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HOUSE ON THE OUTCROP OF A MINE - ARCHITECTURAL FORM VERSUS STRUCTURAL DESIGN CONDITIONS

Introduction

In a period in which typification is becoming more and more common, something which is particularly observable in construction and in architecture, we are dealing with processes of mass production, aimed chiefly at an undefined consumer, jokingly referred to in marketing jargon as a “target”. This particular “target” is becoming the favourite client of architects - printers who “produce” designs, called typical designs. A distinct feature of these designs is the directing of the process of architectural design in a manner that conforms to the results of market analyses, both in terms of preferences regarding architectural form, as well as the functional and spatial solutions of the interior, which are to be as similar to the results of marketing polls as possible. Plainly speaking - they are designed with the “most popular taste” of a client in mind, ensuring that their architectural form is in line with current fashions. This, however, is not any simple approach - we are dealing with a diverse range of forms, from “poorish” and poor forms, through standard ones, of the so-called “barn-type” (rectangular floor plan, horizontal rectangular walls, a gable roof with a hidden gutter), to those that are to be designed “extravagantly”, with a complexity of form bordering on caricature, with mandatory architectural decorations and details, most preferably in gold. In terms of structure, these typical architectural designs are being developed with the simplest geotechnical conditions in mind, for wind and snow load zones with the least stringent requirements, featuring the cheapest possible construction materials. This is the result of the simple fact that success with clients, expressed in the form of the highest possible amount of designs sold, is usually assured not by form and function, but the lowest cost of construction listed in the estimated costs table. Accord-

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ing to latest data [1], single-story houses are preferred, without cellars, with a surface area up to 150 m², heated using gas or solid fuels with a 15% share of other forms of renewable energy generation. One advantage of typical designs in the eyes of clients is their price, as well as a wide selection due to a large supply. In this context, commissioning an individual design is a step that is only made by a small group of the most demanding clients, who are aware of what they want from an architect. It is also obvious that the cost of developing a construction design and a full technical design must exceed the cost of a typical design numerous times. The fact that cheap is actually expensive is usually learned by those persons who purchase a typical design and then attempt to adapt it to the distinct conditions that arise from legal requirements, as well as the factual physical conditions of the direct vicinity of the designed building. Sometimes this is also the case with architects known to be on the covers of architectural magazines, with Robert Konieczny [2] mentioning such a reflection regarding one of his own designs. The problem of typical designs is, however, not the subject of this article, regardless, it seems that devoting it some attention is required, precisely because of the usually omitted problem of adapting the structure of an entire building, not only just the foundations so that they can be appropriate to the geotechnical conditions of the soil. Discussing the entirety of the incredibly complex process of construction in areas of mining activity would require a completely separate and sizeable text, for which the constraints of this article do not allow. The authors, who are architects, do not feel competent to perform these types of broad analyses, requiring appropriate preparation, as well as professional experience, especially in the field of structural design. This is why they leave commentary on this subject to experienced civil engineers, limiting themselves to discussing their own experiences, framed from the point of view of architectural conditions with which a designer must contend with, as well as pointing to already existing bibliographic positions, for instance by Kwiatek [3], Bartkiewicz [4], Ledwoń [5] and others, which discuss this problem in detail.

1. A “typical” architectural form in atypical conditions

The traditional architectural forms that are present in Polish architecture can, with some simplification, also be called typical. Was the form of the country manor not (or perhaps is), in a sense, typical of the landscape of Poland? Individuals who feel particularly attached to Polish architectural tradition and who wish to continue it in current conditions search for a possibility to realize their preferences, making use of opportunities provided to them by the real estate market. After searching for the opportunity to purchase an authentic, historical manor for a time which is often quite long, it turns out that it is not that simple - usually those buildings that have survived through wars and fires are located at distances which are unacceptable from the point of view of the conditions of daily living, at least

if an individual is not a member of a free profession, for whom the placement of their place of residence and place of work are not an issue. All that remains is finding a place for a future home which would meet the requirements of a family's daily functioning. As it is widely known, nearly all areas that were able to optimally fulfill the requirements for such a location in large cities have been already built upon for a long time, which leaves buyers with the necessity to search for a building of a lesser value than that of the plot on which it is located, demolishing it and building a new one in its place. The latter is the case with the building that is discussed here (Fig. 1).

