Many mathematical models are developed to support selection of the D&B contractor [5], [7], [8], [9], [10].

3 FUNCTIONAL-UTILITY PROGRAMME - DESCRIPTION OF THE D&B CONTRACT

According to art. 31, item 2 of the Public Procurement Law, a functional-utility programme is necessary in Design & Build system. The Ordinance of the Minister of Infrastructure dated 2nd September 2004 on detailed scope and form of design documentation, technical specification, performance and acceptance of construction works and a functional-utility programme (Journal of Laws of 2004, No. 202, section 2072) indicates the necessary elements for drawing up. As the Public Procurement Law came into force, a functional-utility programme was introduced into the system public procurement in 2004. A functional-utility programme is used as the basis for determining the predicted costs of design works and construction works, describing the subject public procurement, preparing the offer, calculating the price of design works. The scope specified in the ordinance does not provide sufficient conditions for defining the quality of architecture, so the structure of a functional-utility plan should be supplemented with the elements specifying individual components. The accuracy of the descriptive part is very important, because this part contains the supplement in the form of guidelines on individual features and parameters of quality, due to the need for protecting space quality. According to § 16 of the Ordinance of the Minister of Infrastructure dated 2nd September 2004 a functional programme should contain a cover page, descriptive part and informative part.

The descriptive part of functional program includes:

I. a general description of subject of the contract;
II. a description of the client's requirements in relation to the contract.

Ad. I. General description of subject of the contract include:
1) specific parameters defining the size of the object and scope of work;
2) the current conditions of the subject of the contract;
3) the general functional and operational characteristics;
4) the specific properties of functional and operational indicators expressed in surface-enclosed structures determined in accordance with the Polish Standard PN-ISO 9836:1997. "The performance of the construction industry. Identifying indicators of surface and cubic capacity" as required by the specific nature of the work, in particular:
a) the usable areas of individual rooms together with an indication of their functions,
b) the surface-cubature index, including an indicator of the share of movement area in the net area of the surface
c) the other surfaces, if they are not usable derivative of the previously described indicators
d) determination of the size of possible overruns or out parameters adopted by areas and volumes and indicators.

Ad II. Client's requirements in relation to the of subject of the contract you must specify by description of:

1) preparation the construction site;
2) architecture;
3) construction;
4) installation;
5) finishing's;
6) land use planning.

Description of that requirements includes:

1) the characteristics of the object of construction and engineering solutions and economic indicators;
2) the terms of the performance and acceptance of works corresponding to the content of the technical specifications of the performance and acceptance of works

A structure and number of flats, type and programme of accompanying services, standard of finishing flats and common areas, requirements concerning installations and their durability are important for the residential buildings. The function and purpose of the facilities or networks are important in case of engineering facilities and utility networks in the area. Their basic parameters concerning dimensions, efficiency, construction materials, security and durability, etc. are also required. The informative part includes documents, statements, legislation, building codes and other documents necessary for designing construction works.

The authors of the normative act think that it is enough if the investor specifies its requirements concerning the function, technology and utility features of the building to prepare a functional programme properly [11]. The functional-utility programme should have three levels where architecture acquires its features:

- descriptive features
- parametric features
- material features

The highest level is taking care of the quality by indicating important spaces and setting desired directions of shaping these spaces – providing descriptive features [11]. It will be a description of the most important composition elements [Fig 3.].

Next level - a medium level - is a description of an architectural elements of individual components – providing parameter features, not to set limits for an entire building, but only for its part. In the holistic approach, these can be non-exceedable dimensions or an energy indicator for the building covered by the design as a facade rhythm, axiality, characteristic angles which connect component cubature or expenditure indicator, which takes into account a high standard of architecture, including estimated maximum and minimum thresholds, which would help to avoid excessive savings, contributing to poorer aesthetic features [11]. The low level is a definition of providing material features for example characteristic pattern, colour, selection of specific material or specific type of equipment.

