

## The Role of Prefabricated Materials in Architecture During the Pandemic and Post-Pandemic

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**Abstract.** The purpose of this study is to determine and analyze how big the role of prefabricated materials in increasing construction efficiency in architecture, especially in the post-pandemic era. This research was conducted using qualitative methods because it relates to the views of researchers regarding to the relationship between prefabricated materials and post-pandemic phenomenon. The results obtained from this research are the application of prefabricated material technology that can help the construction process in architecture to be faster in several aspects. The presence of prefabricated materials in architecture, especially post-pandemic, can make the construction process faster in terms of time and installation. The presence of prefabricated materials in architecture, especially post-pandemic, can make the construction process faster in terms of time and installation. Therefore, the use of prefabricated materials is very well applied both during the pandemic and post-pandemic because it can break down the processing time faster so as to minimize the crowd of workers in the field. The final result of this research is to find out how big the role of prefabricated materials in architecture is to make work in the field more efficient and minimize crowds during the pandemic or post-pandemic period. We hope that this research can be useful for the architectural world regarding the advantages of applying prefabricated materials during the pandemic and post-pandemic era.

**Keywords:** Architecture, Prefabricated Materials, Pandemic Covid-19

### 1. Introduction

Construction work is currently divided into two, namely traditional construction work and work construction 4.0. In the current era of the COVID-19 pandemic, the construction sector has also been affected COVID-19 [1]. In the past, before the COVID-19 pandemic occurred, many cases of demolition of buildings were carried out without thinking about the ecological impact related to the waste generated. Thus, there is a crisis of shortage of residential land due to the imbalance between the increasing demand for housing in the city and the limited resources it has. One solution that is often applied to this problem is to prefabricate materials and use a modular system which is proven to be more efficient and effective, especially in

terms of resources and time [2]. This prefab includes fabrication off-site building components to a higher level of completion such as: structures and mass building systems, and their assembly at the project site or site. In this case, prefabricated can streamline work time, construction speed, architectural quality, material efficiency, worker safety, and minimize the human labor required, while limiting environmental impact of construction, compared to conventional construction built at the training ground. In general, prefabs can be categorized into components, panels (2D), modules (3D), hybrid and whole building put together [3]. Prefabrication has been considered as an effective alternative to conventional buildings. After receiving increased attention over the past decades as a way to advance sustainable construction [4].

Prefabricated construction, a new direction for the future development of the construction industry, can maximize the "green" requirements. As a new form of green building, prefabricated construction is very attractive, because this prefabrication can be applied to traditional architecture as well as high-rise buildings [5]. The use of building methods with prefabricated systems able to speed up the development process with the support of modular components. This prefabrication system has the advantage of lower costs due to the construction process which is faster. Lower costs are also due to the workers needed at the project site less, because some of the building components are already manufactured off-site project, to further carry out the module assembly process [6]. However, from several studies this can be seen if this prefabricated material can save time and labor needed to do one job at hand, different from previous research which only discussing the matter of prefabricated materials, we relate the use of material technology prefabrication in this pandemic and post-pandemic era as a solution to minimize transmission in field or project location so that no covid clusters appear on the project.

The purpose of this study was to determine and analyze how big the role of prefabricated materials in increasing the efficiency and efficiency of construction in the scope of architecture, especially in the post-pandemic period. This research was conducted using qualitative methods.

## **2. Method**

The method used in this research is descriptive and qualitative. According to Gill et. Al. in 2008 it was stated that there are several kinds of methods in data collection, in qualitative research namely observation, visual analysis, literature study and interviews (individual or group). After all the data has been collected, then it is analyzed to get conclusions from the research. We use qualitative methods by using data or information in the form of narratives about prefabricated materials. Furthermore, after the information is obtained, it will be developed into a description of prefabricated materials and their role in the pandemic or post-pandemic period.

