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**Theory, Design and Realisation Practice
in Initial Teaching of Construction
in the Faculty of Architecture**

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The initial process of teaching construction in the contemporary digital era is not so different than it was before using traditional methods. The use of computers accelerates the design process and 3d modelling allow students to understand better and quicker how construction works. However, the overall method is not different from the ways which have been used for decades.

To teach theory in relation to design is always the most important issue in the process of construction teaching in architecture faculties (just like in the case of other technical disciplines). It would be very important to continue this learning at construction site work placements, where students could improve their knowledge while taking part in realisations of projects, which had been worked on with student's participation during previous office work placements.

This task is difficult to achieve, because schools universities usually don't run project studios, not to mention construction companies. That is why initial processes of construction teaching do not have direct continuing in real design, and in buildings realisation in particular. The construction teaching at the faculty of architecture in Gliwice begins in the 2nd term of studies. Classes are taught by architects, faculty's employees. During that term students get to know different construction systems and build their own models with different materials. Those models allow to form space imagination and perception of resistance.

In the following terms, in the curriculum there are more specialised construction courses, for instance: General Building, Buildings Static, masonry construction, concrete, steel and the so called special construction, which is the subject of realisation during the last (10th) term of studies, together with preparing the diploma. Those subjects are taught by experts – the faculty of civil engineering.

In the curriculum, according to the so called 'minimal requirements', there are internships that should provide students with opportunities to polish their design skills. Students can do these internships in different architectural practices, often run by architects – teachers at the Architecture Faculty – and construction internships in different construction firms, usually with no connections to the University. Students participate in the process of building, mostly detached houses. Although many architects run their own architecture studios alongside the teaching at the Faculty, it is not common for them to run construction companies.

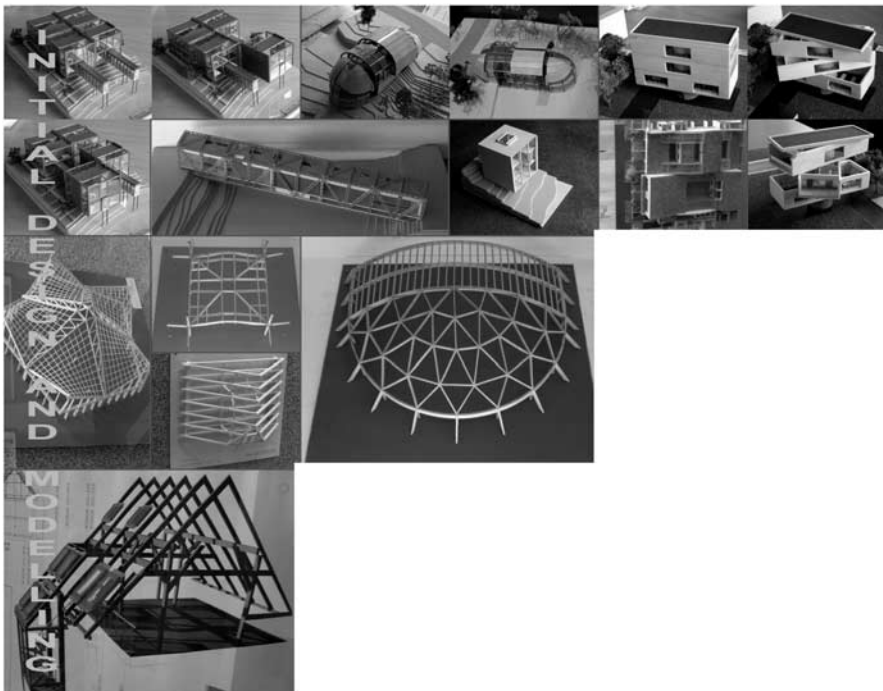
The example presented below concerns the author's experience as an architect, teacher at the Faculty, who is also an associate in an architecture office. In this office, in the late nineties, an original project was developed within the framework of a Polish competition for 'affordable housing', run by a major architecture and building magazine – "Murator". The construction of the house was based on a screwed wooden frame. The project was published for four subsequent years in Polish single family houses catalogues, and in the following years, several 'mutations' of the original design were developed. These are single family houses of different sizes and external materials; only the basic construction principle remained unchanged. The project have been developed with co-operation of students, within the *curricular and extra-curricular internships*.