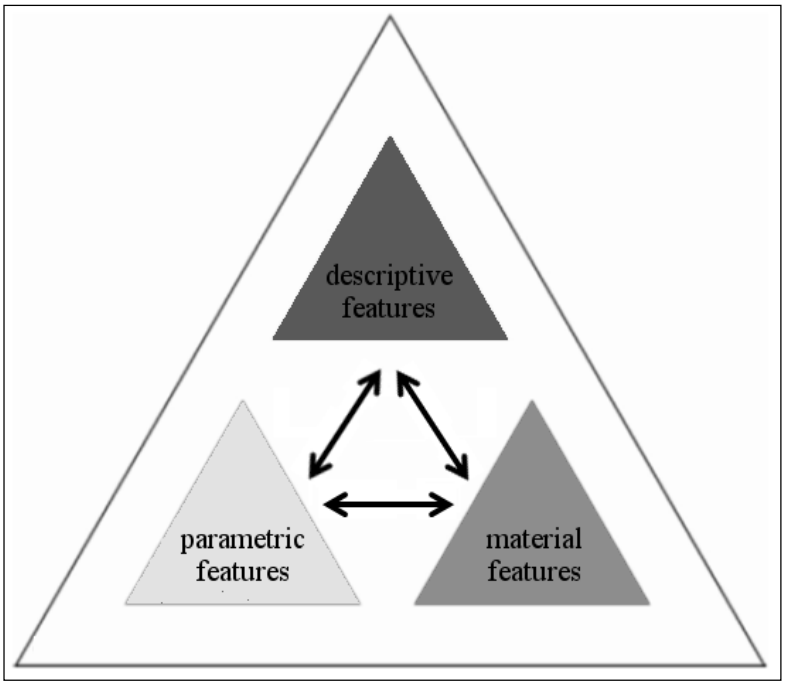

Fig. 3: The relations scheme of attribution in extended method of PFU.

4 CASE STUDY

4.1 Basic information about the analyzed project

The aim of this case-study is a concise presentation and synthetic analysis of the issues of selected construction project realized in the "design and build" system. Presented project was a public contract - the analysis was made on the example of a project which included repair and reconstruction works completed on the bridge structure in Poland, Małopolska province. Exact location of the object, the data about the investor and the contractor has been reserved due to the presented cost data. (The paper uses the information collected by Eng. Monika Rudnicka during her work on the engineer's diploma which was prepared under the supervision of one of the co-authors of this paper.) Basic information about the bridge structure are presented in the table 1.

Tab. 1: Basic information about the object

Type of the construction object	- bridge structure, bridge over a river
Completion date of the object	- 1978-1980
Load classification[1]	- IT-80
Structure of the object	- composite steel and reinforced concrete load bearing structure (steel girders, composite plate girder with reinforced concrete slab) - three column supports, founded on piles
Object's size	- six spans, the total theoretical span of the bridge - 320 m
Type of contract	- "design and build" public contract

The reason for undertaking repair and reconstruction works on the bridge arose from the technical condition of the object. The technical wear and weakening of the structure (which actually was caused by the floods that happened in May and June 2010) caused the decision

[1] according to Polish Standards holding true and being actual at the time when the building was originally designed and completed

of the responsible authorities to repair the bridge. Design and build system has been chosen for this project. Bidding and awarding winning contractor was preceded by the necessary actions of the public investor. According to legal regulations which are in force in Poland the investor has prepared the tender documents and has estimated the expected value of the project. In accordance to applicable Polish law investor has prepared description of the subject-matter of contract for the design and execution of construction works in the form of the functional and utility program – called later in the text FUP. The investor has also estimated envisaged cost of design works and the envisaged cost of construction works on the basis of the information included in FUP.

Both the technical condition and the requirements concerning the project has been presented by the investor in the FUP – actual scope of the design works and in consequence repair and reconstruction works arose from this particular document. Due to the nature of construction works in this particular project, descriptions of damages of the structure included in the FUP were especially important. The damages included:
- numerous cracks and defects in concrete pillars,
- numerous cracks and defects in concrete bridge deck slab,
- corrosion of the bridge deck slab reinforcement,
- corrosion occurring in numerous places in steel elements of the load bearing bridge girders,
- damage to anti-corrosion coatings of steel elements of the bridge,
- numerous damages to the bridge deck slab drainage system,
- deformations, local cracks and defects of the roadway and sidewalks pavements,
- deformations, local cracks and defects of the driveway pavement.

