BESt: Journal of Built Environment Studies
P-ISSN: 2746-9077 E-ISSN: 2746-9069
Journal Home Page: https://journal.ugm.ac.id/v3/BEST

COMPARATIVE STUDY OF PREFABRICATED TEMPORARY SHELTERS BASED ON THE NATIONAL TEMPORARY SHELTER OF THE REPUBLIC INDONESIA

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ABSTRACT

This research is a study comparison of temporary shelters with a prefabricated approach. This research was conducted based on the need for a temporary shelter design precedent with a prefabricated approach that can remain close to the government's temporary shelter standards (at least the closeness of specifications and budget). This research will compare the specifications and budgets of 9 models of prefabricated temporary shelters based on the Indonesian National temporary shelter standards. The goal is to find precedents for prefabricated temporary shelters closer to the standards of temporary shelters in Indonesia. The method in this study uses several methods, namely quantitative in the description of the initial data, qualitative in the final assessment, which is combined with a comparison of the scores given to each shelter. The results of this study are the findings of two types of prefabricated temporary shelters which are pretty close to the standards of the national temporary shelter of Indonesia in the form of sample F 33 points and sample E 30 points. This result is much influenced by two factors: the selection of materials and the assessment points in a shelter.

ARTICLE INFO

Received 20 December 2021
Accepted 27 December 2021
Available online January 2023

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Keywords:
Temporary shelter, prefabricated temporary shelter, Indonesian National temporary shelter standards, comparison research

1. Introduction

As we know that temporary shelter is a program by the government of Indonesia in this case (BNPB/BPBD) in an area where has a goal to fulfill the necessity of temporary shelter in post-disaster conditions. The purpose of making this temporary shelter is to become a transitional shelter and as a transitional bridge from emergency shelter to permanent housing (Santoso et al., 2016).

Based on the implementation of post-disaster shelters in Lombok and Donggala Island in 2018, according to (Sudibyo, 2020) the construction of temporary shelters has several obstacles on the site including, time constraints, constraints on materials, and constraints on the quality of temporary shelter materials. It means that the construction of the temporary shelter is progressing very slowly and has not been able to meet the scheduled provision of temporary shelter. CNN Indonesia (2018) also reported in its report that several factors caused delays in the process of constructing temporary shelters. These factors are: lack of material availability, POKMAS or community groups can not immediately build (the construction process is quite complicated), and there are obstacles in disbursing funds. Suppose it is drawn in the context of architecture. In that case, there are problems experienced in the field: there is a need for temporary shelter that ordinary people can build, can quickly pursue development targets, and can get out from the lack of available materials situation in the site. Based on the above constraints, the need for methods that can be efficient in dealing with the problem on time, material quality, and ease in the manufacturing process is indispensable.

One method that can solve these problems is to use a prefabricated approach. The prefabrication method can be interpreted as a manufacturing design process that can be assembled on a site where the spare parts have been assembled or partially manufactured at the factory first. In the current development, temporary shelters with prefabricated approaches have been widely researched and developed in developed and developing countries, but this has not happened much in Indonesia. In its implementation in Indonesia, so far, it is still using the conventional temporary shelter in its disaster agenda, for example in: steel frame temporary shelter, located in Aceh-2005, the wooden shelter in the Padang West Sumatra earthquake-2009, wooden/bamboo temporary shelter, and steel frame in Lombok-2018 (Fadillah, 2018; Gusti, 2018; IFRC, 2011; Itsmis, 2018; Suhardi et al., 2018). Meanwhile, Indonesia does not yet have a standard on temporary

shelters with a prefabricated approach. The currently available standard is in the form of a national temporary shelter (conventional) standard issued in a 2018 Ministry of SOE (BUMN) circular letter with a statement (Number SE-09/MBU/11/2018), in the form of a steel frame temporary shelter.

However, this national temporary shelter standard must have its limitations. This limitation can be seen from the budget side to the specifications for temporary housing that the government has set. It will be interesting to study if this national temporary shelter's limits (specifications and budget) are used as the basis for standard assessment in comparing specifications and budgets between prefabricated temporary shelters currently being developed.