Within several years since the original design, a building engineering company has specialised in constructing these homes and producing the wooden frames, which are

now manufactured very precisely – all that needs to be done in the building site is to put together the numbered elements, connect them with screws, and to stiffen the ready frames. With all the realisation experiences, the technology have been modified and improved. There now around sixty such houses in and around the city of Gliwice.

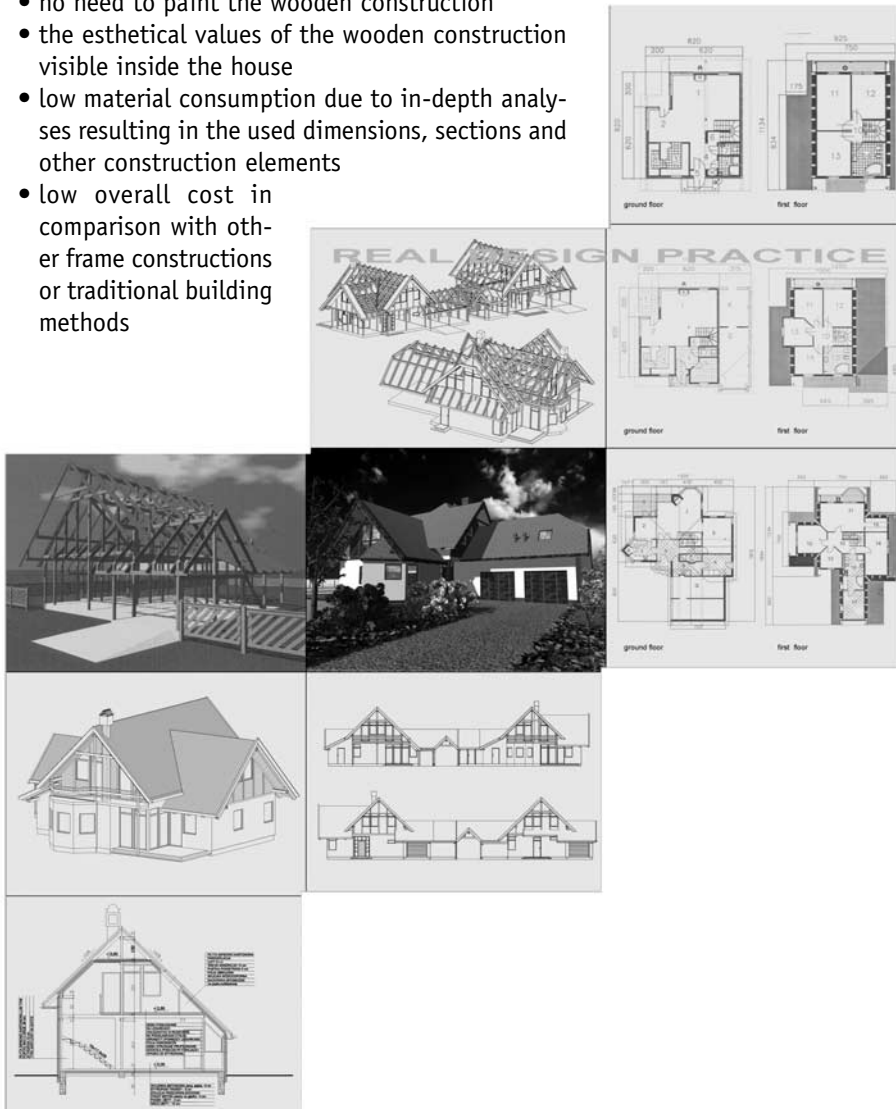
Students of the Architecture Faculty can do the internships in the construction firm. They have a chance to get 'hands on' experience with mounting the wooden frames and observe the construction not just on models, but on real scale buildings. In such a way, *the principle of linking the theory, design practice and construction practice* comes into being.