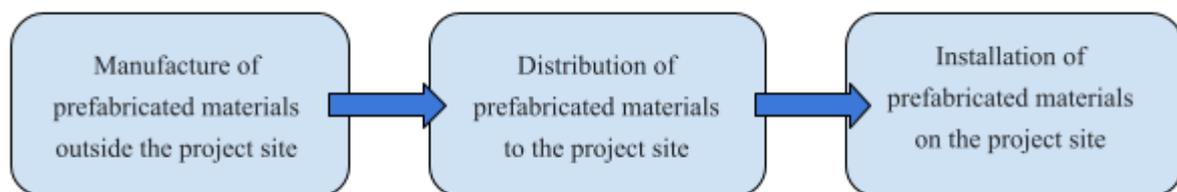
## **3. Results and Discussion**

### **3.1. Prefabricated Materials**

The constituent materials in architecture are of course increasingly diverse in form and type, the emergence of various materials in architecture is certainly inseparable from technological developments. In addition, there is also an appeal for humans to adapt to the environment and conditions such as during the COVID-19 pandemic. One of the materials that is currently being developed is prefabrication. The use of this prefabricated material certainly has various

advantages over conventional materials. Some of the advantages of this prefabricated material are that it can streamline the time and energy needed in the process of constructing or constructing a building. The subject of scheduling is a kind of combinatorial problem consisting of minimizing the time, optimizing consumption of resources, and dealing with uncertainties [7].

The process of applying this prefabricated material has several stages, such as the stages of making materials that are carried out outside the project site which are usually made at the factory, the stages of sending prefabricated materials to the project site, and the stages of installing prefabricated materials within the project site. The process of applying prefabricated materials is shown in Figure 1.



**Figure 1.** Prefabricated material application process

Applications of this prefabricated material can be used for architectural and structural parts. Prefabricated materials used for structures are usually made of steel, wood, and concrete. The application of this prefabricated material has been increasing since the end of 2019 when the COVID-19 pandemic began until now [8]. The use of this prefabricated material has several advantages that are considered suitable for application during the COVID-19 pandemic. Some of the advantages of using prefabricated materials include:

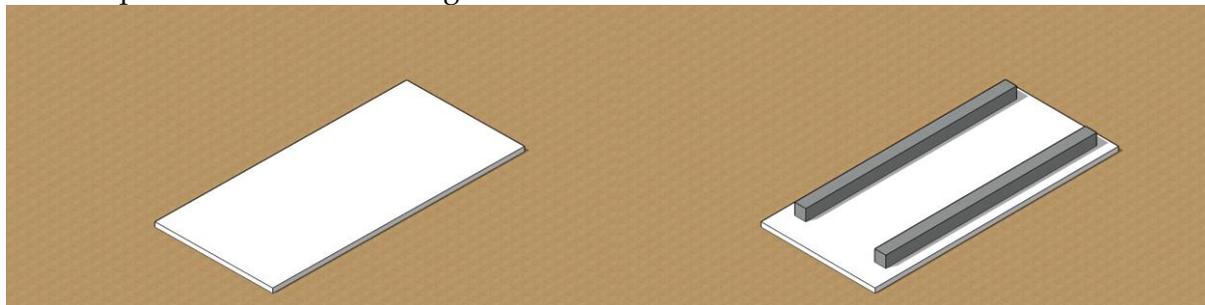
- a. Lower environmental impact (with the exception of abiotic depletion for LSF).
- b. Less ingredients.
- c. Produces a small amount of waste.
- d. Reduce the use of human labor.
- e. Minimize construction time or construction costs.
- f. Cost efficiency. Construction costs are variable and sensitive to local costs (e.g., labor and materials), so the ability to move parts of the building process may present a significant economic advantage for prefabricated buildings. [8].

Based on these advantages, prefabricated materials are more often used in the construction of a building, especially at the beginning of the COVID-19 pandemic. This is due to an appeal to the entire community to minimize the opportunity for the spread of the COVID-19 Virus by using masks, washing hands, and minimizing crowds. Crowds in a construction project usually always occur and are difficult to avoid, therefore the use of prefabricated materials can minimize the use of human labor and indirectly reduce the density of workers [9].

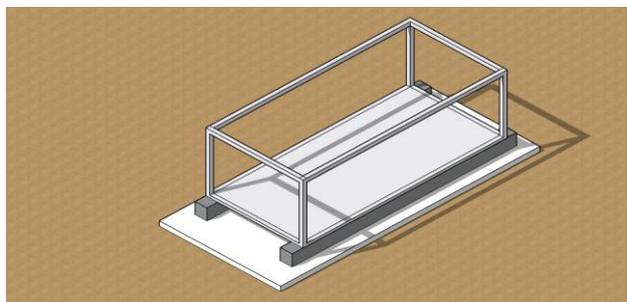
### **3.2. Application of Prefabricated Materials during Pandemic**

