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Application of 3D Visualization for Quarantine and Treatment Centre (PKRC) Layouts in Malaysia Agriculture Expo Park Serdang (MAEPS)

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Abstract 10AN
This study aims to develop a reference platform when converting Malaysia Agriculture Expo Park Serdang (MAEPS) to the Low-Risk COVID-19 Quarantine and Treatment Centre (PKRC) in facing the increased numbers of Covid-19. This study applied qualitative methodologies and further developed 3D modeling involving AutoCAD, SketchUp, and V-Ray software. The findings enhance our understanding of how a multi-functional space transformed into the ideal spaces needed. The limitation is developing a 3D model visualization of MAEPS on Phase 1 and Phase 2 at the main hall. The application of 3D visualization potentially becomes a reference to creating the quarantine center in the future.

Keywords: Covid-19; pandemic; quarantine center; 3D modelling

DOI:

1.0 Introduction

The pandemic of Covid-19 has been with Malaysia for almost two years, resulting in hundreds of Low-Risk COVID-19 Quarantine and Treatment Centre (PKRC) built in every state until today to cater to the need for positive patients of Covid-19 that increasing day by day. The PKRC officially opened on April 16th, 2020, and the first treatment was administered on April 21st, 2020. It was formally closed on July 15th 2020 due to decreasing daily cases but later on December 9th 2020, Malaysia Agriculture Expo Park Serdang (MAEPS) PKRC reopened with a total amendment of the space layout. In the first phase of PKRC, 1362 patients received the treatment, of whom 94% were males, and 69% were illegal foreigners. The PKRC Phase 2, however, reopened with a massive capacity of 10000 beds to cater to the increasing number of positive Covid-19. The conversion also aims to transform the convention hall into a PKRC with completed

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facilities and services similar to a hospital. The facilities include clinical services, wards for COVID-19 patients, a pharmacy, an X-ray room, resuscitation rooms to stabilize patients in emergencies, and pathology laboratory services (interview with Encik Zaidi b Shahrim, Chief Executive Officer of Mardi Corporation, 2020). The second phase works beyond expectation. It received fewer Category 1 and Category 2 patients and provided the treatment for Category 3 of Covid-19 patients who have symptomatic and Pneumonia and Category 4 with symptomatic Pneumonia and require supplemental oxygen (Ministry of Health Malaysia, 2020). Therefore, the layout for Phase 1 and Phase 2 of MAEPS PKRC was adjusted due to the different space needed. The layout change is also caused by the increasing understanding of the virus and the best potential to spread the virus by quarantine procedure. The rules also stated that the PKRC is prohibited from any visitor and public. Therefore, this study aims to establish the 3D visualization of the main hall for both PKRC Phase 1 and Phase 2 to deliver a suitable layout for the quarantine center of the pandemic in the future.

2.0 Literature Review

2.1 Low-Risk Covid-19 Quarantine and Treatment Center (PKRC)

The Ministry of Health (MOH) and the National Disaster Management Agency (NADMA) provided several guidelines on developing and operating the quarantine center. NADMA experienced forcing the task to do quick emergency action in 2014 due to the massive flood (Hanafi et al., 2021). As a background, the facilities provided in MAEPS were the first in Malaysia to form part of quarantine and Low-Risk COVID-19 Treatment Centre comprising two main halls covering 14200 m^2 and 604 beds for Person Under Surveillance (PUS). The transformation led by NADMA to the Work Department (JKR), overseen by Arkitek Hasnah Yun, had to face the challenge of complying with requirements regarding the spatial organization and human movements to control the infectious disease. The design also had to fulfill the active and passive fire protection requirements of the Fire Fighter Department. This included a provision for pathways and an emergency assembly point, the location of fire extinguishers, and appropriate signages. Unlike the NADMA's previous work for the post-disaster of flood in 2014, where the design of the house was to adapt the residents' social activities (Hanafi et al., 2021).

