Sandamini, K.Y. and Waidyasekara, K.G.A.S., 2022. Container-based relocatable modular buildings for construction site offices in Sri Lanka: Contractors' perspective. In: Sandanayake, Y.G., Gunatilake, S. and Waidyasekara, K.G.A.S. (eds). *Proceedings of the 10th World Construction Symposium*, 24-26 June 2022, Sri Lanka. [Online]. pp. 236-248. DOI: https://doi.org/10.31705/WCS.2022.20. Available from: https://ciobwcs.com/2022-papers/

CONTAINER-BASED RELOCATABLE MODULAR BUILDINGS FOR CONSTRUCTION SITE OFFICES IN SRI LANKA: CONTRACTORS' PERSPECTIVE

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ABSTRACT

The temporary site offices are directly provided by the contractor, and hence, any associated risk is non-transferable. Thus, the contractors should be aware of sustainable, and cost-effective technologies to be implemented to survive in the competitive construction industry. Relocatable Modular Building (RMB) technology is employed globally as a multi-beneficial building technology for temporary shelter purposes such as site offices. Hence, the research aimed to explore the applicability of RMB technology for temporary offices on construction sites in Sri Lanka. The literature synthesis reviewed the modular building concept and RMB technology globally. Following the qualitative approach, the research adopted a survey strategy. Data was collected through seven semi-structured interviews with industry professionals who were purposively selected under several criteria. Further, data collection was limited to container-based RMBs due to the limited availability of RMB varieties in Sri Lanka. Template analysis was the data analysis technique followed. The findings disclosed that RMBs have already been established in the Sri Lankan construction industry. 'Relocatability', reusability, high security, larger usable space within limited land space, ability to rent out, and air-conditioned working environment were found as key benefits of RMBs whereas the unbreathable smell of glue in newly fabricated RMB, handling difficulties, the possibility of overturning, initial cost and external body corrosion were identified as key challenges. Significantly, the contractors are recommended to use RMBs for temporary site offices following proposed strategies such as periodic maintenance procedures, systematic site administration, and safety improvements to overcome identified challenges.

Keywords: *Benefits and Challenges; Container-based Site Offices; Contractors; Relocatable Modular Building (RMB); Strategies.*

1. INTRODUCTION

The construction industry comprises an extremely competitive market mostly controlled by prices (Chan, 2012). Hence, the contractors have to constantly pursue the efforts to decrease the cost of projects while concurrently achieving the quality of the final product to adhere to the competitiveness of the industry (Chan, 2012). Although trade work

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accounts for the majority of project costs, project overheads are crucial since they relate to items directly delivered by the contractor, and hence, any related risk is non-transferable (Chan, 2012). In addition, the cost of providing a construction site office is a site overhead that is unavoidable by any contractor (El-Sawalhi and El-Riyati, 2015).

On the other hand, modular construction technology is an innovative method for buildings that can provide significant value to any building project (Ambler, 2013). The benefits of modular construction include faster project duration, improved standardisation, less waste, less pollution in construction sites, less job site disruption, and greater ease of fabrication (Yang, et al., 2005; Ferdous, et al., 2019; Innella et al., 2019; Pasquale, et al., 2020). As cited by Smith (2014), there are two diverse segments in the modular construction industry such as permanent modular, and relocatable modular or temporary modular. A Relocatable Modular Building (RMB) is a structure that provides temporary shelter needs (Smith, 2014). Further, RMBs can be dismantled and reused multiple times (Lawson, et al., 2012). Hence, RMB technology can be identified as a viable option for site offices because, they have temporary nature, and can be reused for several construction projects. However, there is a paucity of research evidence on the use of RMB technology for temporary site office construction in the Sri Lankan context. Therefore, the study aims to explore the applicability of container-based RMB technology for temporary offices on construction sites in Sri Lanka to overcome the existing knowledge gap.

Accordingly, the paper presents the literature review on modular buildings in construction, followed by the use of RMB. Then, the research method adopted, and research findings are presented. Finally, conclusions drawn from the study are discussed.