The focus taken in this research will be on the realm of budget studies and specifications between temporary shelters with a prefabricated approach based on the standard value basis of the Indonesian national temporary shelter. This research will involve selected prefabricated residential products and concepts that have been developed to date. The purpose of this research is to see examples of efficient prefabricated temporary shelters (closer to the Indonesian national temporary shelter standards) in terms of price and specifications. The hope is that this research can be one of the efforts to make temporary shelter standards with a prefabricated approach.

2. Literature Review

2.1 Prefabricated System

The prefabricated system is one of the development methods in buildings that mix technology into it. It proves that the longer the progress of the world of construction and development is growing. Prefabricated systems can be seen in the following sense:

- Based on the Oxford dictionary, prefabrication means "the practice of making sections of something, especially a building, that can be put together."
- According to the Cambridge dictionary, prefabrication means "the act of making parts in a factory that can be put together quickly, or of building something from these parts."

Boafo et al. (2016) explains that prefabrication can be seen in a unique sense, a process of manufacturing design methods carried out outside the project site that combines and uses various materials and systems to become a new product according to the context of the work. According to Akhmad (2008), prefabrication is a building construction system carried out by the printing method, and its installation is carried out by the disassembly method.

2.2 The Principle of Prefabricated

In its application, prefabricated systems have basic principles that must be fulfilled. According to JICA (2019) (Japan International Cooperation Agency), explained that buildings with temporary systems (included in the prefabricated category) have several principles that must be fulfilled: (1) easy to mass produce; (2) light construction; (3) easy to transport (no heavy equipment needed); (4) can use local materials that are easy to buy. More specifically, Mendis (without year) explained that the definition of prefabricated structures is closely related to modular structures, namely: (1) modules have repetition; (2) mass-produced in a controlled environment; (3) can be assembled in the field (can be disassembled); (4) the final finishing is done on-site.

2.3 The National Temporary Shelter

In 2018, the government of Indonesia, in this case, the Minister of State-Owned Enterprises of the Republic of Indonesia, issued a circular explaining the standard of temporary shelter and temporary public facilities in disaster-affected locations with a statement of circular letter number (SE-09/MBU/11/2018). In the statement attached to the letter, there are specifications for temporary shelter materials, designs, and a few technical drawings that can be used as references in making temporary shelters for post-disaster programs. Of course, the budget in its manufacture is not determined, considering that each region has a different price range in terms of material prices. However, based on the regulated material specifications, at least can still be calculated budget accommodations can be budgeted. The recommended materials are (1) soka zinc roof/equivalent; (2) light steel wall framing (similar to channel C and the like); (3) kalsiboard/ GRC wall; (4) Wooden frame plywood doors; (5) residential area of about 20.25 m^2 (4.5 m x 4.5 m).

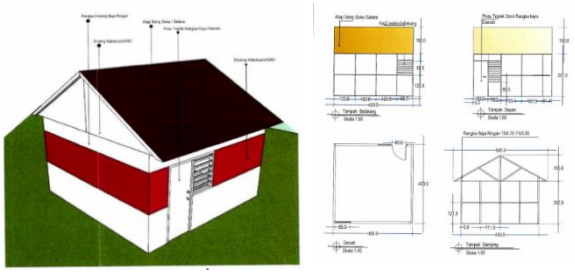


Figure 1. The National Temporary Shelter
Source: Indonesian SOE Ministry Circular (2018)

3. Research Method

3.1 The Method Used

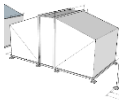
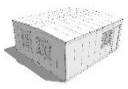
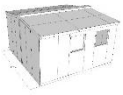
This research is a comparative study comparing national temporary shelters to several prefabricated temporary shelters currently being developed. The method used is a combination of quantitative and qualitative. Each sample in this study is described and calculated on specific points in the form of a total budget, price per meter, occupancy area, weight, transported quantity, occupancy capacity, ventilation systems, projections of space distribution, safety. Each sample will provide a value that can describe the state of the shelters. National temporary shelter becomes the baseline assessment in this research. The shelter that is declared to have passed at the end of the comparison session is a shelter that has a value equal to or exceeding the standard value of the national temporary shelter.