MOH also announced the Guideline of Quarantine Station (Guidelines COVID-19 Management No.5/2020 updated on March 24th, 2020) whereby the establishment of a quarantine station is a requirement under Section 14 of the Prevention and Control of Infectious Disease Act 1988 (Act 342) (MOH, 2020). According to the Act, "*The quarantine station is to be used for isolation or observation of any person who is infected or whom the Authorized Officer has reason to believe is infected to be removed to a quarantine station until the person can be discharged without posing any danger to the public"* (2020). This involves the cooperation of multiple agencies such as the District Health Office, District Welfare Department, Malaysian Royal Police, Army, Local Council, PGA, and others. MAEPS, as a PKRC at the national level, therefore, complied with the guidelines as stated in Annex 32 Quarantine center (MOH, 2020). According to En Zaidi (2020), the management in this PKRC of MAEPS was strictly accomplished with 100% compliance among local companies to the guidelines stated in Annex 32. In terms of the details, establishing a quarantine center was to separate infected and potentially infected persons from healthy people. In addition, it aimed to control the movement of those infected to prevent the disease from spreading. MAEPS also fulfilled the prerequisites for a gazette center for quarantine as follows:

i. Space layout:
The distance between each bed must be at least 1 meter apart if shared space is inevitable. This cohorting procedure applies only to positive situations (MOH, 2020). MAEPS also complied with other prerequisites, such as providing a room for PPE and clinical examinations. The beds provided were made by a local company that assembled and painted them at MAEPS within four days of establishing the PKRC. They had to ensure that the beds followed the MOH requirements with no edgy surfaces and no fabric used for the mattress and pillow covers. In terms of amenities and facilities, the MAEPS convention hall was already provided with toilets, some of which had to be renovated to become bathrooms with specifications that considered safety and health.

ii. Security and safety:
In addition, MAEPS was monitored under the National Security Council to ensure quarantine premises were met. Safety was overseen by Polis Diraja Malaysia (PDRM), the Army, and RELA. There were two sharpshooters or snipers located at the tower near Hall A, MAEPS, to cover the boundary of the premises, which were also protected by barbed wire fences. Additionally, the security and safety aspects were emphasized and assisted by Angkatan Tentera Malaysia (ATM) and PDRM, such as the spatial organization focusing on the openings and the building perimeter, including the coordination of keys and tagging. The selection of the material for the PKRC also had to conform to health and safety factors.

iii. Cleanliness
Two types of cleanliness needed to be provided: clinical waste for which the District Health Office was responsible and general cleanliness and general waste for which the Local Council was responsible.

iv. Food:

The food supply had to pass tests for nutrition and potential poison three times before being distributed to the patients and those on the frontline under the supervision of the District Health Office. The District Welfare Department was responsible for the food supply.

v. Staff duty:
The Incidence Commander coordinated the staff on duty throughout the MAEPS as it became a PKRC.

vi. Linen:
The concession extended from the hospital services managed the linen and clinical waste at MAEPS.

vii. Water supply:
The Work Department was responsible for supplying water to the quarantine center.

This also follows UBBL 133 Final Exit requirements, *UBBL 166 Alternative exits, UBBL 171 Horizontal exit,* and *UBBL 133, UBBL 169 Exit route*. As elaborated in UBBL 165, the travel distance in the designated area should be reachable. The width of the openings to Hall A and Hall C fulfilled the requirements of all stated emergency exits and travel distance, albeit with strict security reinforcements. MAEPS also had to comply with fire devices such as fire trucks, pumping appliances for extended ladders, turntables, and hydraulic platforms as required by the Fire Fighter Department. The security system was also assisted by CCTV, a public announcement system, and a wireless intercom. The MAEPS, as a PKRC, was provided with free high-speed Wi-Fi access contributed by Telecom Malaysia (TM) to ease the health recording and registration system in this PKRC (Rafidah, 2020).