2. LITERATURE REVIEW

2.1 MODULAR BUILDINGS

Modular building is an increasingly important Modern Method of Construction (MMC) in the prefabrication industry. Recent developments in the field of prefabrication have led to a renewed interest in modular buildings. There have been several longitudinal studies involving modular buildings that have reviewed modular buildings from numerous angles. Kamali and Hewage (2016, p. 1172) introduced modular building as "a set of modules that are built in an off-site fabrication centre, delivered to the construction site, assembled, and placed on the permanent foundation". Schoenborn, et al. (2012) mentioned that the Modular Building Institute (MBI) had classified modular buildings as 60% to 80% completed off-site before being moved to a destination. Further, Smith (2014) stated that modular is the most completed 3D volumetric unit, which is manufactured within a factory condition, even up to 95% in some scenarios. Similarly, Lawson, et al. (2012) claimed that modular building construction is an illustration of high-level prefabrication technology. Referring to available literature, modular building can be introduced as an assembled collection of 3D modules which are fully fabricated in an enclosed factory environment and transported to the site.

Kamali and Hewage (2016) argued that modular building delivers a wide range of environmental, economic, and social benefits, it may help to achieve sustainability goals. Further, the same authors have summarised the key benefits of modular construction according to six parameters such as time, cost, on-site safety, product quality, workmanship and productivity, and environmental performance. Table 1 illustrates the

key benefits of modular building construction as summarised by Kamali and Hewage (2016) and further acknowledged by many researchers.

Table 1: Benefits of modular construction

Benefits	Source of References											
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Time saving	x	x	x	x	x	x	x	x	x	x	x	x
Cost reduction		x	x		x	x	x	x				
On-site safety			x		x		x	x				
High product quality		x	x		x	x		x		x		x
High productivity		x	x		x	x		x				x
Less environmental impact			x		x	x		x		x		x

Source of Reference: [1] (Bertram, et al., 2019); [2] (Blismas, et al., 2006); [3] (Chen, et al., 2010); [4] (Kawecki, 2010); [5] (Kyjaková, et al, 2014); [6] (Lawson and Ogden, 2008); [7] (Lu and Liska, 2008); [8] (Mapston and Westbrook, 2010); [9] (Modular Building Institute (MBI), 2012); [10] (Pasquale, et al., 2020); [11] (Schoenborn, et al., 2012); [12] (Trubiano, 2013)

Similar to benefits, there are several challenges of modular construction identified by the previous researchers. According to Molavi and Barral (2016), the list of challenges of modular construction includes a lack of quality control over structural integrity, aesthetic appearance, and the need for greater design work to maintain structural and architectural integrity. Further, Samani, et al. (2016) stated that avoiding overheating in buildings is a big challenge in modular buildings. Further, the challenges of modular construction as identified by Kamali and Hewage (2016, p. 1175) are listed in Table 2.

Table 2: Challenges of modular construction

Challenges	Description
Project planning	Need for more pre-project planning
	Extra engineering effort
	Hard to make changes later
Transportation Restraints	Modules' dimensional constraints
	Hard to transport modules far away
	Time delays due to late transit permits for oversized components
	Customs delays in borders when transporting internationally
Negative perception	Negative perception of new construction methods
Site constraints	Availability of cheap labour in the area
	Availability of experts such as engineers and designers in the area
Coordination and communication	Need for increased and more detailed coordination in all stages of a project
	More communication among all stakeholders
Initial cost	Need for a large initial investment to run modular services

Source: (Kamali and Hewage, 2016)

Moreover, Kamali and Hewage (2016) and Schoenborn, et al. (2012) explained that the construction of modular structures can be more costly than traditional structures in several

circumstances. As an example, when the number of storeys in a modular building project climbs, the time saving decreases significantly since the project becomes more difficult, necessitating additional engineering and communication as well as more workforce on the site (Kamali and Hewage, 2016). Similarly, Schoenborn, et al. (2012) stated that cost savings from time savings (i.e., time means the money in the construction) in modular construction might be countered by transportation or extra professional needs.