After careful analysis of the documents, the investor has decided to complete the project in two stages:
- the first stage involved the repair and reconstruction of left river bank revetments in the area of the bridgehead,
- the second stage involved reparation and reconstruction of a bridge structure.

The investor has also estimated the value of the contract in accordance to applicable legal regulations as envisaged cost of construction works and envisaged cost of design works:

$$WRB = \sum_i WC_i \cdot n_i$$

where:
WRB – envisaged cost of construction works,
WC_i – cost indice of the *i*-th cost component,
n_i – number of measurement units of the *i*-th cost component.

$$WPP = W\% \cdot WRB$$

where:
WPP – envisaged cost of design works,
WRB – as above,
W% – percentage indice.

Contractor responsible for the whole project has been awarded a public contract according to the procedures and legal regulations applied in Poland.

Awarded contractor (called later in the text contractor) was responsible for preparation necessary design documentation for the whole scope of the project (mentioned in the descriptions of two project stages). The design stage included development of the design for bridgeworks, road works, gas network and the plan of traffic arrangement. The contractor has

also obtained all the necessary permits and administrative decisions. After the preparatory stage the contractor started the construction works. The scope of the construction works in respect of the FUP and the way of execution is prepared in the table 2 and 3.

Tab. 2: Scope and the way of execution of construction works in the first stage.

Scope of construction works described in FUP	**The way of execution of construction works resulting from design documents and adopted technological and organizational solutions**
- repair and restoration of damaged revetment on the left bank of the river	- reconstruction of the revetment made of the boulders
- construction of the revetment in the pillar area,	- reconstruction of the revetment made of the boulders
- repair and reconstruction of the bridgehead on the left bank of the river	- dismantling the stone pavement, reconstruction of the base made of concrete, reconstruction of the bridgehead made of the boulders
- repair and reconstruction of the bridgehead on the right bank of the river	- filling cavities with gravel, dismantling of the existing pavement made of stone, reconstruction of the base made of concrete, reconstruction of the bridgehead made of the boulders
- strengthening the pillars of the bridge	- removing corroded concrete from the pillars and strengthening the pillars of the bridge by applying steel mesh reinforcement and additional layer of concrete

Tab. 3: Scope and the way of execution of construction works in the second stage.

Scope of construction works described in FUP		**The way of execution of construction works resulting from design documents and adopted technological and organizational solutions**
Preparatory works and site organization	- site organization	- organization of the site in such a way that makes possible the usage of the bridge,
	- temporary traffic organization	- installation of temporary road marks and traffic signals,
	- geodetic inventory	- geodetic measurements of object ordinates and adjacent land
Repair and reconstruction of structural elements (bridge spans)	- installation of deck slab reinforcement and fastening pavement covers	- placement of the lower and upper mesh reinforcement
	- construction of the bridge deck slab	- concrete placement in in the deck slab, placement of concrete of C30/37class
	- repair of the underside surface of the existing deck slab	- repair of the underside surface of the existing deck slab
	- strengthening the steel girders	- strengthening the steel girders with use of stressing ropes
	- cleaning of the steel structure	- sandblasting of the steel structure,
	- anti-corrosion protection of the steel elements of the structure	- application of the protective coatings (3 coats: undercoat, curing and final) on the steel elements of the structure
	- cleaning and lubrication of the bridge bearings (reparation or replacment if necessary)	- replacement of roller bridge bearings on the bridge heads, cleaning and lubrication of the bearings on supports
Repair of the bridge drainage system	- execution of bridge inlets and drainage filters in the roadway at the curbs, execution of suspended sewerage system to the bridge construction	- execution of inlets and drainage filters, execution of rainwater drainage system from the outlet of the well and the filters by sewage pipes, suspended from the underside of the structure
	- execution of sewer outlets on slopes together with concrete gutters	- assembly of prefabricated reinforced concrete sewer outlets on slopes discharging purified water runoff to adjacent area
Securing of the various devices existing on the bridge	- securing and restoration of geodetic points	- reconstitution of damaged benchmarks
	- securing of the gas network	- suspending the existing gas network to the underside of bridge structre
	- pavement milling and subbase disassembly,	- pavement mechanical cold-milling and subbase mechanical disassembly,
Reparation of the driveways	- reconstruction of the driveways drainage	- profiling the roadsides to allow efficient flow of rainwater,
	- concrete curbs	- installing concrete curbing, on mortar, securing connections with sealing adhesive
	- assembly of of safety barriers	- assembly of of safety barriers
	- sidewalks‘ pavements	- reconstruction of the sidewalks‘ polymer modified

		pavements
	- bridge load test	- bridge load test with use of set of trucks, the deflection measurements
Ancillary works	- road signs and roads markings	- painiting of the road marks and assembly of road signs
	- site restoration	- embankment slopes profailing and treatment, ordering the construction site, removal of temporary offices and social facilities, elimination of landfill material