When the COVID-19 pandemic began to spread in many countries, there were several buildings that had implemented the use of prefabricated materials, one of which was in China. In early 2020 China built Huoshenshan Hospital and Leishenshan Hospital in about 10 days with a capacity of 1000-1300 beds. Leishenshan hospital was built as an emergency response

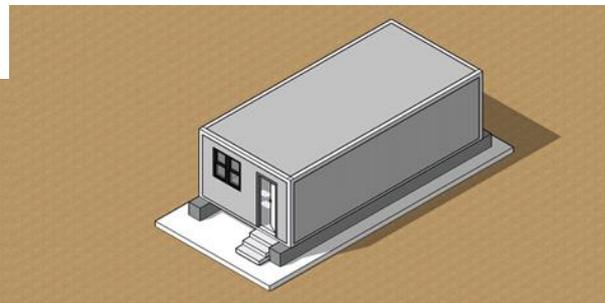
to provide healthcare to patients infected with the novel Covid 19 virus. The hospital was designed by Zhongnan Architectural Design Institute and later constructed by China Construction Third Engineering Bureau. The hospital included isolating units' of 1600 beds located on a 79900 m<sup>2</sup> covering the area of 21.97 ha. To reduce the workload and accelerate the project, engineers and architects have used modular prefabricated systems [10]. The two hospitals can be built in a short time because they use prefabricated materials which are expected to immediately accommodate patients infected with the COVID-19 virus during an emergency due to its wider spread. The hospital construction process uses a lot of prefabricated materials, including a waterproof geotextile layer at the bottom. Furthermore, there is prefabricated concrete applied to the foundation, prefabricated panels for walls and roofs. All hospital components are pre-assembled at the factory [10]. The installation process for a hospital ward is shown in Figure 2.



1. Geotextile layer, waterproofing



3. Frames



4. Prefabricated Panels

**Figure 2.** Process of prefabricated materials in a modular hospital [10]

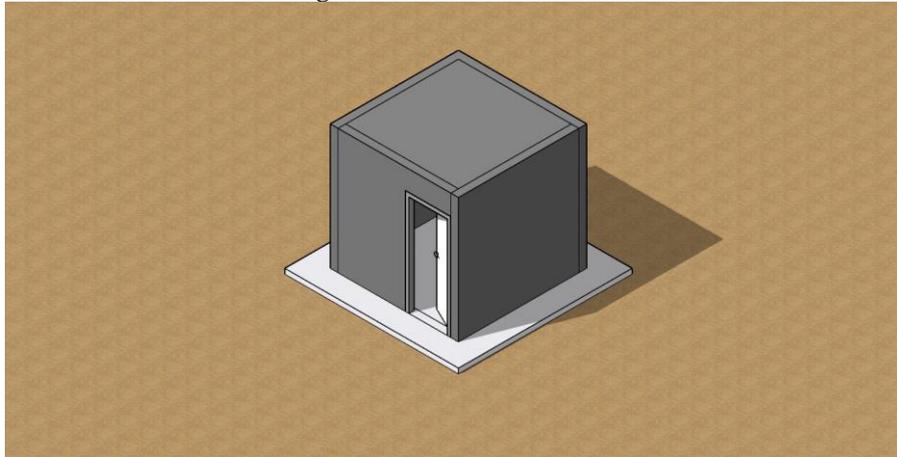
In addition to health facilities or hospitals, this prefabricated material has also begun to be widely applied to residential buildings such as apartments and flats. Residential buildings for the current COVID-19 pandemic must be able to create healthy housing, such as good air circulation and sunlight that can enter the house. If healthy housing can be met, the immune system of the occupants will be quite good and the chance of transmitting the virus can be minimized.

Some prefabricated components that are widely used are floor slabs, wall panels, stairs, balconies, and even structural components. Houses built with prefabricated materials have different advantages compared to houses built using conventional materials. One of the advantages is that the house can be disassembled based on its components, making it easier

