

Design Process in the Stage of Changes

Architects learning new role

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Abstract. *Many researchers spent time analyzing design process, some of them were focused even on architectural design. Many of them presented possible views how to understand (architectural) design. They try to find universal description of what design might be and how and what principles it uses. Concern in their approach is given on „conceptual“ stage of the design process, or simply all design process is referred as conceptual, with some features of „product“ design. That is an aspect, which we, as practitioners, see from a slightly different point of view. It relates to what we consider to be architecture. In our point of view architecture is completed building.*

Keywords. *Design process; design phases; project team.*

INTRODUCTION

To support our thesis, we documented our approach to design on a case study of the facade of the office building called „Vysočanská brána“. We show here how development of particular details of any building may influence the final result and how architect deals with particular situations in “non-design” stages of the building process. Simultaneously we will show how development of software design tools influences architects position in the whole process.

To understand the mechanism we consider necessary to illustrate how rapidly nowadays architectural practice changes and describe the most important technical and social influences as well. We decided to base our considerations on our practice in the Czech Republic. Hence we documented use of particular software, which could be considered as characteristic in nowadays practices in the Czech Republic.

CASE STUDY - “VYSOČANSKÁ BRÁNA” OFFICE BUILDING, FACADE

In September 2007 we started working on the design of an administrative building in Vysočany, called “Vysočanská brána”. The client was ORCO Property Group, one of the key developers on Czech building scene, the contractor of the project was SKANSKA. Our task was to design an “Iconic” building, thanks to its location symbolically creating a gate to the city quarter Vysočany. Building was completed in May 2009.

If there is any part of a building, that is most responsible for creation of the image in observer’s mind, it is the facade. Hence it is natural, that it is primary subject of architects concern. But there is a long way from initial sketch to the snapshot of constructed facade. It is a process of successive steps, each of them is important for the final result. The task of an architect (in cooperation with other pro-

professionals) is to keep and maintain his initial idea during this process. That means to have some level of knowledge of construction and assembly processes, ability to identify and solve important details and high level of patience and communication skills.

It is necessary to say, that facades of contemporary mid and large-size administrative buildings are produced as systems with an accuracy of mechanical engineering product. This is a fact, which crucially influences the design process of this part of the building. Generally we can say that there is a strong preference to use typical details and avoid developing of original detail solutions.

In this case study we want to show particular steps in developing most important facade details, with description of the decisive moments.

Phase 1: Concept study

During initial stage of our work we developed shape of the facade, that was inspired by waves. Geometry was based on a sine wave, each floor has its sine wave shifted by a half of the wavelength (comparing to the neighbouring floor).

In this stage of the design process we were developing ideas, initial sketches and testing our solutions using models and visualisation software. According to our primary task we did not use any technical or „cost motivated“ corrections (as we usually do), we relied on our sense for technical and structural regularities and clients generosity. We convinced our client about our design, but it was only „conditionally approved“, because we did not know the costing.

Phase 2: Building permit

This stage might be considered not decisive, but we had to deal with some not-very-precisely defined regulations, especially in case of fire protection, that might result in fundamental changes in our facade concept. If any regulation is not precisely defined, or is changed during the design process, it often results in changes of approved design, and that means time losses and high risk of breaching the concept as well as budget. Dealing with such situations needs spe-

cific level of expertise.

To speed up the construction process, construction documentation of underground levels was made in advance in this stage.

Phase 3: Construction documentation

One of the crucial phases in the decision process. Due to extraordinary character of the facade contractor was unable to guarantee fixed price, hence client refused to approve construction documentation. It remained „conditionally approved“.

One of the parts, we discussed very intensively with client were corners of the building. In our original design corners were rounded. In this phase the Client decided to replace them with rectangular ones.

Phase 4: Bidding and negotiation

In our case, it was decisive stage. With every participant of the tender process we filled prepared protocol and explained crucial details to avoid possible misunderstandings. After this stage when price was finally set design was approved by client.

Phase 5: Production and assembly documentation

This stage is very sensitive on specific types of details. Especially all types of connections between materials, visible/invisible rivets, screws, nuts etc. Client changed his mind and got back to rectangular corners instead of curved ones.



Figure 1
One of the early-stage visualizations with client's remarks. The external staircase is still without greenery, but the requirement is already written here.

Figure 2 (left)
Mock Up was built on sub-contractor's site.



Figure 3 (right)
Completed facade .



Phase 6: Production

In the production stage of the facade mock-up was built to help with making decision about specific details and deciding about color of glass panels. It was not so easy, as it may appear, because many sensitive details could not be visualized or understandably described by another way to the client. Approximately ten minor changes (without changing costs) and three important changes (window openings added, LED lights changed, glass fixing partially changed) were made.