The whole project (according to the scope presented in the table above) has been completed within eighteen months - including the design development and getting all necessary permissions and administrative decisions lasting six months and the completion of construction work lasting fourteen months. (Design stage and construction stage partially overlapped).

4.2 Organizational and technological aspects of the analyzed project

Investor's and the contractor's duties and tasks relating to the organization and successive stages of the project are synthetically presented in the table 4.

Tab. 4: Investor's and the contractor's tasks in the successive stages of the project

Stage of the project	**Investor's tasks**	**Contractor's tasks**
Pre-bidding stage	- analysis of the technical condition of the bridge structure, - decision to repair and reconstruct the bridge in the the design and build system, - preparation of the tendering procedure for the design and execution of the construction works including repair and reconstruction works in the bridge, - securing financial means for the project,	-
Bidding stage	- announcing the information about the public works and release of the tender documents, - smooth completion of the tendering procedure, awarding chosen contractor, signing agreement for designing and execution of the repair and reconstruction of the bridge	- analysis of the tender documents, - analysis of the technological and organizational variant solutions the possible to be applied in the project, - choice of one of the variants (compying with the requirements given in the FUP), - cost analyses and estimations, preparation of the tender - submission of the tender for the design and execution of repair and reconstruction of the bridge
Design stage	- acceptance of the developed design documents	- development of the design documentation for repair and reconstruction of the bridge structure according to the requirements given in the FUP, - obtaining permits and administrative decisions necessary to start construction works,
Construction stage	- supervision of the construction works	- execution of the construction works – completion of the repair and reconstruction works.

Regarding the organization of the analyzed project investor's role came down to preparation of tender documentation and to carry out the tendering procedure smoothly. After the awarding of the contractor, the investor's due was also to accept the developed design documentation. What is important and noteworthy here, the investor did not interfere to the design process, and thus also in technology and the organization of actual construction works.

The contractor was to prepare design documentation and then to complete the construction works. The contractor, who borne the responsibility and financial risk associated with both design and construction stages of the project, acted in the conditions of uncertainty associated with the nature of works – especially noteworthy are issues related to demolition works and

the and actual technical condition of the bridge structure. However, the adopted design and build system allowed in the case of analyzed project to overlap some scope of construction works (namely demolition and securing a bridge structure) and development of the design documents (stages that have been realized parallel were mentioned earlier in the paper). What is important and significant the decisions about the design solutions as well as technology and organizational matters have been made by the contractor (method of execution of construction works is presented in the tables 2 and 3).

4.3 Comparison of cost estimates of the investor and the contractor

Figure no. below shows the comparison of cost estimates of the investor and contractor (the given estimates include net costs of: design work, construction works and the costs of design and construction works together - excluding VAT).

According to the figure 4 estimates of the investor and the contractor significantly differ from each other. The difference in the estimate of the total cost including the design and execution of work are 16.94 million PLN. Contractor's net price accounted for 34.2% of the contract value estimated by the investor. This difference is mainly due to the method of estimation. Public investor based his estimate on the formulas which are given previously (nos formulas), general information on the scope of work included in the PFU and collected and published data on the costs of the construction works which characteristic feature is a high degree of aggregation. In turn, the contractor has based his bid estimate on the detailed cost estimate calculation method, strict assumptions about the technology of construction works and the data resulting from the market analysis of costs of labour, construction materials, plant and meticulous analysis of overhead costs and profit.