3.2 Collecting Data

The data in this research were collected by reviewing several selected journals containing the prefabricated temporary shelters or their designs developed to date.

Data (temporary shelter samples) were collected as many as 9 sample shelters selected based on the criteria and one temporary shelter with national standards. The selected samples based on the results of screening criteria standard that has been set:

Table 1. The Selected Samples (Prefabricated Temporary Shelters and National Temporary Shelter Specification)

Samples & Design/Researcher owner	The Shelter	Shelter Area (m^2)	Occupancy Capacity (people)	Assemble Time	Material	Construction System
Sample A (Wiliamson, 2013)		37.5	8-10	3-5 hours	Steel structure, scaffolding adjustable, sandwich panel	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular panel structure, no special skills required
Sample B (Irwan et al., 2016)		18.91	4-5	4.6-5 hours	Aluminum structure, polypropylene panel	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular panel structure, no special skills required
Sample C (Pero, 2014)		14.56	5-10	11 minutes	A hollow structure, aluminum foundation, polyester, and polypropylene	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular component structure, no special skills required
Sample D (Deepblue)		27.5	4-8	-	A hollow structure, lip channel, SIP (Structural Insulated Panel)	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular panel structure, no special skills required
Sample E (Lynch, 2017)		17.50	3-5	5-6 hours	Galvanized pipe structure, polyolefin foam, polypropylene	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular component structure, no special skills required
Sample F (Lundgren & Carboni, 2014)		23.1	4-8	-	K245 board, polyethylene, rafter, plywood	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular unit structure, no special skills required
Sample G (Extremis Technology)		20.47	4-5	-	Plywood, galvalume, polyolefin foam, wood beam	No heavy equipment needed, easy to assemble and mass produce, repetition module, no special skills required
Sample H (Borgobello, 2013)		18.75	-	Two hours	Aluminum extruded, SIP (Structural Insulated Panel)	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular unit structure, no special skills required
Sample I (AFS, 2016)		47	4-6	-	Hollow steel, SIP (Structural Insulated Panel), scaffolding adjustable	No heavy equipment needed, easy to assemble and mass produce, repetition module, modular unit structure, no special skills required
National Temporary Shelter (Minister of State-Owned Enterprises of Indonesia, 2018)		20.25	4-5	10 days	C channel frame, rooftile/zinc, partition wall, cement, sand	No heavy equipment needed, easy to assemble and mass produce, repetition module, need carpentry skills, modular component structure

Source: Researcher Analysis (2021)

3.3 Criteria Standard

In this research, standard criteria for sample selection were set. According to the problem's context, it is a sample filter tool to obtain and select the desired prefabricated temporary shelter. This criterion is obtained through existing temporary shelter standards. The standard on this research is the standard issued by the Ministry of Social Affairs of the Republic of Indonesia, the SPHERE project standard, and the addition of the principle of the prefabricated method in it. This criterion is a combination of variables that explain the minimum needs that must be met in the sample of temporary shelters that will be selected. The explanation can be seen in the following table:

Table 2. The Selected Prefabrication Temporary Shelter Criteria

Variable	Sample Indicators
Module	Repetitive
Easiness	Easy to assemble
	Easy to mass-produce
The Construction	Light
	Accessible to transport (no heavy equipment needed)
	Short time constructed
	Ready to assemble/disassemble
	Fixed on site
Material	Used affordable local materials
	It can be mass-produced in a controlled environment
	A durable material used can protect the user from thread or lousy weather
Durability	It can be stored and reused
	It can be used for short or long term
	Durable material is essential
	Provide the safety
Design	There is ventilation for maintaining user healthy
	Provide space for household activity
Area	Space requirement is 3.5 m^2/people
	Shelter occupation up to 5 people or higher
	Closed room minimal 18 m^2

Source: Researcher Analysis (2021)

3.4 The Data Process Method

The processing and analysis are generally divided into two stages, they are the quantitative method's initial calculation and the qualitative method as the final assessment. In the quantitative method, adjustments are made that can simplify the calculation process, for example: (1) adapting material prices according to Indonesian currency, JABODETABEK (Jakarta, Bogor, Depok, Tangerang, and Bekasi) as the chosen region that represents Indonesian material price; (2) narrowing the choice of transportation mode to only land vehicles; (3) simulating the formation of flat packs with SketchUp software to determine the amount of packaging that will be loaded on the vehicle.