2.2 3D Visualization in Spatial Planning

During the last two decades, digital documentation started to gain more attention amongst scholars and practitioners in the field. Despite the wide range of applications and customization ability,it is also due to its flexible implementation at different levels of the archival and documentation process. For instance, digital archiving in heritage preservation plays a significant role in preserving records and reconstruct buildings' data. This includes 3D models and related semantics. However, the application of 3D specifically in spatial design has become a trend, increasing and utilizing 3D digitalization and visualization in architecture. According to Centofanti and Brusaporci (2013), the effectiveness of the 3D model application for a restoration architecture project, for example, still has some issues, such as the validation and dissemination of shared standards regarding the 3D configuration. There is no specific software compulsory to develop the 3D visualization and simulation, but the impact must represent the information needed for future reference. In focusing on the layout of the quarantine centre, dedicated officers or designers must consider the prevention of disease and fulfill the behavioral needs simultaneously. Thus, the 3D visualization can simulate the spatial layout of the dedicated PKRC to determine the suitable arrangement of spaces to serve the officers and patients. The development of 3D visualization of the PKRC contributes a new approach to layout design selection and provides effective space planning and management healthcare. In addition, de Oliveira (2000) stated that; “simulation is a powerful tool to ease the plan of new hospital facilities because it provides means to reflect about crucial issues involved with the planning”. The case study applied at Hospital Cardoso Fontes, Rio De Janeiro, Brazil showing the utilization of 3D visual simulation in examining the functionality and space layout of the hospital using 3D Max software and 3D Fashion simulation. Figure 1 depicts the simulation of 3D visualization of the new facility of a hospital as proposed by de Oliveira (2004).

Fig.1: Simulation of a new facility in a hospital
(Source: De Oliveira,2004)

3.0 Methodology

A qualitative methodology was employed to achieve the objectives of this study. A focus group interview was conducted with the Chief Executive Officer of Mardi Corp and staff. The aim is to determine the exact operational works undertaken during the transformation by the Mardi Corporation, which was responsible for the venue owner and facilities. The sharing of experiences illuminated the management and monitoring of all teams and the spaces needed. The data were analyzed, and the findings were utilized to determine the factors underpinning the successful transformation of MAEPS in a short time into the first massive interim quarantine center for Malaysia. The data then was developed into 3D modeling animation using AutoCAD, Sketch-Up and V-Ray 3D Render.

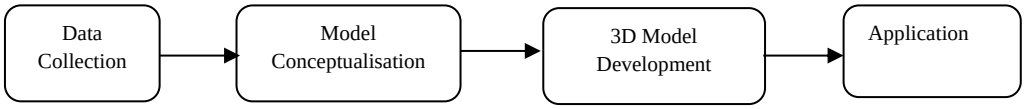

Fig.2: The methodology applied to develop 3D visualization of the quarantine center

4.0 Findings

According to the literature review and the interview, the useful information about MAEPS and PKRC were analyzed to develop the 3D modeling layout. Ensuring the hall was columnless meant numerous compartments could be assigned in this hall during the transformation. NADMA and all agencies faced minimal challenges in organizing the spatial zoning and circulation. Figure 3 depicts the plan layout of Hall A, MAEPS, after the transformation to PKRC. Hall A is a fully air-conditioned space with a height clearance of up to 9 meters, with three sectional wings converted to a gym and a rest area for PUS. The activities inside Hall A were under the surveillance of those on the frontline with high consideration for safety from any potential infectious diseases. The circulation and spatial organization of the Red Zone allocated for the Person Under Surveillance (PUS) complied with infection protection standards by ensuring the correct distance and height of all compartments. COVID-19 is believed to be spread by water droplets and is not an airborne spreader at Phase 1 of PKRC. Hall C was explicitly dedicated to those on the frontline. It comprised a meeting area, resting area, lounge, counseling area, and more as most staff could not return home. Figure 4 shows the transformation work of the main hall to be the first Low-Risk Covid-19 Quarantine and Treatment Centre (PKRC) in Malaysia.

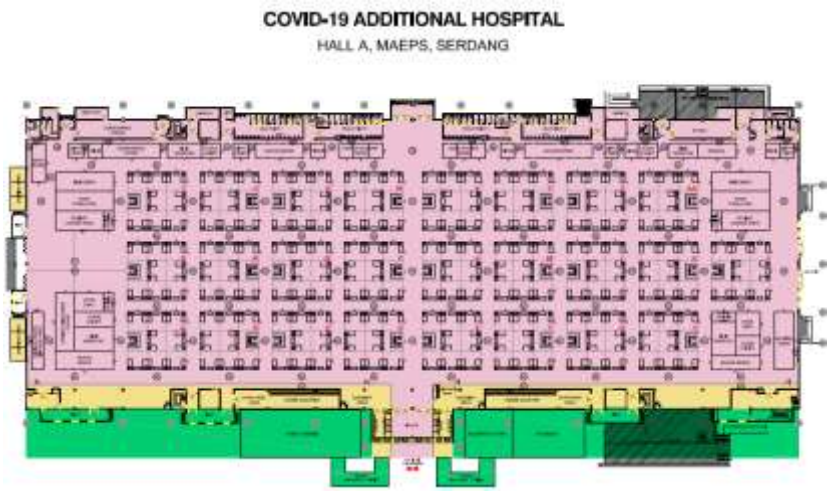

Fig. 3: The plan layout of MAEPS PKRC at Phase 1
(Source: Mardi Corp. Sdn. Bhd.)