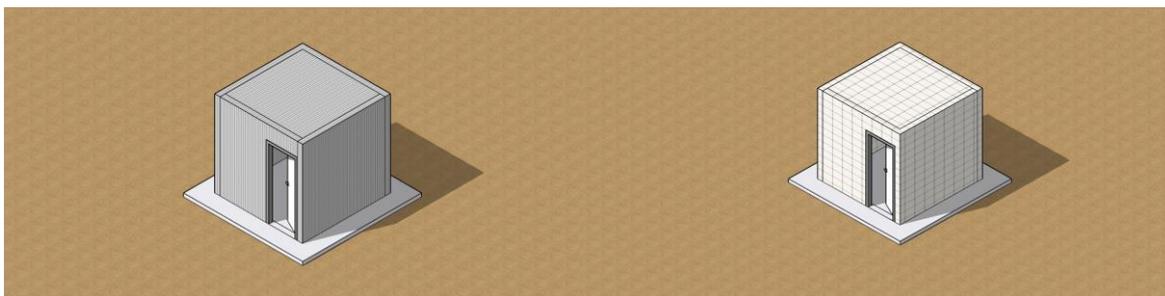
for renovations. In addition, houses with prefabricated materials can increase the space or reduce the existing space without destroying the entire house, this can be useful during the COVID-19 pandemic. The application of several prefabricated components such as exterior windows and skylights can also be applied and results in a healthier space, because only with the application of these two things, sunlight can enter the house properly. As a result, it can form a space that can be used for sunbathing to increase body resistance during the COVID-19 pandemic [11].

### 3.3. Application of Post Pandemic Prefabricated Materials

The use of prefabricated materials is certainly not only popular during the COVID-19 pandemic. Some of the post-pandemic applications of prefabricated materials can be seen from several countries that have started to apply prefabricated materials for high-rise buildings, such as hotels and apartments. There are buildings that use prefabricated materials only for some parts, such as the walls and some apply them to form one room directly. Some examples of prefabricated walls are shown in figures 3 and 4.



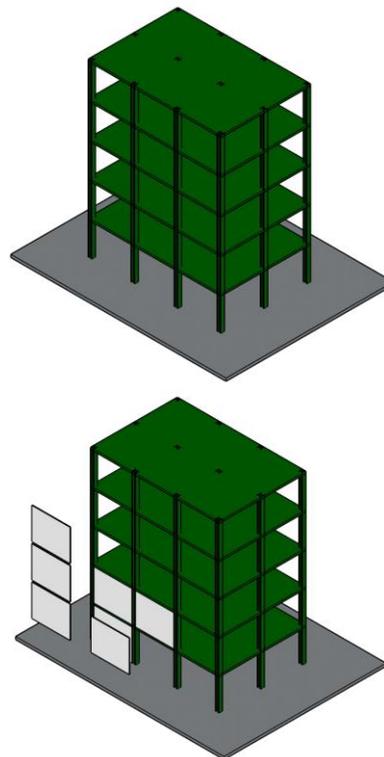
**Figure 3.** Prefabricated brick wall [13]



**Figure 4.** Prefabricated panel wall [13]

There are also prefabricated materials that are applied to high-rise buildings, usually the application of prefabricated materials is due to the faster installation process in construction. One example of this application is in an area that has a fairly dense population but the existing land is already widely used. One example of its application is in the Mohali City, India. In the city there is a building with 10 floors which was built in a fast time, which is 48 hours or 2 days. After just 6 hours, 3 floors had been constructed, and in 24 hours, nearly 7 stories had

been completed. This ultra-fast construction had more than 80 per cent work pre-made and the rest happened on the site. The material used was manufactured in the previous two months in a nearby factory [14]. The majority of building components used are prefabricated materials, both structural and architectural. The structure uses prefabricated steel and the walls use prefabricated panels [14,15]. Illustration of the application of prefabricated steel for high-rise building structures is shown in Figure 5.



**Figure 5.** Illustration of the application of prefabricated steel for high-rise building structures

#### 4. Conclusion

Technological advances in architecture are not only developing in the field of digitization, but also in the field of materials. Prefabricated materials are evidence of technological advances in existing building materials. Although this prefabricated material has begun to develop since before the COVID-19 pandemic, the use of this prefabricated material began to increase quite significantly during the COVID-19 pandemic. One of the driving factors for the use of prefabricated materials is the existing advantages, including minimizing costs, project waste, efficiency processing time, minimizing the manpower required, and can be assembled and disassembled. Apart from the advantages of these prefabricated materials, the COVID-19 pandemic they are facing is increasingly encouraging people to use prefabricated materials. The reason is that construction must continue while the transmission of the COVID-19 virus must be minimized. One way to prevent the spread of infection is to minimize crowds. We value the use of prefabricated materials to minimize overcrowding on the project because the

installation uses a lot of heavy equipment and does not require a lot of people. In addition, the use of prefabricated materials can meet space needs effectively in a fast time, such as hospitals for handling COVID-19 and housing for the community.

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