While the qualitative method determines the scoring on each sample, this scoring stage has five levels where each level has its description. The national temporary shelter will be the basis for standard assessment, where each point will be worth a 3-point scale. Then the total standard points that all samples must have to pass the assessment must be 27 points (3 x 9) or more. Examples of scoring values are as follows:

Table 3. The Scoring Level Assessment

Score	Description
1	Much worse than standard
2	Worse than standard
3	Same as standard
4	Better than standard
5	Much better than standard

Source: Researcher Analysis (2021)

To give a value to each sample, it must have a strong basis. Therefore, a score requirement standard is set for each assessment point:

Table 4. The Score Requirement Standard

Score	Area (m^2)	Total budget (IDR)	Price per m^2 (IDR)	Weight (kg)	Transported Quantity	Occupancy Capacity (people)	Ventilation Systems	Space Distribution	Safety
1	Covered area less than 14	> 27 million	> 1.338 million	More than 1.800	Cannot use 3 or more types of vehicles Dry Container 40 FT cannot be used (special conditions)	< 3	Have no windows at all	Only has one facility	Does not have two aspects of the 5-point properties of material standard
2	Covered area about 14 – 17.9	25.1 – 27 million	1.239 – 1.333 million	1.410 – 1.800	It cannot be loaded in Pick Up Colt Diesel Ankle Filled (1 unit or unfilled) Colt Diesel Double Filled (< 5 units) Fuso Bak filled (< 6 units) Tronton Bak (< 17 units) Dry Container 40 FT (< 20 units)	3 - 4	Have window Not support cross ventilation system	One of the facilities is less than the standard area Covered area less than 18 m	Does not have any of the five material standard point properties

3	Covered area 18	18 – 25 million	888 thousand – 1.234 million	1.000 – 1.400	It cannot be loaded in Pick Up Colt Diesel Ankle Filled (1 unit) Colt Diesel Double Filled (5 units) Fuso Bak filled (6 units) Tronton Bak filled (17 units) Dry Container 40 FT filled (20 units)	5	There are two windows and supports cross ventilation system	There is a multipurpose area (11.49 m^2) and a sleeping area (7 m^2)	The material has the property of being resistant to fire Resistant to water Reduce heat The structure is not easy to collapse Not easy to break-in
4	Covered area 18.1 - 28	12 – 17.9 million	590 – 880 thousand	600 - 900	Colt Diesel Ankle Filled (> 1 unit) Dry Container 40 FT filled (> 20 units)	6 - 8	There are four windows and supports cross ventilation system	The multipurpose area (> 11.49 m^2) and sleeping area (>7 m^2), or one of the more extensive facilities. The covered area still has an area of not less than 18 m^2 Has additional function space	Have additional residential safety systems
5	Covered area > 28	< 12 million	100 – 587 thousand	< 600	Pick Up filled (> 1 unit) Dry Container 40 FT filled (> 20 units)	> 8	More than four windows and supports cross ventilation system	Have additional privacy and gender segregation between rooms Have service rooms such as kitchens or toilets	Has the addition of being able to withstand bad weather

Source: Researcher Analysis (2021)

4. Results and Discussions

Based on the assessment results carried out, various values are obtained between each sample of temporary shelters. Two of the 9 test sample units got the highest score, which the result of the acquisition value exceeded the national temporary shelter standard value. The two samples are E and F, where sample F is the sample with the highest score. To get the results of this analysis, one must go through the stages of calculation first. To describe it in detail, the following is an explanation and discussion of each sample:

4.1 The Base Line Assessment (National Temporary Shelter)

Based on the circular letter that explains the national temporary shelter design standards, the specifications in the form of sizes and materials used in the shelter are explained. Then based on these data obtained the size of the shelter area along with the essential materials used. Based on these standards, the 9 points described above are calculated based on the area of the shelter, the total budget, price/m^2, and the shelter's safety. The following explains the calculation:

Table 5. The Base Line Assessment

Sample	Area (m^2)	Total Budget (IDR)	Price per m^2 (IDR)	Weight (kg)	Transported Quantity	Occupancy Capacity (people)	Ventilation Systems	Space Distribution	Safety
National Temporary Shelter	20.25	19.765.850	976.100	1.173	Pick Up 2.30 m x 1.40 m: (0 Units)	4 - 5	There are two windows	A multipurpose area (11.49 m^2)	Resistant to fire and water
					Colt Diesel Engkel (CDE) 3.00 m x 1.60 m: (1 unit)				
					Colt Diesel Doble (CDD) 5.50 m x 2.20 m: (5 units)				Reduce heat
					Fuso Bak 5.50 m x 2.20 m: (6 units)		Supports cross ventilation system	Sleeping area (7 m^2)	The structure is not easy to collapse
					Tronton Bak 9.40 m x 2.20 m: (17 units)				Not easy to break-in
					Dry Container 40 FT 12.00 m x 2.35 m: (20 units)				

Source: Researcher Analysis (2021)

After the calculation, the above data is used as the standard assessment compared with the prefabricated temporary housing sample. The legal basis of this assessment is given a score of 3 points for each rating point for a total of 27 points (3 x 9).

4.2 Comparison Between Samples

After knowing the standard assessment basis, all existing samples began to be calculated and described according to each assessment point. Then after that, a comparative analysis based on the scores that have been formulated above is carried out. The following is an explanation of the data and the stages:

Table 6. The Comparison Between Samples

Sample	Area (m^2)	Total Budget (IDR)	Price per m^2 (IDR)	Weight (kg)	Transported Quantity	Occupancy Capacity (people)	Ventilation Systems	Space Distribution	Safety
Sample A	37.50	67.890.800	1.812.850	5.263	Tronton Bak 9.40 m x 2.20 m: (1 unit)	8 - 10	4 Windows (floor 1)	Multipurpose area (25.84 m^2)	Sturdy structure /not easy to collapse
							Two windows (floor 2)	Sleeping area (9.80 m^2)	Not easy to break-in
							Supports cross ventilation system	Mezzanine (15.31)	Resistant to fire, water, and reduce heat
Sample B	18.91	60.957.350	3.223.600	3.508	Colt Diesel Engkel (CDE) 3.00 m x 1.60 m: (1 unit)	4 - 5	Four windows (two on the left and right side)	A multipurpose area (11.30 m^2)	Resistant to water and reduce heat
					Colt Diesel Doble (CDD) 5.50 m x 2.20 m: (3 units)				
					Fuso Bak 5.50 m x 2.20 m: (3 units)		Two little ventilations	Sleeping area (8 m^2)	The structure is not easy to collapse
					Tronton Bak 9.40 m x 2.20		Supports cross		Not easy to break-