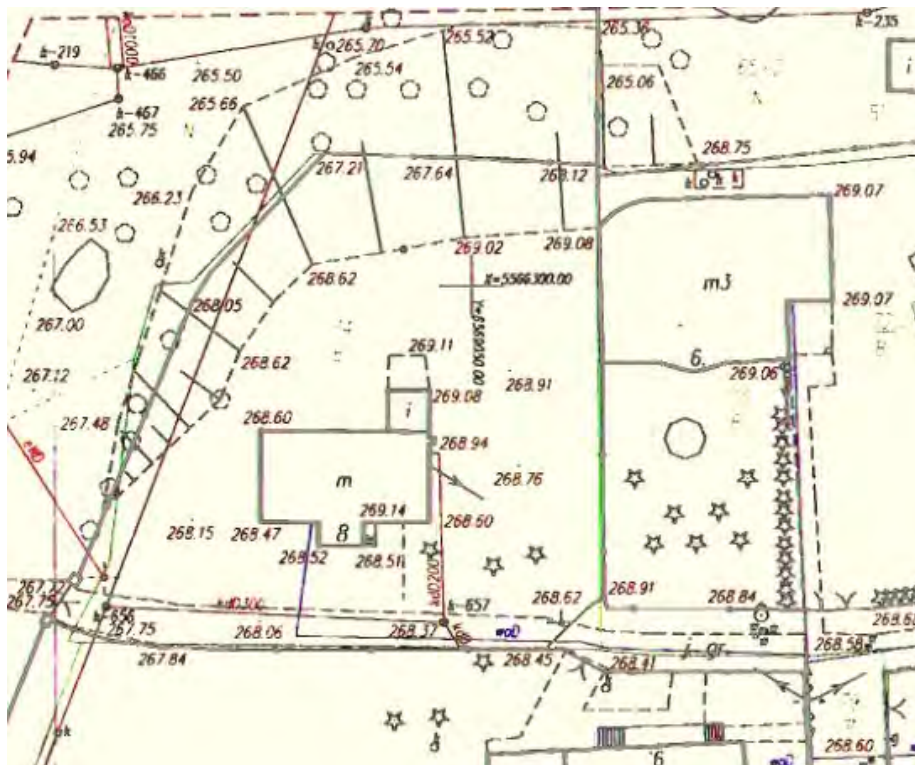


Fig. 1. Fragment of a map depicting the state before the demolition of the old building, which had been in very poor technical condition

Sometimes, however, it turns out that the well thought out tactic - from a client's point of view - of searching for a location, even when it has been successful in finding such a site and finalising a deal, can cause a surprise. One occurred in the discussed example. After analysing the regulations of the local area development plan in detail, it turned out that the purchased piece of real estate, while ideally meeting nearly all of the client's requirements, was in the influence zone of an outcrop of a mine (Fig. 2).