2.2 PERMANENT MODULAR CONSTRUCTION VS RELOCATABLE MODULAR BUILDING

Relocatable modular and permanent modular are the two different industry segments in the modular building industry (Smith, 2014). Permanent modules are off-site manufactured modular units used to construct a permanent modular building with a lifespan ranging from 30 to 60 years. In general, their performance is comparable to that of conventional buildings (Mapston and Westbrook, 2010). Correspondingly, permanent modular buildings provide a service similar to on-site construction where permanent modules are affixed to a permanent base of the structure (Schoenborn, et al., 2012). Further, permanent modules are used for the buildings utilised for any purpose including multi-storey residential buildings, government buildings, hospitals, schools, and hotels (Smith, 2014). This construction technology is known as Permanent Modular Construction (PMC).

Relocatable modules as its name implied are used to build relocatable buildings that can be moved according to user preference. While whole building prefabricated off-site is only transported once from the construction yard to the project site and is permanently connected to the foundations, relocatable buildings are meant to be moved a few times during its life lifetime (Shahzad, 2016). Generally, relocatable modular structures that are used to provide temporary space facilities can be leased by short-term leasing arrangements or purchased (Smith, 2014). Similarly, movable buildings, such as portable toilets and site offices, are lightweight and small-scale constructions that are designed to be relocated as and when required (Shahzad, 2016). This construction technology is also referred to as Relocatable Modular Building (RMB) technology.

2.3 RELOCATABLE MODULAR BUILDINGS

Withstanding the current literature, an RMB can be defined as a repetitively usable temporary structure of a volumetric unit or combination of several units that is movable from one location to another according to user requirements. RMBs are built to be readily disassembled, transported, and relocated. They are primarily intended for temporary or semi-permanent structures and have a relatively limited lifespan of 15 to 30 years owing to material selection more than workmanship (Mapston and Westbrook, 2010). Generally, if an RMB is well maintained and operated, it has usable life equivalent to any other form of building. These units should be often upgraded with HVAC repair and roof replacement, which can prolong their usable life by many years (MBI, 2019).

Recent RMB markets include real estate development, industrial production, commercial firms, education, financial organizations, government entities, and resource industries. Customers in these industries move to utilise RMBs mainly because of the speed, flexibility, practicality, and cost of the construction (MBI, 2019).

2.4 RELOCATABLE MODULAR BUILDINGS IN THE CONSTRUCTION INDUSTRY

RMBs are mainly used in construction sites since speed, temporary space, and 'relocatability' are important in the construction market. Construction-site trailers are used as standard site offices in the industry cause they are readily available at construction sites and plants for instant delivery (MBI, 2019).

Commonly, RMB can be used seven times on average within its whole life span. However, it will vary depending on the size, type, and the market served of that RMB unit. Basu (2012) described this fact through the typical usage pattern of a construction site office. Construction site offices are generally manufactured for the fulfilment of limited space requirements. Therefore, they are made up of one or two relocatable modular units that are comparatively smaller than RMBs used in other markets. Further, according to the industrial nature site offices have to be continuously relocated. Because of these reasons, RMBs that are used as construction site offices can be moved an average of 12 to 15 times within its whole usable life cycle.

According to MBI (2019), though wood is the standard material, steel units are widely used in the North American context to achieve incombustible requirements. Further, RMBs are available as one or two-storey relocatable units for construction site environments with soundproofing and they can be typically moveable by a forklift. Additionally, these units contained electrical and telecommunication wiring, service lines for heating, air conditioning, and even plumbing.

Further, RMBs may be modified for a variety of access control situations, including toll booths, ticket sales offices, security posts, and weigh stations, all of which are typical uses (Basu, 2012; MBI, 2011). In the construction industry, RMBs are used as security huts to facilitate access control to the construction site.

Additionally, RMBs can offer economical and convenient equipment protection facilities and storage facilities for stored items such as raw materials, work-in-progress goods, and final products at on-site protection from adverse weather conditions and burglary. Regularly, RMBs offer durability and strength to the unit which can increase the protection for equipment and stored items. RMBs are used for construction equipment shelters, chemical storage structures, temporary generator housing, pump room housings, and other applications which provide a guard to equipment. Further, RMBs which are heavy-duty storage units, have ground-level entry and are excellent for construction site storage and equipment storage (MBI, 2019).