Phase 7: On site assembly

Participating in this stage is valuable for designers due to possible feedback. There might be seen in detail every construction and assembly process, with its mistakes and difficulties. As usual in Czech practice, as-built documentation was made in this phase.

SUMMARY

Our developing of the facade design during the design phases may be generally considered as typical (in Czech conditions). That means project team

Table 1
Software used by different participants of the design process.

Participant	Software	Design phase
Architect	AutoCAD Architecture 2008/ Autodesk VIZ/ Adobe Photoshop	1-7
Civil engineer	Allplan R2008	1-3
Structural engineer	Allplan R2008	1-3
HVAC/plumbing/electrical	AutoCAD R2004	1-3
Energy calculations	Svoboda software (TEPLO/ CUBE3D)	3
Lighting calculations	DIALux	3
Acoustic calculations	LimA	3
Sub contractor – facade	AutoCAD R2004 / CAD-Plan (Athena, Flixo)	5-7
Exchange formats	dwg/ dxf (vector)/ doc/ pdf/ xls (text)/ jpg/ png (images)	

structure (developer - contractor – architect), design phases (creative, „non creative“) and use of particular software. What was unique was the complexity of the design and amount of non-typical solutions and details. It resulted in a time shortage and in exceeding our (i.e. architect's) budget. More precious description of the design process, its participants and architectural practice we present in the next chapter.

Comparing year 2007 with the end of the 90's(10 years before) we can see some different aspects in the design process:

- Relatively experienced CAD users, with some level of design expertise.
- Visualisation has become standard in communication with client.
- "Old experts" were forced to use CAD, in 2007 it was already usual .
- E-mail has already become usual standard of communication for the whole team.
- Developers have learned to use CAD and Spreadsheets.

Comparing today's practice with the year 2007 we can although see some differences:

- 3D CAD modelling in conceptual design phase is more common.
- Some parts of buildings are designed using parametric structures.
- Some design teams have begun to use BIM solutions.
- Some specialists use BIM as standard (steel structure, MEP).

ARCHITECTURAL PRACTICE - COMPLEXITY OF PROJECT TEAMS

Design process could be described as a set of flows. The main issues are information, instruction, knowledge, ideas and of course, money. If we adopt this idea we can watch these flows, investigate its sources and see where the flows clashes between each other and also what can arise or how the flow can dry up (see Figure 4).

Usually at the beginning of each project is an idea; it could be driven by desire for new stunning

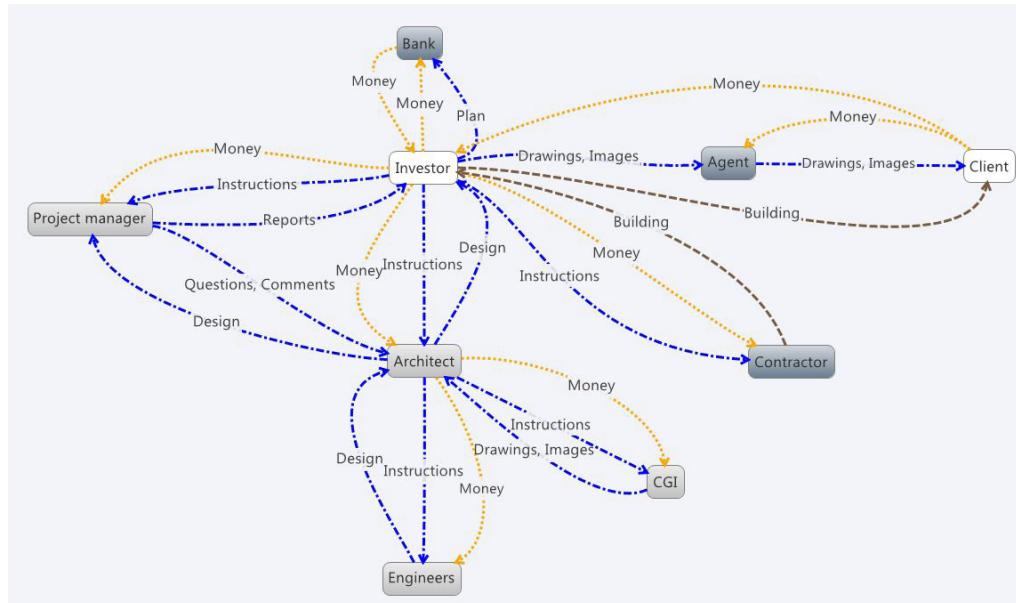


Figure 4
Complexity of project team – simplified scheme.

architecture, the need of satisfying necessity or it can just be the plan to make money. As the buildings are usually very expensive works of human hand (in respect to the exceptions) whether the process of designing of new building starts the investor decides.