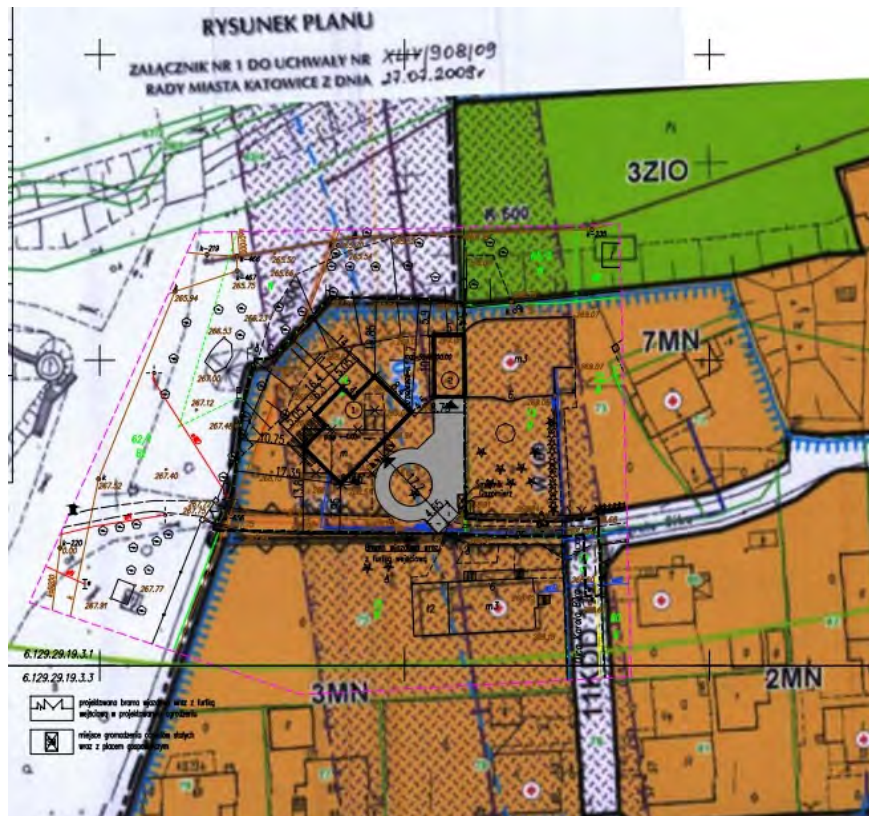


Fig. 2. A fragment of the local area development plan of the city of Katowice with the design imposed upon it, as well as information regarding the range of the zone of influence of the mine's outcrop

This information made it particularly important to conduct legally required geotechnical probing, as well the formulation of guidelines for the appropriate construction of the building's foundations on its basis. The conclusions of the geotechnical engineering documentation underlined that the foundation conditions are very complex, in addition to the probability of there being non-linear ground deformation. In this situation it was necessary to undertake appropriate action in terms of structural design, in order to ensure that problems with the building's stability do not occur after construction, in addition to eliminating the possibility of the deformation of the building's structural elements, resulting in small damage or microfractures that do not influence the stability of the whole, and the result of which would amount to the aesthetic worsening of the quality of the building's appearance.

In order for it to be possible to develop a construction design and a technical design afterwards, it became necessary to discuss the possibility of applicable, real solutions with the client - ones that could be used in this particular location, both in terms of the composition of the new building on the site, as well as in relation to

distinct urban and landscape conditions, in addition to other contexts - the aesthetic, functional, economic, technical and technological. Each individual design, developed as a unique work, requires the designer to learn the needs of, as well as understand the philosophy of life of a client and their family. If this is not the case, then a design is not addressed to a particular person or family, and unfortunately becomes a product, not a work. The designer must also remember that he is not working for oneself, but for somebody else and the wishes he is making a reality are not his own, but those of another person! The notion that a designer knows better what the client wants is one of the most commonly made mistakes in architectural design, equally serious as attempting to construct oneself a monument at the client's expense, by proposing them a design that reflects the designer's own imaginings, instead of meeting the needs of the client. Nothing, however, frees the designer from the obligation to communicate to the client the true conditions and possibilities of shaping architectural form in the spatial and legal context that is appropriate for a given location.

2. Architectural and structural solutions

The client's requirements were quite complex and featured precise demands in terms of design solutions regarding the architectural form and function, which came down to imitating the traditional form of a manor, but with a modern functional layout and meeting the requirements of an energy efficient house. Furthermore, the building was to have a limited area and a set budget constraint for the entirety of the costs of construction and arranging the building's immediate vicinity. In this particular location, meeting these seemingly simple requirements constituted a challenge, as - as practical experience indicates - one should always be prepared for unforeseen events during construction. Nevertheless, the basic problem was incorporating the building into its surroundings in a manner that would make the most use of the unique qualities of the location, providing privacy to residents and neighbours and a coherence of the space in terms of the landscape. The concept that was presented for discussion was minimal and very simple. It was illustrated on Figure 3.