Fig. 4: The transformation work of the main hall
(Source: Mardi Corp. Sdn, Bhd.)

5.0 Discussion

The 3D visualization of the MAEPS PKRC of Phase 1 and Phase 2 successfully was developed, and the experts were asked for clarification. Phase 1 indicated the application of compartments between zones and bed layout. 3D development of the space layout in MAEPS begins with scaled drawing using AutoCAD (Figure 5). Furthermore, the scaled drawing was converted to 3D modeling using SketchUp (Figure 6) and rendered using the V-Ray software (Figure 7).

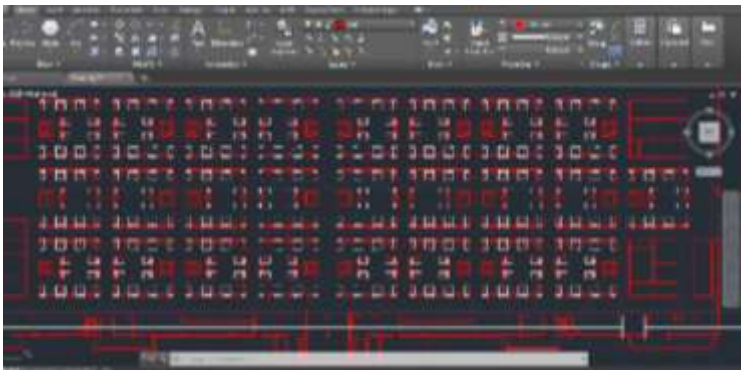

Fig. 5: The development of scaled drawing using the AutoCADD
(Source: Authors)

Fig. 6: The development of 3D modeling using Sketch-Up
(Source: Authors)

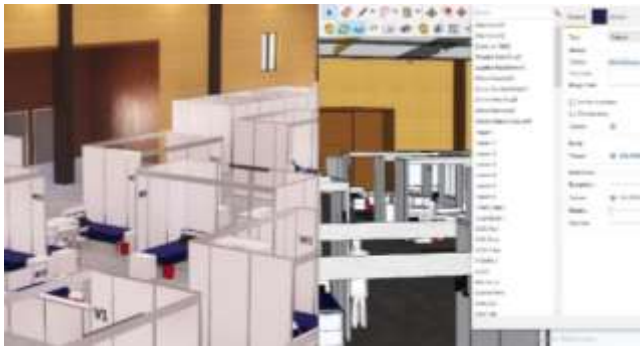

Fig. 7: The rendering process of 3D modeling using V-Ray
(Source: Authors)

According to the 3D visualization, many spaces and facilities can be referred to as visual guidelines and improvements. For example, Figure 8 depicts the compartment that allows the PUS to be monitored and has the privacy required to rest and sleep. It also can give complete visualization of the proportion in the cubicles installed in the hall. Compliance with the guidelines, laws, and regulations regarding the particular implementation of material spaces and the facilities achieved the planned objectives. Figure 9 demonstrates that the measurements complied with the MOH guidelines as the compartment panels are 10 feet in height and the distance between the beds exceeded 1 meter. The 3D visualization also can visualize the staff area, such as the treatment and working area, namely the Red Zone. In this Red Zone, PKRC also accommodated a lounge area for the PUS. Figure 10 represents example activities in the lounge area.