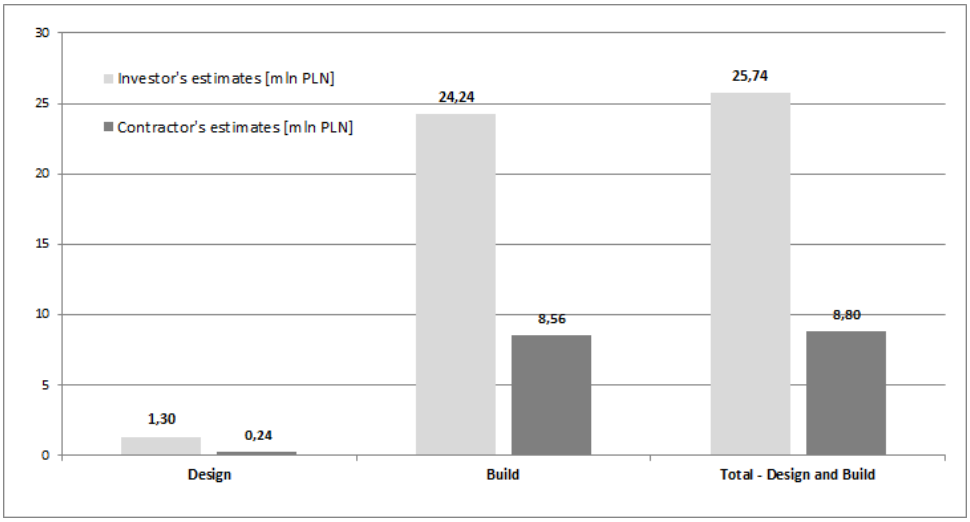

Fig. 4: Comparison of cost estimates of the investor and the contractor

5 SUMMARY

Execution of a project including described repair and reconstruction works of a bridge structure in the design and build system has allowed the efficiency in completion of construction works. The project has been completed in eighteen months (likely duration of a comparable scope of works in the design-bid-build system in Poland would be twice as long).

The characteristic features resulting from the adopted system are:
- a single entity responsible for the design and execution of works,
- ensuring close cooperation of design team with the contractor both at the design and the

construction stage of the project,
- design developed in strong accordance with a technology well-known for the contractor,
- minimization of design changes and, hence, the change orders and additional construction works,
- high financial risk of the contractor.

REFERENCES

[1] Rowlinson, S. (1988). *An analysis of factors affecting project performance in industrial building: with particular reference to design build contracts*, Ph.D. Thesis, 1988, University of Brunel, U.K.

[2] Leśniak, A. and Zima, K. (2012). Realizacja przedsięwzięć budowlanych w systemie zaprojektuj i buduj, *Przegląd Budowlany*, **7-8**, pp. 67-70.

[3] Leśniak, A., Plebankiewicz, E. and Zima, K. (2012). Design and build procurement system - contractor selection, Archives of Civil Engineering, LVIII**, 4**, pp. 463-476.

[4] Leśniak, A. and Zima, K. (2013). Design and Build procurements in the polish public sector, *Journal of Public Procurement*, **13**(3), pp. 315-336.

[5] Molenaar, K. R., Songer, A. D. and Barash, M. (1999). Public-sector design/build evolution and performance. *Journal of Management in Engineering*, **15**(2), pp. 54-62.

[6] Palaneeswaran, E., Kumaraswamy, M. (2000). Contractor selection for design/build projects. *Journal of Construction Engineering and Management*, **126**(5), pp. 331-339.

[7] Potter, K. J., Sanvido, V. (1995). Implementing a design/build prequalification system. *Journal of Management in Engineering*, **11**(3), pp. 30-34.

[8] Palaneeswaran, E., Kumaraswamy, M. (2005). Web-based client advisory decision support system for design-builder prequalification. *Journal of Computing in Civil Engineering*, **19**(1), pp. 69-82.

[9] Al-Reshaid, K., Kartman, N. (2005). Design-build prequalification and tendering approach for public projects. *International Journal of Project Management*, **23**(4), pp. 309-320.

[10] Xia, B., Chan, A. & Yeung, J. F. Y. (2011). Developing a Fuzzy Multicriteria Decision-Making Model for Selecting Design-Build Operational Variations. *Journal of Construction Engineering and Management*, **137**(12), pp. 1176-1184.

[11] Chlasta, L. (2011). Metodyka aplikacyjna programu funkcjonalno-użytkowego. *przestrzeń i FORMA*, 16/2011, pp. 203-212.