As an answer to the conceptual design, after an initial, makeshift outlining of the building on the site and pondering the advantages and disadvantages of the proposal by the client, it turned out that it is necessary to allow the residents to have more contact with the green surroundings. In this situation, the designers were left with the option to use the technique of "borrowed space", which features the orientation of the building in a manner that creates the impression that the site that surrounds it is much larger, by using the difference in height of the terrain directly adjacent to the building in relation to the other parts of the area. It was decided that an additional element was to be incorporated, in the form of a glazed part of the living room, which was extruded outside of the main outline of the plan, from the side of green areas, as well as evening out the terrain in order to make it

possible to build a large terrace directly adjoining the building [6]. This action allowed the designers to attain the surprising effect of providing the ability to “reside” in a green area all year - in winter it was indoors, while in the summer - on the terrace. The result in the form of the final shape of the floor plan and, in effect, of the altered appearance, is shown in Figure 4.

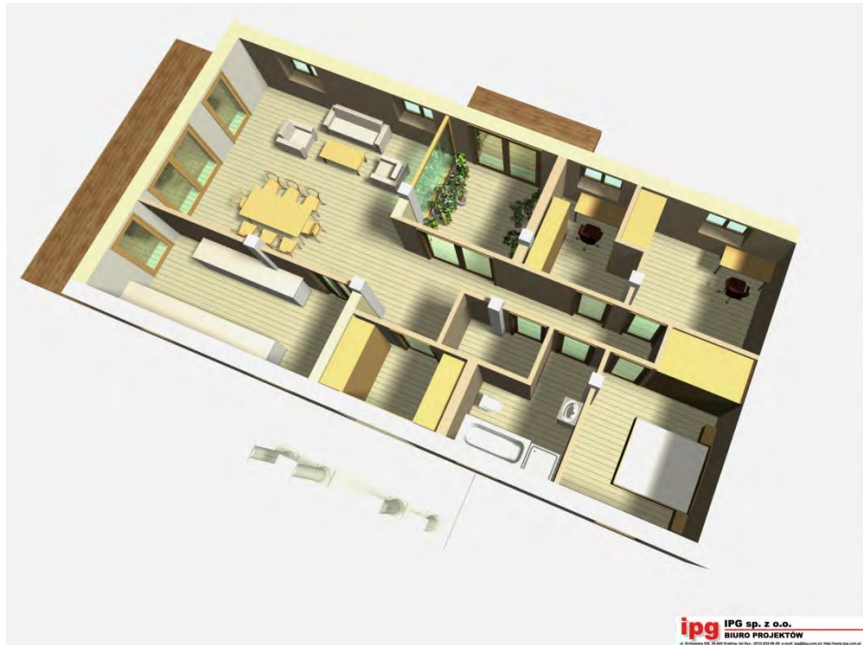


Fig. 3. Axonometric view of the interior of the house according to the initial conceptual design, which minimised costs through the reduction of surface area, as well as the compactness of the floor plan and the massing

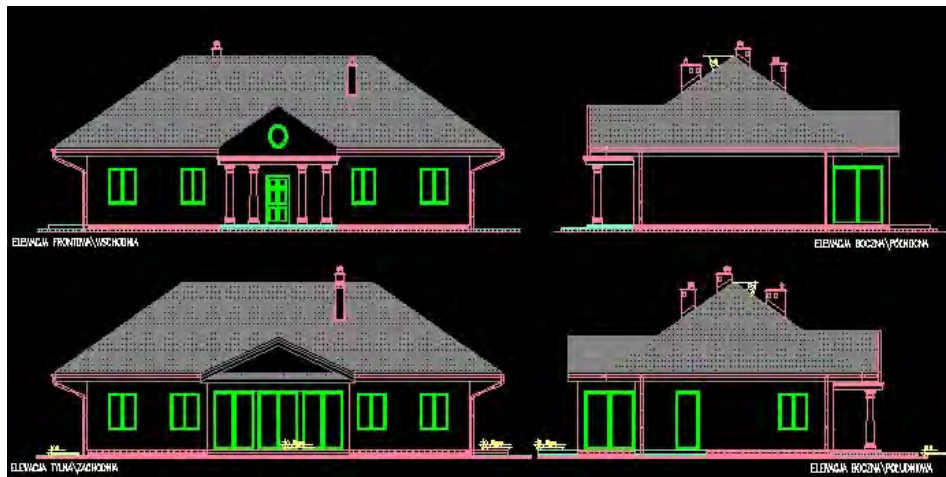


Fig. 4. Facades of the house altered after consulting the conceptual design with the client