					m: (5 unit) Dry Container 40 FT 12.00 m x 2.35 m: (7 units)		ventilation system		in
Sampel C	14.56	26.038.500	1.788.400	1.056	Colt Diesel Engkel (CDE) 3.00 m x 1.60 m: (1 unit) Colt Diesel Doble (CDD) 5.50 m x 2.20 m: (1 units) Fuso Bak 5.50 m x 2.20 m: (1 unit) Tronton Bak 9.40 m x 2.20 m: (3 unit)	4 - 6	Not have window/ ventilation	Multipurpose area (2.80 m^2) Sleeping area (11.76 m^2)	Resistant to water and reduce heat Easier to break-in The structure is not easy to collapse
Sample D	27.50	55.516.100	2.018.800	6.878	Fuso Bak 5.50 m x 2.20 m: (1 units) Tronton Bak 9.40 m x 2.20 m: (2 unit)	4 - 5	6 Windows Not supports cross ventilation system	Multipurpose area (9.38 m^2) Two bedrooms for 1 – 2 people (15 m^2) Toilet (3.13 m^2)	The structure not easy to collapse Resistant to fire, water, and reduce heat Not easy to break-in
Sample E	17.50	17.084.400	905.400	347	Pick Up 2.30 m x 1.40 m: (2 Units) Colt Diesel Engkel (CDE) 3.00 m x 1.60 m: (4 units) Colt Diesel Doble 5.50 m x 2.20 m: (17 units) Fuso Bak 5.50 m x 2.20 m: (20 units) Tronton Bak 9.40 m x 2.20 m: (43 units) Dry Container 40 FT 12.00 m x 2.35 m: (46 units)	3 - 5	4 windows Four ventilations Supports cross ventilation system	Multipurpose area (10.30 m^2) Sleeping area (7.19 m^2)	Sturdy structure but easier to break in the then-standard structure Resistant to water and reduce heat
Sample F	23.10	24.759.200	1.071.850	228	Colt Diesel Engkel (CDE) 3.00 m x 1.60 m: (3 units) Colt Diesel Doble 5.50 m x 2.20 m: (15 units) Fuso Bak 5.50 m x 2.20 m: (21 units) Tronton Bak 9.40 m x 2.20	4 - 8	2 windows Supports cross	Terrace (4.14 m^2) A multipurpose area (7.20 m^2) Sleeping area (11.72 m^2)	Resistant to water and reduce heat The structure is not easy to collapse Not easy to break-

					m: (38 units) Dry Container 40 FT 12.00 m x 2.35 m: (30 units)		ventilation system			in
Sample G	20.47	31.202.450	1.524.350	1.705	Colt Diesel Doble 5.50 m x 2.20 m: (2 units) Fuso Bak 5.50 m x 2.20 m: (2 units) Tronton Bak 9.40 m x 2.20 m: (4 units)	4 - 5	Four windows Supports cross ventilation system	A multipurpose area (9.17 m^2) Sleeping area (9.17 m^2)	The structure is not easy to collapse Not easy to break-in Resistant to water and reduce heat
Sample H	18.75	45.358.300	2.419.150	4.146	Colt Diesel Doble 5.50 m x 2.20 m: (1 unit) Fuso Bak 5.50 m x 2.20 m: (1 unit) Tronton Bak 9.40 m x 2.20 m: (4 units) Dry Container 40 FT 12.00 m x 2.35 m: (7 units)	4 - 5	6 windows Four windows for natural light Supports cross ventilation system	Multipurpose area (10.80 m^2) Sleeping area (7.20 m^2) Terrace (9 m^2)	The structure not easy to collapse Resistant to fire, water, and reduce heat Not easy to break-in
Sample I	47	63.870.900	1.359.000	11.512	Tronton Bak 9.40 m x 2.20 m: (1 unit) Dry Container 40 FT 12.00 m x 2.35 m: (1 units)	4 - 6	Four windows Supports cross ventilation system	Family room (11.40 m^2) 2 Bedrooms (10.72 m^2 x 2) Toilet (3.38 m^2 Kitchen (6.81 m^2) Terrace (5.08 m^2)	The structure is not easy to collapse Not easy to break-in Resistant to fire, water, and Reduce heat

Source: Researcher Analysis (2021)

Table 7. The Analysis of Comparison Between Samples

Sample	Area (m^2)	Total Budget (IDR)	Budget per m^2	Weight	Transported Quantity	Occupancy Capacity	Ventilation Systems	Space Distribution	Safety	Total
National Temporary Shelter	3	3	3	3	3	3	3	3	3	27
Sample A	5	1	1	1	1	5	5	4	3	26
Sample B	4	1	1	1	2	3	5	4	2	23
Sampel C	2	2	1	3	2	4	1	2	1	18
Sample D	4	1	1	1	1	3	5	5	3	24
Sample E	2	4	3	5	5	3	5	2	1	30
Sample F	4	3	3	5	5	4	3	4	2	33
Sample G	4	1	1	2	1	3	4	2	2	20
Sample H	3	1	1	1	2	3	5	4	3	23
Sample I	5	1	1	1	1	4	4	5	3	25