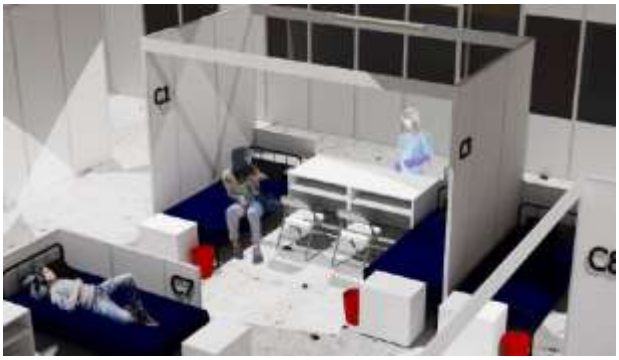

Fig. 8: The visualization of compartment installed at the hall
(Source: Authors)

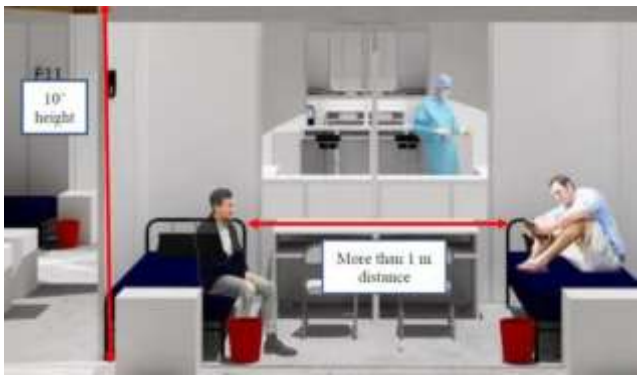

Fig. 9: The visualized measurement of the distance between the PUS
(Source: Authors)

Fig. 10: The visualized example activities in the lounge area
(Source: Authors)

The hall also provides the Yellow Zone dedicated to a registration counter and a surveillance area for the frontline. Figure 11 describes the compartment for the surveillance counter that complied with standard measurements to avoid direct contact with PUS.

Fig. 11: The image surveillance counter in the Yellow Zone
(Source: Authors)

The second phase of MAEPS PKRC drastically changes the space layout, especially for Category 1 and category 2 of positive patients. Bunk beds were the best solution to cater to massive numbers of expected positive patients to this PKRC, up to 10000 persons. Figure 12 shows the bunk beds arrangement in Phase 2 of PKRC in MAEPS, where the partitions were reduced and removed, such as in Phase 1. Thus, the comparative spatial layout between Phase 1 and Phase 2 of MAEPS PKRC can be stimulated by the concerned person in charge of developing a new PKRC at any time in the future.

Fig. 12: The visualized of bunk beds arrangement in Phase 2
(Source: Authors)

The 3D visualization of both Phase 1 and Phase potentially become the reference for improving facility layout in the future for the quarantine center. The issues of the spatial domain of the private, semi-private, and public areas can be enhanced by the respected organizations. For instance, the bunk bed users, particularly the upper level, must consider the age and disability where the senior citizen is more suitable for the single bed. Therefore, through the 3D visualization, the bed layout of the quarantine center can indicate the zoning area for the patients and calculate the capacity of the specific hall. The privacy of the patients and the security of the belongings can be designed through the controled access by the zoning.

6.0 Conclusion and Recommendations

The 3D animation of the PKRC layout represented by PKRC of MAEPS can be a benchmark to all states in converting a public space to become a PKRC. The 3D visualization works as a template for the related agencies to manage the area and arrange the layout to quarantine the low-risk patients of Covid-19. Due to the understanding of the characteristics of the Covid-19 virus increasing day by day,

the design of PKRC also has several amendments such as the usage of partition between the cubicle. Thus, it results in two types of PKRC layouts, and both can be valuable references for the future. PKRC is only accessible for the front responders and patients; therefore, this 3D visualization also contributes to giving the information of Covid-19 quarantine and low-risk treatment centers in Malaysia to the public. The 3D animation of the PKRC also contributes to education through the explorative space layout animated that can be referred to in classroom and research as the PKRC is a temporary space that only develops during pandemic at its peak. The 3D animation of the PKRC also explains the historical moments of Malaysian facing the pandemic of Covid-19 that can be our future proud. This 3D visualization can be developed further to be as Augmented Reality and Virtual Reality in the future. Future researchers also recommended developing 3D visualization of the other quarantine centers and comparing with Malaysia Agriculture Expo Park Serdang (MAEPS).

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Paper Contribution to Related Field of Study

This research established that 3D modeling visualization of the Low-Risk COVID-19 Quarantine and Treatment Centre (PKRC) is necessary as a reference for future action in facing the pandemic. The 3D visualization depicts the plan layout, dimension of the walkway, zone, and space requirement needed to convert a building into a quarantine center.

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