Within the largest project, a housing estate in Wilcze Gardlo, Gliwice (Poland), 25 buildings of different size were constructed with the same wooden frame technology (S-W) and various external and filling materials. The wooden frame construction of the house was based on two types of timber elements: pillars with 10 X 10 cm section, and beams with 15 x 5 cm section. The buildings have no cellar, and have two floors – the ground floor, and the usable attic story, allowing for flexible arrangement. Such solution is driven by economic factors such as the roof to overall floor space ratio, foundation surface to floor space ratio, overall floor space to building volume. All of these factors are much better than for comparable building in a traditional way.



Besides the factors mentioned above, the advantages include:

- light construction
- speed of assembly – it takes just a few days to put together the frame on a previously prepared concrete slab (foundation or cellar roof)
- after putting together the frame, roof is put on top, and all the next work is done undercover
- the flexibility of internal division of the house – this is particularly important, as the experience shows, that the function is the element of building which becomes outdated the fastest (at last once every generation)
- the flexibility of locating the windows in walls, allowing the end user to take the decisions in real scale and real settings
- no need to paint the wooden construction
- the esthetical values of the wooden construction visible inside the house
- low material consumption due to in-depth analyses resulting in the used dimensions, sections and other construction elements
- low overall cost in comparison with other frame constructions or traditional building methods



The manufacturing detail and care in producing the frame elements are crucial for the advantages above mentioned – from drying the wood (14-16% humidity) to precision of manufacturing and drilling (max.1mm tolerance), to the quality of wood according to the position of each particular element.

With few exceptions, most of the buildings are being built with no basement, on a cement foundation base, cross reinforced, strengthened in the places where the columns are set. The ground floor walls are tightening the construction, and are usually built with concrete blocks, with an external layer of Styrofoam or mineral wool (or, alternatively, cell concrete blocks, such as YTONG). Buildings with external wall of natural stone have been realised, too. The roof floor walls are built with two stiff layers (wood-waste board from inside and siding or other filing from outside). Light interior walls with light metal frame construction. Additional elements for the roof beams are used to stiffen the construction. The construction is visible from inside. Interior circulation – wooden stairs (15*19*25). The wooden roof construction is a part of the prefabricated frame, and the roof cladding can be light (steel, etc.) or heavier – tiles require additional wooden construction. The interior elements and all instalations depend solely on the investor and site infrastructure. The buildings are facilitated with modern chimneys, which are used for heating. Also, floor heating and convector heating in the attic are used.

Conclusions

1. The initial teaching of construction in the Faculty of Architecture should be realised by architects, members of academic staff, to show the students relations of construction and function to the form of the object.
2. There are no special differences between the initial teaching of construction in the 'new digital era' and before. The differences are based on using computer programs and films showing how the structure works. Students can also use the software to help in modelling. More developed stages



- are run by constructors with teaching and design experience, using advanced software, showing constructions designed by famous architects all over the world.
3. The initial teaching of construction starts from practice modelling, then theory, and architectural design practice which is connected very often with realisation practice at the site where the buildings are erected.
 4. In the initial period of teaching of construction teachers are chosen among architects with experience in teaching, designing and realising designed buildings.
 5. The initial teaching of construction should be realised on simple examples such as single family housing, which are easy to design for the students. Then in advanced construction subjects teachers (meaning constructors) should be encouraged to limit the number of time devoted strictly to calculation, but extend the analysis of modern structures, which would allow teaching students to choose suitable modern structures and evaluate sections required for architectural objects.
 6. Teaching construction should be based on visual effects appealing to imagination. This may include films showing disasters caused by mistakes in building structure, as well as analysis of destruction following natural disasters.