Source: Researcher Analysis (2021)

4.3 Explanation of Analysis Results

Sample E

a) Area: The area of this shelter is broader than the minimum criteria for shelter enclosed space in table 1 and the scoring requirements in Table 4 above, with an area of 18.84 m^2. That way, the score given is 4 points (better than the standard).
b) Total budget: The amount of the price obtained is 17.084.400 IDR, which is cheaper than the total budget for the national temporary shelter, which costs 19.765.850 IDR. Based on this, the score given is 4 points (better than the standard). It is because the required range for the total budget is between 12.000.000-17.900.000 IDR.
c) Budget per square meter: With a total budget more minor than the National temporary shelter, automatically, the budget per meter of this shelter will also be cheaper than the National temporary shelter. The budget per meter obtained from the above calculations amounted to 905.400 IDR. The score that can be given is 3 points because the scoring has a price range of 888.000-1.234.000 IDR. It also makes this shelter the shelter with the smallest total budget and budget per meter compared to other samples
d) Weight: The shelter's weight reaches 347 kg, lighter than the standard weight of the National temporary shelter, with a weight difference of about 826 kg. It is included in the criteria for scoring with a score of 5 points where the occupancy weight requirement is recorded below 600 kg.
e) Transported quantity: Vehicles that can accommodate this shelter are six types of vehicles. The vehicles used are: Pick Up (2 Units), Colt Diesel Engkel (4 units), Colt Diesel Doble (17 units), Fuso Bak (20 units), Tronton Bak (43 units), Dry Container 40 FT (46 units). It can be categorized as included in the criteria for scoring requirements with 5 points (much better than the standard). It happened because the upper limit standard specified is the filling of 40 FT Dry Container > 20 units and the lower limit standard with Pick Up > 1 Unit filling. It should be noted that this shelter uses a packaging method in which the components of the shelter are arranged and shaped in the form of a flat pack in order to facilitate the delivery process using transport vehicles.
f) Occupancy capacity: The total capacity of this shelter is 4-5 people. It can be categorized into the criteria for scoring requirements with 3 points (same as standard). It happens because the total standard maximum capacity is up to 5 people. It should be noted that national or international standards require that one person in a shelter has a movement area of 3.5 m^2, so the area that a shelter must own with a capacity of 5 people is at least 17.5 m^2 or can be rounded up to 18 m^2.
g) Ventilation systems: There are four windows in the shelter. The left and right sides of the shelter have two windows each. As for the front and rear sides near the roof, there are four vents with two vents on each side. This condition allows for good air exchange. The score given to this factor is 5 points because the number of ventilations has exceeded the standard limit. The description of the requirements for scoring in the form of a total number of windows is more than four and supports a cross-ventilation system.
h) Space distribution: The space distribution in this shelter is in the form of a multipurpose area (10.30 m^2) and a sleeping area (7.19 m^2). One of the facilities is less than the existing standard. The enclosed area is less than 18 m^2 as required. Based on this, this factor is given a score with a value of 2 points.
i) Safety: The materials used in the structure are galvanized pipes, polyolefin foam on the roof and walls of the shelter, and doors and windows made of polypropylene. The material will still provide strength in terms of structure, but in terms of wall strength, it will be easier to penetrate when compared to national temporary shelter standards. The polypropylene foam material is no more resistant to fire than the GRC partition wall material owned by national temporary shelters. The score of points given is 1 point because it only has two aspects of the 5 points required for safety standards.

