EU MIGRANT CRISIS AND INCREASING DEMAND FOR MODULAR CONSTRUCTION: MODULAR SOCIAL HOUSING COMPLEX FOR REFUGEES IN MUNICH

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Abstract

More than a million migrants and refugees crossed into Europe in 2015. The number of asylum applications received in 2014 in EU Member States has risen by 25 per cent compared to the same period in 2013 and it is still increasing (The UN Refugee Agency). The current migrant crisis in Europe is described as the most serious since the Second World War. Reception Centers that provide homes for asylum-seekers and refugees, both as individuals and families, in most EU countries are overcrowded. Due to a growing problem of the lack of infrastructural facilities, the topic of modular construction is more and more relevant in European context. The article deals with the problematic of increasing demand for modular buildings as an answer (time, and cost effective) for European migrant crisis that requires delivery of the housing infrastructures in a very short time frame. The author asking the question about the near future of the modular social housing. How would it reflect on urban-space, living-space and whole attitude to modular construction issues? What is the role of the architect during the process of design-build? Is it possible to make references to “beauty” in the context of modular construction? The focus will be placed on the project based on permanent modular construction (PMC) - the modular social housing complex, implemented in July 2015 in Munich (scientific partner of the project is the Faculty of Architecture, Cracow University of Technology).

Introduction

The European refugee crisis is described as the most serious since the Second World War, driven by the wars in Syria and Iraq, as well as conflict and instability in Afghanistan, Eritrea and elsewhere. According to Eurostat, in 2015, EU member states received over 1.2 million first time
asylum applications, a number more than double that of the previous year (Eurostat, 2016). The highest number of first time applicants was registered in Germany, with 35% of all first time applicants in the EU Member States (Eurostat, 2016). These figures have direct impact on the increased demand for modular construction, especially on the German market.

Figure 1. Asylum claims in Europe, 2015

Reception Centers that provide homes for asylum-seekers and refugees, both as individuals and families, in most EU countries are overcrowded. There is a huge lack of housing, schools, kindergartens, etc. Traditional construction is not able to carry this challenge in such a time frame. For example, experts say that more than 400,000 apartments are needed in Germany to meet increasing demand (Tomkiw, 2016). Regarding the long-term process characteristic for traditional, on-site construction, that numbers seem to be a huge challenge for the construction market.

The EU migrant crisis creates the situation in which, virtually, all investments are implemented "at once". That is one of the reason of increasing number of investments based on the modular construction technology (Permanent Modular Construction) that - when compared with traditional construction - can provide the buildings in a much shorter time frame. The schedule reduction is the biggest incentive that this method of construction ensures. It is also one of the
largest claims that the industry has and the majority motivation as to why permanent modular construction is used in the projects (Smith, 2015, p. 20). As evidence of the changing approach, it worth to mention that many of the public tenders in Germany require the modular construction, instead of traditional (i.e. City of Hamburg, City of Munich). This is absolutely a great opportunity for the modular industry market grow. At the same time, this challenge carries a major threat. The design and build process characteristic for modular construction industry very often limits the role of architect and architectural design. The most promoted features are related to schedule-reduction, cost-reduction, number of units and multiplication. The values such as relation to the urban context, esthetic and architectural form seem to be overlooked. How would it reflect on urban-space, living-space and whole attitude to modular construction issues? What is the role of architect in the modular construction industry? Is it possible to make references to “beauty” in the context of modular construction?