3. METHODOLOGY

This paper addresses the research inquiry "How container-based RMB construction technology is implemented as the temporary site office construction technology in construction sites?". To assess the modular construction concept as the study's basis, an exhaustive literature research was undertaken by referring to journals, books, conference proceedings, and other reliable sources. Though the global literature highlighted the benefits and challenges of modular construction, RMB technology had not been treated in detail. Thus, the researchers attempted to ascertain the benefits and challenges of the RMB construction and propose strategies to overcome challenges in the contractors' perspective to implement container-based RMB technology successfully for temporary

site office construction in Sri Lanka. However, due to the lack of existing knowledge with relevance, the researchers needed to identify the contextual background to get a better understanding through expert knowledge and experiences. As Naoum (2007) stated, this kind of research which concerns the subjective evaluation of attitudes, views, and experiences adopts a qualitative research approach. Hence, the current study adopts a qualitative research approach to investigate the utilisation, applications, benefits, and challenges of RMB technology as a temporary site office and strategies to overcome the key challenges for the contractors in the Sri Lankan construction industry through the experts' experiences.

Since the study focuses on a specific construction method, centralising to the purposive sampling method, only eligible experts who have experience on using container-based site offices for construction projects were selected to gather reliable data. The following two criteria were considered when purposively selecting experts for the data collection.

- Industry professionals who currently work at a container-based site office, and
- Industry professionals who have previous experience working at container-based site offices from construction to dismantling stage.

Guest, et al. (2006) mentioned that sample size of six is sufficient to develop meaningful themes, if a higher level of homogeneity is maintained within the sample. Accordingly, the initial sample was limited to ten interviewees. However, the sample size was reduced to seven since the data was saturated (Mason, 2010). Therefore, seven professionals were interviewed following a semi-structured interview guideline which was based on literature findings. Table 3 summarises the profiles of the interviewees.

Table 3: Profiles of interviewees

Interview Participants	Profession	Designation	Industry Experience
IP1	Civil Engineering	Project Manager	27 years
IP2	Civil Engineering	Manager (Civil Works)	13 years
IP3	Civil Engineering	Site Manager	10 years
IP4	Civil Engineering	Site Manager	9 years
IP5	Engineering	MEP Engineer	6 years
IP6	Quantity Surveying	Project Quantity Surveyor	9 years
IP7	Quantity Surveying	Project Quantity Surveyor	8 years

Further, 70% of participants in the sample have more than eight years of experience in the construction industry. Hence, the collected data from the interview participants was more reliable. Furthermore, the template analysis technique was implemented to analyse the primary data collected. Referred to Saunders, et al. (2019), template analysis provides a methodical, adaptable, and approachable method for analysing qualitative data. It adopts a greater degree of structure through the formation of initial coding templates mainly based on literature findings. However, both literature findings and the transcripts of initial interviews in the study were used to form the initial templates, in the qualitative data analysis process.

4. RESEARCH FINDINGS

To determine the current level of knowledge over the RMB technology in Sri Lanka, the knowledge on the concept of RMB was investigated through the construction industry professionals. Research findings on the RMB concept in terms of utilisation and applications in the construction industry, benefits, and challenges of RMB technology, and strategies to overcome identified key challenges are discussed in this section.

4.1 UTILISATION AND APPLICATIONS OF RMB TECHNOLOGY

The professionals' opinion on the level of utilisation of RMB technology was that the RMB concept is widely used in the construction industry in many applications. Further, the interviewees revealed that the RMBs used in the construction industry are mainly container-based units.

Moreover, applications of RMB in the Sri Lankan construction industry were identified. Table 4 presents the applications of RMB in the construction industry highlighted by the interview participants.