Sample F

a) Area: The shelter area is 23.10 m^2, more comprehensive than the national temporary shelter, which has an area of 20.25 m^2. Then the score that can be given is 4 points (better than the standard) because the standard limit is a closed area ranging from 18.1 m^2 – 28 m^2.
b) Total budget: After calculating the total budget of 24.759.200 IDR. This budget is indeed slightly more expensive when compared to the total budget for the National Temporary Shelter, which is 19.765.850 IDR. Based on the above conditions, the score that can be given is 3 points where the total budget for this shelter is in the range between 18.000.000-25.000.000 IDR.
c) Budget per square meter: Based on the budget and the existing shelter area, the budget per meter reaches 1.071.850 IDR. The score that can be given is 3 points because the budget per meter of the shelter is included in the conditions for awarding 3 points with a limit range of 888.000-1.234.000 IDR.
d) Weight: The weight of this shelter is 228 kg. Compared to the national temporary shelter, which weighs 1,173 kg, the sample F shelter is lighter. Based on the above conditions, the score that can be given is 5 points (much better

than standard) because the weight in this shelter is lighter than 600 kg.

e) Transported quantity: There are only five types of vehicles that can accommodate this shelter. The vehicles used are: Colt Diesel Engkel (3 units), Colt Diesel Doble (15 units), Fuso Bak (21 units), Tronton Bak (38 units), Dry Container 40 FT (30 units). It still makes the shelter score much better than the standard. Then the score that can be given is 5 points because a Dry Container 40 FT > 20 is filled as the upper limit, and the standard lower limit is filled with Pick Up > 1 Unit.

f) Occupancy capacity: The capacity of residents in this shelter ranges from 4-8 people, more than the national temporary shelter with a maximum capacity of 5 occupants. According to the scoring requirements above, the score point is 4 (better than the standard) because the occupant's capacity has reached a maximum of 8 people.

g) Ventilation systems: There are only two windows on the shelter that support the cross-ventilation system. The window can generally be adjusted as desired, generally located on the front wall and the sidewall. The score that can be given is 3 points where the situation is the same as the National temporary shelter, which has two windows and supports a cross-ventilation system.

h) Space distribution: The spatial distribution in the shelter consists of 3 zones, namely terrace (4.14 m^2), multipurpose area (7.20 m^2), and sleeping area (11.72 m^2). It can be seen that there is an area zone that exceeds the standard score requirements. The terrace can be categorized as an additional zone, and the bedroom gets a broader space than the score requirements above, with a maximum capacity of 8 people. Even though the multipurpose room is smaller, the total number of enclosed spaces still has an area of not less than 18 m^2 or more. With this condition, the shelter can be given a score of 4 points.

i) Safety: On the safety factor, the shelter has a building material in the form of a cardboard type K245 with a thickness of 6 mm. Two cardboards are put together using gluing and are made in duplicate so that the thickness becomes 12 mm. This material is coated with polyethylene liquid. Other materials are plywood and rafter on the roof. Based on these materials, the structure of this shelter is quite solid and not easy to break through. The K245 type cardboard system is a double-wall corrugated cardboard type where the inner layer has a wave structure that holds and strengthens the cardboard shape. This cardboard will also not be weathered by rain because the polyethylene layer can protect it from water. The disadvantage of this material is that it cannot withstand fire, so it is easy to burn. Because of this situation, the score that can be given is 2 points which is worse than the standard.

5. Conclusion

The results of the comparison above answer that prefabricated shelters are more efficient (closer to government standards) in terms of price and specifications, namely shelter F and E. Shelter F has the highest score with a score of 33 points, followed by shelter E with 30 points. This is quite large influenced by the 9-point aspect of the assessment factor.

Based on the research result above, the shelter cannot only be judged from one assessment point of view (e.g. only a lower total price or the safety factor of a shelter) but is much broader than that. A broader perspective is needed so that the assessment of a shelter can be comprehensive. The material factor also plays a major role in the final assessment which affects aspects of the total budget, price per m^2, weight of shelters, number of units that can be transported by vehicles, as well as residential security.

In other words, a prefabricated temporary shelter that can meet the standard aspects of temporary shelter that has been set by Indonesia is a temporary shelter that not only meets the standard aspects like the elements of the usual prefabricated approach but must meet the 9 aspects of the assessment that have been determined in the form of: Total area, total budget, budget per m^2, weight, transported quantity, occupancy capacity, ventilation system, space distribution, and safety. This of course must go through a standard score test based on the value of the national temporary shelter first.

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