**Background - the advantages of modular construction**

Modular construction is a process in which a building is constructed off-site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventionally built facilities – but in about half the time (Fig. 2). Buildings are produced in “modules” that when put together on site, reflect the identical design intent and specifications of the most sophisticated site-built facility – without compromise (Modular Building Institute). There are two types of modular construction: Permanent Modular Construction (PMC) and Relocatable Buildings (RB). Permanent Modular Construction is a method of construction that greatly differs from temporary buildings, such as construction trailers or mobile homes. According to the definition of Modular Building Institute, PMC is an innovative, sustainable construction delivery method utilizing offsite, lean manufacturing techniques to prefabricate single or multi-story whole building solutions in deliverable module sections. PMC buildings are manufactured in a safe and controlled setting, and can be constructed of wood, steel, or concrete. The structures are 60% to 90% completed in a factory-controlled environment, and transported and assembled at the final building site (MBI)\(^1\). PMC, as an off-site solution, has marked as a higher quality, faster to market and greener solution than traditional stick built, site built construction. They are custom-designed commercial buildings much the same as their traditional site-built counterparts (MBI Website). In many cases, using PMC does not change the design, structural system, or options for finish materials. The main difference is the method of construction (Piper, 2015, p.17).

Many studies and report indicate the undeniable superiority of modular construction over traditional buildings\(^2\). According to the recent report "Permanent Modular Construction: Process, Process, Practice, Performance, University of Utah, Integrated Technology in Architecture Center, College of Architecture and Planning, Raport, April 2015.

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\(^1\) A recent report by the National Institute of Standards and Technology and the National Research Council (US Department Commerce) identifies modular construction as an underutilized resource and a breakthrough for the U.S. construction industry to advance its competitiveness and efficiency, [after]: Why Build Modular, (online):http://www.modular.org/htmlPage.aspx?name=why_modular, (date of access: 2016-04-15).

\(^2\) One of the most recent report is: Smith R. E.; Permanent Modular Construction: Process, Practice, Performance, University of Utah, Integrated Technology in Architecture Center, College of Architecture and Planning, Raport, April 2015.
Practice, Performance published in 2015 by the University of Utah, there are following key findings which prove several advantages of permanent modular construction, when compared with traditional construction. Regarding the Quantitative Analysis, there are following results:

- Schedule: 39% saving,
- Cost: 16% saving,
- Quality: 5.4 Average Change Orders,
- Safety: 0.25 Average Safety Incidents.

Regarding the key benefits of using permanent modular construction, there are following:

- Schedule reduction during construction phase,
- Quality of product (monitoring system ensures stable, constant quality),
- Site Operations (Smith, p. 3-15).

**Figure 2 Diagram of Modular Construction Schedule vs. Site Built Construction Schedule**

![Figure 2 Diagram of Modular Construction Schedule vs. Site Built Construction Schedule](source)

However, when analysing numerous documents and articles, included mentioned above, is noted that one important element is frequently omitted - architectural design, aesthetically pleasing. Nevertheless an architecture based on modular construction should still belong to works of art. According to theory of Vitruvius, a good building should satisfy the three principles of durability, utility and beauty (Latin: firmitas, utilitas, venustas). Unfortunately, the majority percent of the modular buildings demonstrate the reduction of architecture to numerical parameters and engineering. The assessment criterias usually concernes execution time, manufacturing time, assembly time, as well as number of units. It also refers to international competitions on modular construction, including the biggest world competition “Awards of Distinction” organized each year by the Modular Building Institute (as a part of the World of Modular event in US). The aesthetically pleasing is not really considered in many modular construction developments. Obviously is it a statement that does not refer to all the modular construction projects.

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3 The research focuses on commercial construction and does not include single family residential. The research uses a case study method to compare PMC projects to traditional site built projects globally for construction performance parameters such as cost, schedule, quality, and safety.

4 i.e. reports published by the Modular Building Institute.

5 Vitruvius, the Ten Books on Architecture, Harvard University Press, 1914.

6 One of the good
Boom of Modular Social Housing in Europe

According to the *European Construction Market Forecast from 2015-2020*[^7], the construction industry is expected to prosper in the near future and it is expected to have a steady growth pattern. 2015 was a very important year for the construction industry in Europe. As the table presents, the biggest growth refers to the new residential sector. In 2016, the growth is much higher, compared to the previous year and will gradually increase up to 2020. Basing on that figures we can indicate the boom in the residential sector. Regarding German market, extra push to construction boom gives refugee influx. German public sector is doubling its funds for social housing to more than 4 billion euros up to 2019 to cope with the asylum seekers (Nienaber, 2015).