3. Structural solutions

The structural design was developed while taking into account the conclusions arising from the geotechnical engineering probing, as well as those that were the result of approvals by appropriate mining services [7]. The solution that was adopted featured a raft foundation, stabilised with sand filling. Due to the excavation that was left after the demolition of the existing building, there emerged the necessity of stabilising the base underneath the foundation with sand, laid out in layers of 25-30 cm, made denser until a density index of 0.9 was achieved. The raft was surrounded with drainage, which directed ground water outside of the excavation. By constructing such a foundation structure, which took into account the bearing of the operational loads from the possibility of adapting the attic to a residential form of use, the designers made sure that the structure had an appropriate level of structural safety (Fig. 5).

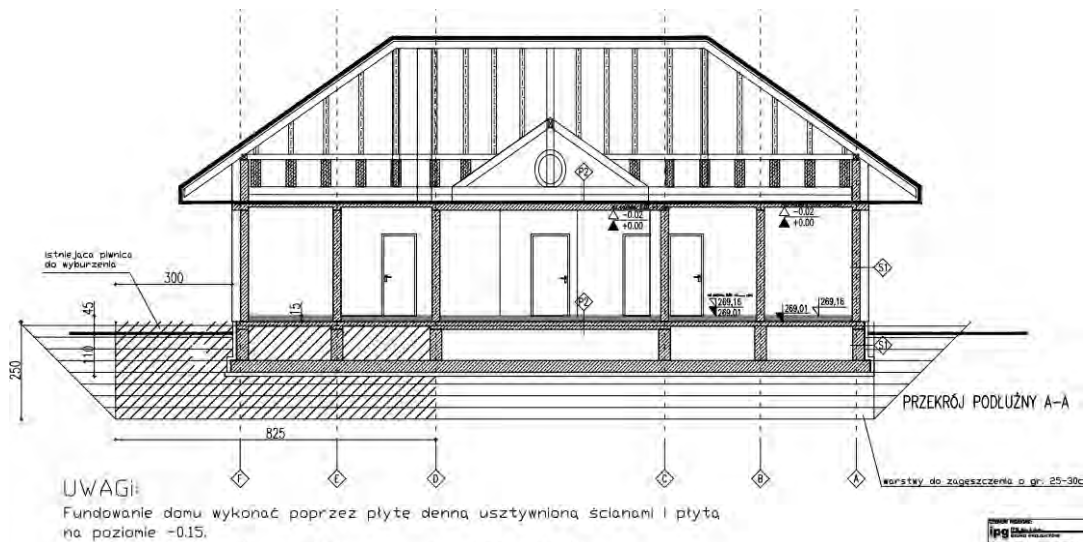


Fig. 5. Longitudinal cross-section of the building, depicting the foundation solutions in the area of the influence of the mine's outcrop

The construction of the building was performed appropriately, with all construction work being carried out under the supervision of a licensed and experienced construction site manager, with particularly difficult work being overseen by a construction inspector. There were no problems requiring immediate action on behalf of the design team. This overall simple building in terms of function, turned out to be demanding in terms of preserving appropriate proportions and designing its architectural form in such a manner that the client's intent would be preserved regardless of the use of modern construction materials. Furthermore,

an appropriately rigid reinforced concrete skeleton and floor slab were designed, aimed at securing the shape of the building from possible deformation. Due to the fact that the building only has a single storey, there was no necessity to use more complex structural solutions.