Table 4: Applications of RMB in the Sri Lankan construction industry

Applications	Interview Participants						
	IP1	IP2	IP3	IP4	IP5	IP6	IP7
Site offices	√	√	√	√	√	√	√
Labour accommodation	√			√	√	√	
Houses						√	
Storerooms	√	√		√	√	√	√
Meeting rooms	√						
Security huts							√
Toilets	√		√				√

As per interview participants, the concept of RMB has already been established in the Sri Lankan construction industry. Further, applications of RMB spreads in a wide range of construction site administrative purposes such as site offices, labour accommodation, houses, storerooms, meeting rooms, security huts, and toilets.

4.2 BENEFITS AND CHALLENGES OF RMB TECHNOLOGY FOR SITE OFFICE CONSTRUCTION

The interviewees were questioned regarding the benefits and challenges of using RMB technology for site office construction. The listed benefits and challenges of modular construction in the literature synthesis were used as a guide. Although RMB is a type of modular construction, there are major dissimilarities between PMC and RMB construction. Thus, the interviewees were questioned on their agreement on the benefits and challenges of modular construction relating to the benefits and challenges of RMB technology for site office construction.

Table 5 provides the agreement of interview participants on the facts identified through the literature survey (L) and additional benefits recognised through interviews (I).

Table 5: Benefits of RMB technology for site office construction

Benefits	L/I	Interview Participants						
		IP1	IP2	IP3	IP4	IP5	IP6	IP7
Time-saving	L/I	√	√	√	√	√	√	√
Cost reduction	L/I	√	√	X	X	X	X	X
On-site safety	L/I	X	X	√	X	√	√	√
High product quality	L/I	√	√	√	√	√	√	√
High productivity	L/I	√	√	√	√	√	√	√
Less environmental impact	L/I	√	√	√	√	√	√	√
Relocatability	I	√	√	√	√			√
Reusability	I		√		√			
High security	I	√		√		√		√
Larger usable space within limited land space	I	√						
Ability to rent out	I	√					√	
Air-conditioned working environment	I	√		√				

As per interview participants, time-saving is the main benefit regarding RMB technology due to less mobilisation period. However, IP1 mentioned that time-saving is a benefit only when the contractor buys a fully finished RMB from a manufacturer rather than the contractor manufactures its own office using a container box. Though it is mentioned cost reduction as a benefit of modular construction in the literature, IP5 stated that the mandatory requirement of an air conditioning system results in high energy cost, maintenance cost, and repair cost. Therefore, cost reduction can be identified as a benefit when the contractor owns an RMB because the contractor can get the benefit of Whole Life Cycle Cost (WLCC) reduction due to reusability. The majority of the interviewees agreed that using RMB increases onsite safety because of less construction at the site. However, IP2 and IP4 highlighted several risks such as overturning, and electric shocks in the utilization stage of RMB. Even though all interview participants believed that high product quality is a benefit of RMB site offices, IP5, and IP6 mentioned that RMBs can be bought according to the contractor's requirements since there are both high quality and low-quality RMBs on the market. All interviewees agreed that the contractors can achieve high productivity using RMB site offices in comparison to traditional methods because of less construction time at the site and IP2 further elaborated that productivity is high since the contractors can have a site office as the final product within less construction period and less labour involvement. It is the common view of interviewees that RMB construction has less environmental impact because of reusability and no construction waste generation in the contractor's hand.

Moreover, 'relocatability' was highlighted as a benefit by most respondents because the RMB site office can be relocatable according to the construction stages of the project. As per IP2, reusability is a sustainable feature of RMB and beneficial for the contractors, especially in terms of cost. IP4 confirmed that an RMB can be used for four to six projects throughout its lifetime. Further, the container box site offices are lockable, and hard to break the walls and enter to the office, and thus it provides high security to the kinds of stuff such as important documents, computers, photocopy machines, and scanners inside the site office. As commented by IP1, RMB serves larger usable space within limited land

space, as modules can be stacked one on top of another. Both IP1 and IP6 remarked that the ability to rent out is a benefit of owning an RMB because the contractors can rent out the RMB when they are not in use. According to IP1 and IP3, since an air conditioning system is a mandatory requirement when container-based RMB is used as a site office, office staff can have an air-conditioned working environment. As a result, contractors can have a dust-free room and it reduces the damage to the computers, scanners, and photocopy machines. Therefore, the repair cost of the electronic equipment used can be considerably reduced.