It is uncertain how much of the construction market permanent modular construction (PMC) constitutes in volume. However modular broadly is estimated to make up 3-5 % of the total construction industry (MBI, 2011) and is still growing. At Bauer Holzsysteme (Germany), orders have been placed for more than 100 modular buildings in 2016, up from 20 delivered this year. Max Boegl, which is also making modular buildings for refugees, is experiencing the same upswing. "We're noting sharply increased demand since October and we expect this trend to continue next year" (Nienaber, 2015).

| Table 1 Total output development by market segments – % growth rate in real terms |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| New Residential                 | -4    | 0,1   | 2,6   | 4,6   | 3,7   | 5,0   | 6,2   | 7,6   |
| New Non-residential             | -5,2  | 0,6   | 2,7   | 2,1   | 2,3   | 3,1   | 4,1   | 4,7   |
| Building R&M                    | -0,3  | 1,4   | 1,6   | 1,1   | 1,4   | 1,8   | 2,2   | 2,6   |
| Civil Engineering               | -4,2  | 1,4   | 2,2   | 2,6   | 2,7   | 3,7   | 4,4   | 4,9   |
| **Total**                       | -2,7  | 1     | 2,1   | 2,2   | 2,2   | 2,9   | 3,6   | 4,2   |

Source: European Construction Market Forecast from 2015-2020

But what does this demand actually means - aside from economic benefits - for the modular construction and built environment? Facing such a big challenge in a very short time frame means that the risk of failure is much higher. From the architectural and urban perspective, the failure mostly refers to the architectural design and the quality, resulting in an impact on the urban landscape and the society. Providing fast solutions often brings associates to temporary shelters, low quality, grey boxes or containers. Indeed, many projects are planned as temporary accommodations, that in three or five years will be relocatable or will just collapse. Fortunately, a considerable percentage refers to objects design as permanent. Recalling again German construction market, is worth mentioning the statement of Thomas Bauer, head of the Confederation of the German Construction Industry, who argues that the construction in

Germany of permanent apartments for the refugees to use shouldn't be ruled out because economically, providing them with temporary accommodations on a long-term basis is not feasible. The main reason is relatively high cost of the investment, considering "a short life". The temporary shelters costs about 1,000 euros per square meter. While spending a little more then 1,300 euros per square meter would already make it possible to construct normal residential buildings which will meet basic standards and will be serviceable for up to 30 years. "If we have a great demand in the segment of low-cost apartments for refugees, why don't we build in line with the standards that were in place fifteen years ago?", he said, recalling that many Germans currently reside in such apartments.

Time and money are indeed the key benefits of factory-built construction versus traditional construction, and the main reasons of increasing demand for permanent modular construction. The more, it is good to see, that next to those key advantages that define at the same time important boundaries for the whole design and build process, there are examples, in which the values such as design - estetic pleasant constituted an important element of the project.

**Modular Social Housing for refugees** - an attempt of integration of numerical parameters and aesthetics

Modular Social Housing in Munich is a three-part development, comprising two housing and one office building. It is situated on the outskirts of Munich, surrounded by lush green areas. Low-rise horizontal buildings fit seamlessly into their immediate context, their elegant anthracite facades framed by trees preserved on site. Two residential buildings consist of 75 modules each laid out in a straightforward pattern: corridor modules running along the central axis with perpendicular units containing all the functions located on both sides. Each building offers 43 double rooms for 86 people. The gross floor area of the buildings is 1,416 square meters and the gross covered area is 718 square meters. The circulation is completed by two external steel staircases flanking the building at both shorter facades. Interior quality was the architects’ priority. Rooms were designed and manufactured together with finishing, furniture and equipment to achieve perfect detailing and harmonious experience for future inhabitants. Special care was taken while producing toilet and kitchen units with finishing made of high-quality Corian and waterproof Pfleiderer boards.