3. Energy saving solutions

Due to adopting a traditional architectural form of the roof, as well as due to respecting the aesthetic tastes of the client, the designers refrained from placing photovoltaic or solar panels on the south-western surface of the roof. Considering the limited surface area of the building, the installation of these elements would be relatively expensive, and a simulation of their return rate had turned out to be unfavourable. As a form of compensation, the construction entailed the use of windows and doors with very good technical and technological parameters, as well as appropriate layers of thermal insulation within structural partitions. A gas-powered condensing furnace was used to heat the building and provide warm water. As a transitional source of heat during transition periods or times of ill weather, a gas-powered, two-sided fireplace can also be used, which was placed in a wall between the living room and the kitchen.

Conclusion

The conclusions from the example that has been presented can be seen as obvious on the one hand, while on the other - atypical. The latter ones include deliberately resigning from implementing a very robust functional programme, instead opting to respect traditional architectural form and making the spatial solutions compliant with the landscape conditions. In terms of infrastructure and materials, common sense was followed, contrary to the tendencies of using all the various possible infrastructural systems and robust automatics, which can be seen in architectural journals, unless there was a legitimate economic basis for their profitability. Basing the energy balance of the building on very good thermal insulation properties of the external partitions and energy regaining through recuperation and the consequent use of environmentally friendly gas as fuel seems to have been a practical and economically sound solution. Equally simple and effective structural solutions made it possible to keep the costs of construction within the established economic constraints. Opting for a covered parking spot instead of a garage and the electric heating of driveways in periods of intense cold, which is a solution commonly used in Scandinavian countries, can be seen as another example of exercising temperance, which - as we all know - apart from simplicity, is one of the qualities that define beauty. It is also obvious that, as far as it is

possible, one should avoid locating new structures in areas in which deformations of the orogen have been proven. However, in situations in which a designer has no influence on placement decisions, he is forced to design a structure within reach of this type of influence, and must completely submit to the solutions that are the result of assumptions and statical calculations of the civil engineer.

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Abstract

Designing houses seem to be a trivial issue only if the environment does not set any requirements, and when geotechnical conditions are ideal. Leaving aside the complex problems of the relationship between the designer and the client and between the designer and the architectural administration, there are significant issues concerning architectural form, function and structure. Complications arise in cases of difficult spatial conditions, arising under existing local spatial development plans, as well as in the case of locations that feature complex geotechnical conditions. Designing a single-family home for very a demanding client in the middle of a big city, in the immediate vicinity of other structures and greenery protected due to architectural conservation and - in addition - located almost exactly on the outcrop of a mine, is already a kind of challenge for all the parties involved in the whole process of design and, subsequently, construction. The paper presents the manner in which these complex problems have been solved, illustrating important issues using fragments of the structural and architectural technical design, as well as photographs of the construction process.

Keywords: the outcrop of the mine, architectural form, structural design conditions

Dom na wychodni kopalni - forma architektoniczna a uwarunkowania konstrukcji

Streszczenie

Projektowanie domów jednorodzinnych wydaje się banalnym zagadnieniem jedynie w przypadku, gdy otoczenie nie stawia jakichkolwiek wymagań oraz gdy warunki geotechniczne są idealne. Pomijając złożone problemy relacji projektant - klient oraz projektant - urząd, istotne stają się zagadnienia dotyczące formy architektonicznej, funkcji oraz konstrukcji. Komplikacje pojawiają się w przypadkach złożonych uwarunkowań przestrzennych, wynikających z ustaleń obowiązujących

miejscowych planów zagospodarowania przestrzennego, a także lokalizacji o skomplikowanych warunkach geotechnicznych. Zaprojektowanie domu jednorodzinnego dla bardzo wymagającego klienta, w środku dużego miasta, w bezpośrednim sąsiedztwie obiektów i zieleni objętej ochroną konserwatorską, a na dodatek położonego prawie idealnie na wychodni kopalni, stanowi już pewnego rodzaju wyzwanie dla wszystkich stron zaangażowanych w cały proces projektowy i następnie realizację. W artykule przedstawiono sposób, w jaki rozwiązano te złożone problemy, ilustrując istotne zagadnienia fragmentami projektu budowlanego konstrukcji i architektury, a także zdjęciami z realizacji.

Słowa kluczowe: wychodnia kopalni, forma architektoniczna, uwarunkowania konstrukcyjne