Returning to the challenges of RMB technology, Table 6 indicates the agreement of the interview participants on the facts identified through the literature survey (L) and additional challenges recognised through interviews (I).

Table 6: Challenges of RMB technology for site office construction

Challenges	L/I	Interview Participants						
		IP1	IP2	IP3	IP4	IP5	IP6	IP7
Project planning	L/I	X	X	X	X	X	X	X
Transportation restraints	L/I	√	√	√	√	√	√	√
Negative perception	L/I	√	X	√	X	X	√	√
Site constraints	L/I	X	√	X	X	X	X	X
Coordination and communication	L/I	X	X	X	X	X	X	X
Initial cost	L/I	X	√	√	X	X	X	X
Newly fabricated RMB	I		√					
Handling difficulties	I	√	√	√	√			
Possibility of overturning	I	√				√		
External body corrosion	I						√	

As summarised in Table 6, though project planning, coordination, and communication are challenges in PMC, according to interviewees, they are not challenges in RMB construction because only simple work must be done at the site and a maximum of two days will be spent. Further, all interviewees hold the view that transportation is challenging, because of high transportation costs and difficulties in transporting involved. The majority of the interview participants stated that people involved in the construction industry have negative perceptions of modular construction due to less aesthetic appearance, less comfort for occupants, and less space. By contrast, IP4 and IP5 commented that industry people are familiar with this concept and therefore, now the contractors have a positive perception regarding RMB technology since it is easy and time-saving. However, IP2 argued that negative perception results due to poor site administration. The common view amongst interviewees except IP2 was that site constraints are not a challenge. The majority of the interviewees highlighted that if the land surface is not flat, the contractors must level the surface to locate the building unit. Thus, RMBs can be used as site offices even in a sloping area. By contrast, IP2 argued that an RMB can be overturned when it heavily rains and if the area is full of ground settlement because even no proper foundation is used to place the RMB. Accordingly, site constraints can be identified as a challenge for the contractors. Turning to the initial cost, the general opinion of the interview participants was that though the initial cost is comparatively higher than traditional methods of construction, it is worth investing in

RMB because of its long-life span. However, IP2 and IP3 argued that RMBs are not suitable for large-scale construction projects, because when the site staff increases, the initial cost to bear is considerably high. Hence, the researchers deduced, that the initial cost of RMB is only a challenge when the office space becomes larger.

IP2 pointed out that, using fresh built RMB is a challenge for the contractors because the smell of glue used to fabricate the RMB is not bearable. Further, most of the interviewees expressed handling difficulties as a challenge for the contractors in the construction process of RMB especially when limited space is available at the site. As IP1 and IP5 mentioned, the overturning possibility of RMB is a challenge for the contractors because RMB has a high possibility to overturn due to heavy rains, hurricanes, ground settlement, and lack of connection with the ground. Further, the research focused on container-based RMB site offices in which the external body is made of steel. Therefore, the external body corrosion of RMB is a challenge for the contractors in the maintenance stage.

4.3 STRATEGIES FOR CONTRACTORS TO IMPLEMENT RMB TECHNOLOGY SUCCESSFULLY FOR TEMPORARY OFFICE CONSTRUCTION

Table 7 illustrates the strategies that were proposed by the interview participants to overcome key challenges identified and so to successfully implement the RMB technology for temporary site office construction in Sri Lanka.

Table 7: Strategies for contractors to overcome challenges

Challenges	Strategies to overcome challenges
• Unbreathable smell of glue in newly fabricated RMB	• Place the order earlier
• Possibility to overturn during bad weather	• Avoid two-storeyed RMB in a windy area
• External body corrosion	• Avoid RMB standing on the bare ground
	• Follow periodical maintenance procedure
• Negative perception	• Adhere to systematic site administration
	• Use thermal insulation layer (Mac foil) inside the RMB wall
• Initial cost	• Reduce LCC
• Electric shocks	• Use an earthing system to increase the safety