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9 Ibid.

10 Basic information about the project: Location: Munich Germany; Usable area: 2 800 sq.m.; Number of units: 163; Beginning of the off-site production: 6 April 2015; Beginning of on-site: 29th May 2015; The end of on-site assemble: 20th June 2015; Total Cost: 3.2 mln Euro.Design & Manufacturing: DiamondModule (BrilliantModule Sp. z o. o.), Poland; Team: M. Śpiewak, G.Schaaf, D. Kalinowska, A. Trybek, M.Korzeniak, E. Wozniak-Szapakiewicz (Faculty of Architecture, CUT), M. Dudziak, A. Odrzywołek. Support: students from the Faculty of Architecture of Cracow University of Technology (CUT) Scientific Partner: Faculty of Architecture, CUT
Figure 3-4. Diagrams of the social housing building: an axonometry and ground floor

Source: BrilliantModule Ltd. (DiamondModule)

Figure 5-6. Modular Social Housing - Exteriors

Source: BrilliantModule Ltd. (DiamondModule)

Technical Innovation, Cost Effectiveness & Sustainability:
For the manufacturing process is used high-performance CNC machines. The assembly lines are specifically prepared for the production of modular buildings. The production lines is under monitoring system that ensures stable, constant quality and the continuity of the production process, confirmed by the Certificate of Consistency of Performance 1488-CPR-0499/W (ETA-14/0466). The fully-equipped modules for the “Modular Social Housing” were produced at a factory in Poland (Skawina, close to Cracow) and then transported to its destination (around 950 km). The technology allows modular units to be complete, requiring only small patches of
the facade and corridor finishing to be installed in-situ. At the construction site modules were assembled on concrete foundations and covered with wooden roof frames. The whole process of installation on site was just few weeks long.

The project’s energy design is aimed to meet the high requirements of the german EnEV(Energieeinsparverordnung). This is achieved by providing best quality thermal insulation, carefully designed to avoid thermal bridges resulting in low values of heat permeability. All parts of the building envelope are tested and certified in terms of thermal, acoustic and fire-proof performance. A highly efficient heating system provided by the swiss brand Zehnder is integrated into modules’ ceiling structure. It is operated using a heat pump to reduce energy loss. Each room is equipped with an air conditioning system\textsuperscript{11}. Rooms are lit by large floor-to-ceiling windows ensuring sufficient amount of daylight. Whole roof area of the smaller building was covered with photovoltaic cells to provide energy for the complex.

\textbf{Figures 7-9. Modular Social Housing - Interiors.}

\textsuperscript{11} radiant conditioning comprise of a network of panels which boast dual heating and cooling functionality, rapid response times, very good controllability and high energy efficiency.
Despite the overwhelming presence of the modular construction developments lacking high aesthetic values which are a carrier of negative connotations, there is more and more projects that present the changing approach to the modular construction market. Permanent Modular Construction gives a huge possibilities for architectural creations. The key benefits mentioned before - competing for traditional technology - that are the result of an advanced technology - are also a base of a much wider range of aesthetic options that allow designers to achieve architectural variety (i.e.: for the building envelope\(^\text{12}\), with all the speed and quality benefits of building off site). That approach can now deliver award-winning architecture and landmark buildings. However the EU Migrant Crisis creates very threatened situation in which all development are implemented in a high rush, with the main focus on the meeting the necessary number of units. It does not announce a positive scenario of the future of modular

\(^{12}\) Exteriors and interiors. Regarding exteriors, options include a palette of attractive colours or claddings such as cedar, terracotta tiles, stone, composite metal panels, brick, and render.
construction. Therefore it is important to emphasize the value associated with aesthetic. Otherwise in a very short time, modular buildings will be despised and stigmatized. Let's modify the main password of the Modular Building Institute: “Smarter, Greener, Faster”, by adding extra phrase “Eesthetically Pleasing”.

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