What he is in need of depends on the character of the client (see Table 2); whether it is experienced professional with many-years experience with construction or whether it is a newcomer that wants to build complicated project and knows that this is the only building for next 50 years. All these factors affect the arrangement of the whole team. When the

Table 2
Types of clients.

Types of clients			
Clients	Priorities	Advantages	Disadvantages
Small individual clients	Cost, key ideas of project, rarely quality of architecture	Flexible decisions	Need to earn (borrow) money, limited experience, usually no assessment
Companies	Cost, durability, effectiveness, quality, complex life-cycle of a building	As companies are more effectively orientated it is easier to find a solution that fits, can afford experts – sophisticated assessments	Need to earn (borrow) money
Developers	Cost, marketing advantages, not interested in life-cycle of a building	Don't need to care what will be with the building after sale	Might be one of most risky ways of investing money
Institutions	Building, other issues (except political) are less important	Don't have to earn money, need to succeed in competition	Lower effectiveness, might need to pay project from their own budget, political issues

Table 3
Summary of client's characteristics.

Client	
Interests	Building in time, within the budget according to assignment.
Subject of work	Defining of goals of the project, ensure financing, supervise the process and assess the outputs of the process, take decisions and react to course.
Risks that might influence the process	Lack or late giving of information, late or insufficient response on designers questions, appointment of unsuitable project team members, changing the instructions, deadlines or budget when the process has already started.
Software used	Spreadsheet, text processor.

Project manager	
Responsibility	Delivery the building in time, within the budget and economically, according to instructions
Subject of work	Keeping an overview of processes, checking the balance between instructions and design, balance between the money that has been given and value for it
Risks that might influence the process	Late evaluation of information, Wrong identification of important processes, underestimating the risks, inactivity or exaggerated activity
Software used	Spreadsheet, text processors, CAD/BIM

*Table 4
Summary of project manager's characteristics.*

Architect	
Responsibility	Deliver quality project according to assignment
Subject of work	Finding a solution defined by synthesis between client's instructions and concept, coordinating with engineers, solving the clashes
Risks that might influence the process	Design out of budget, late, not fully coordinated
Software used	CAD/BIM, Spreadsheets, text processors

*Table 5
Summary of architect's characteristics.*

Engineer	
Responsibility	Find a solution suitable for architect's design and client's instructions
Subject of work	Finding a solution in accordance with all relevant norms, code, good practice. Coordinating with other engineers and architects
Risks that might influence the process	Late, incomplete information, uncoordinated parts, solutions unsuitable for particular building, overcomplicated solutions
Software used	CAD/BIM, special analysis software, Spreadsheets, text processors

*Table 6
Summary of engineer's characteristics.*

Contractor	
Responsibility	Build a building according to project in time for the price agreed
Subject of work	According to project building the construction, finding the products in accordance with specifications, checking the feasibility in advance, finding more cost-effective ways to build same or similar
Risks that might influence the process	Late delivering of building/parts of building, building not fully according to the project, poor quality of work
Software used	CAD/BIM, special analysis software, Spreadsheets, text processors

*Table 7
Summary of contractor's characteristics.*

client has experience with building design process he usually knows how to run the process, how to predict risks, how to check the processes, how to be able to respond on unwanted progress etc. When the client has no (or limited) experience with building he usually hires a project manager.

When the client has set up his organization the next step is to find the architect (and engineers) that will work on the building. Architect can be charged to prepare project as a winner of competition (either public or invited) or according to good name. Until this step it is mostly about economy, information, money and system engineering now we are getting another flow – flow of creativity. Architect is transforming the assignment from the client into the form of a building.

Project team participants

The overview of main characteristics of project team members as follows is based on our experience and focused on the Czech Republic environment. The situation in different countries may differ more or less. Please refer to Tables 3, 4, 5, 6, and 7 for basic characteristics of project team members.

CHANGES IN PROJECT TEAM OVER TIME

Project team, as the solution is being developed in time, changes position of participants, affects the importance and validity of their decisions. Hence the way of decision making is developing as well. For better orientation and more comprehensive description we would like to split the design pro-

cess into two different phases for these phases differ significantly. What is the most important change between these stages is the volume of creative work vs. technical solution finding.

Creative stages

At the beginning of nowadays typical project still the hand drawn sketch is the source of initial thoughts. After that building is usually being formed in CAD/BIM software. This is well known process. See Table 8 for Creative stages participants' characteristics.

We would like to focus on one particular part that, as we believe, describes the relationship between human and software and illustrates the strong sides of both. It is the issue of costing. Very interesting in this phase is the handover of information. As the process is at the very beginning and many decisions are not definitive and quite a lot of decisions hasn't even been made we do not obviously have proper drawings that describe every single part of a design. But for example for costing purposes we need the information that would be as close to the real building as possible. However, the way used in these cases is either reference example or a written description of standard. Then the task for cost consultant comes. There is a lot of methods he can use. Most often in this stage they use a database of reference projects and cost related to either square meter or cubic meter. It is a very important step that can save us a lot of troubles (mainly undesired changes due to value engineering or even stopping of a project) to assess the design in terms

Table 8
Creative stages participants' characteristics.