According to the previous discussion, newly fabricated RMB was identified as a challenge for contractors because the smell of glue used to fabricate the RMB is unbearable. To avoid this, the contractors have to order the RMB earlier, if they need a new RMB. IP2 detailed that if the contractors can purchase RMB at least one month before the requirement, this challenge can be overcome. Since prevention is better than cure, avoiding two-storeyed RMB and going for a large flat office complex in the windy area is a solution to eliminate the risk of overturning modular units due to strong winds. Further interviewees suggested solutions for external body corrosion such as the contractors should avoid RMB standing on the bare ground, use an appropriate foundation structure, and periodical maintenance procedures such as clearing the rust with sandpaper and painting with appropriate paint. The previous discussion revealed that negative perception is a challenge of RMB technology where site administration is poor. Hence,

IP2 recommended that the contractors should follow a systematic site administration procedure to provide appropriate facilities to avoid negative feedback from the staff. Further, the contractor can use a thermal insulation layer such as a Mac foil layer inside the cladding and it is useful to retain the cool air inside the building. As the solution to high initial cost, the interview participants suggested reducing LCC through different strategies such as the use of durable materials for flooring and cladding boards, and precautions for steel corrosion to reduce repairing and maintenance costs. And also, there is a risk in the utilisation stage of RMB because electric shock can happen. The use of an earthing system is a solution provided by the interviewees to prevent the risk of electric shock and increase the safety of the site staff. Along with the discussion, the contractors can use these strategies to avoid key challenges, which were identified as barriers to the implementation of RMB technology successfully for temporary site office construction in Sri Lanka.

5. DISCUSSION

The lack of literature on RMB technology in the local context forced the researcher to fill that gap by identifying the utilisation, applications, benefits, and challenges of RMB technology. According to Uthpala and Ramachandra (2015), the practice of modular building technology is lesser than in other countries. However, it was found that the RMB technology has already been established in the Sri Lankan construction industry and spreads in a wide range of construction site administrative purposes such as site offices, labour accommodation, houses, storerooms, meeting rooms, security huts, and toilets. Along with this, it was realised that the RMBs used in the construction industry are mainly container-based units. This finding further supports the finding of Uthpala and Ramachandra (2015) that the volumetric prefabrication practiced in Sri Lanka is mainly container-based modular units.

The research found that the benefits of modular construction discussed in the literature review relate to RMB technology. However, the findings showed that time-saving is a benefit only when the contractor buys a fully finished RMB from a manufacturer. Expanding the list of benefits, the research disclosed that benefits such as 'relocatability', reusability, high security, large usable space within limited land space, ability to rent, and the air-conditioned working environment can be served by RMB technology. Further, results revealed that RMB technology is a sustainable site office construction method since reusability results in considerable waste reduction.

Though Kamali and Hewage (2016) had identified project planning, coordination, and communication as challenges for modular construction, research indicated that they are not challenges in RMB construction. However, other challenges of modular construction recognised by Kamali and Hewage (2016) are relatable to RMB technology as well. In addition, the current study showed that newly fabricated RMB, handling difficulties, possibility of overturning, and external body corrosion are challenges in the RMB approach. Moreover, the study recommends the contractors to pursue strategies identified in Table 7 to successfully implement the RMB site offices.

6. CONCLUSIONS

In the Sri Lankan context, there is a lack of research evidence on utilisation of RMB technology. However, the global literature provided evidence on RMB applications for

temporary site office construction, thusly the study aimed to explore the applicability of RMB technology for temporary offices on construction sites in Sri Lanka to bridge the existing knowledge gap. The study revealed that RMB technology has already been established in the Sri Lankan construction industry but is limited to container-based RMBs and spreads in a wide range of construction site administrative purposes. Further, the research findings contributed to link the knowledge gap by acknowledging the specific benefits and challenges of RMB technology. Further, the research proposed strategies to the contractors for the avoidance of key challenges and the implementation of RMB technology successfully for temporary site office construction in Sri Lanka. However, the strategies recommended in the study are limited within the scope of contractors, strategies for all the challenges identified were not addressed. Hence, further studies are needed to identify strategies to overcome challenges, within the scope of modular building manufacturers.

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