Wooden Construction as a Housing Estate Design Model

Tomasz Orłowski, Kinga Palus, Barbara Rubińska-Jonczy
University of Technology, Faculty of Architecture, Civil Engineering and Applied Arts, Rolna 43, 40-555 Katowice, Poland
pakip@wp.pl

Abstract. The program challengers “Timber in the city” Urban Habitat Competition entrance to imagine new possibilities for the future and urban living in New York in the district Queens – the relationship between the individual dwelling and the collective aggregation of units; the use of timber and wood is leveraged to create living spaces that are connected to natural systems. The article presents the main principles of the residential flats which are founded upon a concept that reflects the construction of boxes that fit harmoniously together - inspired by the traditional Japanese art of joining wood consisting of minimal participation of mechanical connectors, enabling the construction of a single modular segment consisting of both columns and beams, merged together. This universal system design would support the recommended natural insulation of the adobe wall. Locations of the windows and door openings are not restricted, allowing for an ambient lightening of apartments. The exterior finish can be flexible, depending on the context of the environment in which the building is made. In alignment with the competition’s needs, we decided to finish the brick with natural bricks as a reference to the traditional, distinctive facades of New York tenements houses. The article shows contemporary challenges in the design of housing estates with the use of wooden construction. The design of the residential part started with the elaboration of functional and spatial systems of apartments, based on an established modular system, followed by putting the blocks together, creating a heavily fragmented piece. The free spaces between apartments are meant to be a featuring characteristic, designing an open space – with the intention of development of neighborly relations and bonding local community. The system has been developed on recurrent, modular apartments that are universal and flexible enough to replicate – anywhere, with consideration given to the immediate surroundings. This flexibility of the system and freedom of shaping a building’s piece enables the avoidance of monotony, despite the recurrence. The conclusions may be useful for architects, urban designers, academics in the field of architecture and urbanism.

1. Introduction
The subject of the analysis is the analysis of technical techniques used for constructing buildings based on the performance of competition tasks under the name Timber in the City.

In the following list of the main offers of the competition, its analyses, conclusions and results, what work was performed.

The study will contain the following sections:
- Description of issues
2. Description of issues

The goal of each task should be its result, therefore pre-project work is the most important. In the competition’s matter organized by Binational Sofwoodod Lumber Council together with the Collegiate School of Architecture Association, it was the design of the building in a modern structure using prefabricated products. The subject of the competition work was the conceptual design of a multi-family building in New York. The building had to meet not only pre-defined conditions but also locally adapt to the surroundings. The plot, of which was task has allowed for buildings with a height of over 100m and choose the assumed high rate of construction. The project also required the future superstructure to built at various stages. In a high urban space, determined by the size of the structural elements that must be flexible enough able to enter the construction site in full or in cross section, the time spent on assembly is also important. It was also important to provide solutions for construction, solutions to enable correspondence with the user of the object - the apartment of this building. They aimed this treatment at broadly understood sensory education.

3. Material selection

We should ask the question what materials are and whether everyone is suitable for processing it. An important issue is also its selection in relation to its destination. CLT - Cross Laminated Timber, LVL - Laminated Veneer Lumber or SVL Structural Veneer Lumber have different properties, therefore their applications can be used only for the proper parts of the object’s structure. Lumber as a processed material has features that can be placed on a par with traditional building materials such as steel or reinforced concrete [1]. The material is resistant to compression and, contrary to popular opinion, is resistant to fire [2].

Because of the availability of materials and the possibility of their use for the task at hand, the material that makes the most of all conditions is Glulam - which meets the strength and quality requirements.

4. Carpentry corner log joints

Carpentry joints have been known for centuries since human has commonly started using wood to build structures. Appropriate combinations resulted from evolution and emphasizing cultural conditions [3, 4]. In order to optimize the discussed object and future possible prefabrication of connections, they were simplified, and as a result of analysis, the author’s four-way connection was solved. The problem of such connections is the use of additional steel elements, which despite their advantages (reduced size of the tongue and groove or even its lack) simultaneously generate a disadvantage in the form of a material difference. In the case of designing objects, each joining of materials creates an additional set of variables, which is, among others, material deformability. Among the various elements that have been considered, it can be stated that the type of joining is also the result of the wood used [4]. If the elements to be joined have the same material properties, for example, Glulam type, then more durable joints can be realized.
5. Conclusions
As a result of previous pre-project work, I designed a module consisting of three simple elements.

The structural frame is a component of three types of beams and columns that complement each other, creating a uniform, flush surface. Four-pole proprietary connections have been designed in intermediate axes, which make it necessary to divide the element into a shorter one. The modular spread is thereby increased to 40 feet (i.e. 12,192 m) in every direction. This type of combination is simple in prefabrication and through a self-wedging rigid system that is resistant to external factors.

Individual elements combined each other form a frame in which you can enter the necessary function. For a multi-family residential building, the mesh flexibility is important enough for the basic function to fulfill the residential function.

Modules designed in this way in combination with each other enabled the design of a residential unit with the required individual apartments with south-eastern exposure. Free spaces connected with arcades can add variety to a residential complex due to the freedom of shaping the modules. The concept of the building can be freely expanded and completed in urban gardens.

The final form of the designed object correlates with the competition assumptions, its external wood structure clearly indicates the characteristic connections. Elements of the building are clearly understood not only for the residents of this building but also for recipients from the neighborhood. The building is forming in urban rules and meets local requirements.

Acknowledgment(s)
Special thanks to Paweł Białas, who undoubtedly inspired in the search for projects.

References
[1] M. H. Ramage, H. Burridge, M. Busse-Wicher, G. Fereday, T. Reynolds, D. U. Shah, G. Wu, L. Yu, P. Fleming, D. Densley-Tingley, J. Allwood, P. Dupree, P.F. Linden and O. Scherman, The wood from the trees: The use of timber in construction, Volume 68, Part 1, February 2017, Pages 333-359, 2017.
[2] C. Chang-kun, Y. Jian, C. Jie, Z. Jia-wei, W. Wei-yu, and Z. Xiao-long, Fire resistance performance of glulam beam, Pages 929–936, 2017.
[3] P. Kłosowski, I. Lubowiecka, A. Pestka and K. Szepietowska, Historical carpentry corner log joints—Numerical analysis within stochastic framework, Pages 64-73, 2018.
[4] T. ueda, and K. Fumoto - A study on historical transition of Sashimono joint in the framework of Japanese early modern houses, Pages 8-83, 2017.