Creative stages				
Member	Description of role	Importance of decisions	Number of decisions	Software solution
Client	Defining the goals, supervision	High	Moderate	Spreadsheet, text processor, pdf writer
Architect	Design	High	High	CAD/BIM
Engineers	Design	Relatively low	Relatively low	CAD/BIM, special analysis sw.
Cost consultant	Assessment	High	Relatively low	Databases, CAD/BIM

Changes stages				
Member	Description of role	Importance of decisions	Number of decisions	Software solution
Client	Defining goals, making decisions	High	Moderate	Spreadsheet, text processor, pdf writer
Architect	Finding solutions, Designing	High	Moderate	CAD/BIM
Engineers	Making/Keeping technical design work, Finding solutions	High	Relatively low	CAD/BIM, special analysis sw.
Cost consultant	Finding solutions	High	High	Databases, CAD/BIM

Table 9
Creative stages participants' characteristics.

Main causes of changes
Cost / time saving
Approximation from previous stages does not work
Client's changes
Mistakes on site
Better solution has become available (eg. new window frame has been introduced)

Table 10
Main causes of changes.

of typical and special solutions. There is a lot of materials, technological processes and other parts that are well described. For the purpose of this paper we call them typical. We can predict the final cost with reasonable amount of accuracy. In contrast with this (for the architecture is creative discipline and it brings the desire for new solutions) there are also examples of what we call here special solution. In these cases we either do not have enough information from reference constructions for reliable costing or the construction is so unique that has never been built.

Here comes the task for the cost consultant. He (according to his experience) must define typical parts for which he can use the software solution and non-typical parts where he must use his experience and find the way for the best costing possible. We can see pretty well the possibilities of human and computer on this example.

Changes stages

In this phase of a project all main design decisions were made. The task is to develop the design so all necessary design aspects are well covered, contractor will have clear assignment and the project is ready for tender / construction. This phase for architect is mainly about developing details and keeping the main ideas of the concept despite for example technical solution limits. Engineers are developing their solutions based on their previous proposals and up-to-date design from architects. For overview of roles in these stages see Table 9. For list of main causes of changes please refer to Table 10. After this process has been finished and contractor has the project there is new round of changes. Contractor's interest is mainly optimization of resources and cost. In this phase still design changes for architectural purposes may occur but it is more complicated and usually more expensive. It is necessary to keep the up-to-date project that reflects the main changes

that has been made and enables the decision makers to see the impact of decisions in advance and assess the relationship to others.

OBSERVATIONS / CONCLUSIONS

In our paper we describe the role of an architect in different situations, team around him, changes of approaches and connections between players. We want to illustrate their motivation, possibilities, responsibilities and preferences. Nowadays we see that the meaning of word architect changes.

Trends - Architecture:

- Architecture became more complex .
- More parts of buildings became „systems“ or „products“.
- Pressure to cut time and costs.
- Changes in every stage of the building process.

Trends - Software vendors:

- Minimum changes in PLC (product life cycle).
- No responsibility.
- Annual fee as „subscription“.

Trends - Architects as software users:

- Dependence on „built in technologies“ (formats, interfaces, etc).
- “Blind” confidence in computed outputs.
- Dependence on commonly used software (professions).

If we take a look at renaissance, architect was personification of complexity, creativity, knowledge, research and return to ideals. Since the Bauhaus era, different approaches emerged and new theoretical concepts were investigated. But no matter which style you prefer, they have something in common, they were created by human, every decision was made by human. Now, we are experiencing situation where many decisions are based on inputs from computer. This inevitably brings change of architect’s thinking. We have new possibilities we can use. They can even mislead us. Certainly. We need to find new points of view on the process of designing and assign suitable roles for architect and com-

puter. 2000 years BC Egyptians had their canon that was describing the ways how the building had to be build. The canon was changing very slowly and just few changes happened in human lifetime. In 2000 AD progress is incomparably faster. However people who are designing buildings are still called architects, even despite the fact that their work doesn’t resemble each other. The goal is still to create environment for people.

Some researchers like to compare architecture to chess play, because it is both creative and analytic. As an illustration of this wonderful parallel we present two sayings of well-known chess grandmasters:

“I don’t know whether computers are improving the style of play, I know they are changing it. Chess has become a different game, one could say that computers have changed the world of chess. That is pretty clear.” (Vladimir Kramnik, 2006)

“Don’t worry kids, you’ll find work. After all, my machine will need strong chess player-programmers. You will be the first.” (to Karpov & students, Mikhail Botvinnik, 1965)

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