Journal of Theoretical and Applied Information Technology
30th November 2019. Vol.97. No 22

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

DETERMINING VERTICAL SHELTER LOCATION BASED ON THE HEIGHT OF TSUNAMI

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ABSTRACT

This research maps buildings which are potential to be vertical shelter in Padang. According to the Regional Disaster Management Agency of Padang, there are 62 buildings which can be used as shelter. The parameters used to determine the buildings which can be used as vertical shelter are the building locations measured by the distance of the building to the shoreline, the capacity, the height of the building and the length of time required for tsunami evacuation. The system is made using the Election et Choix Traduisant La Realite (ELECTRE) method to determine buildings which are potential to be vertical shelter location. The system worked in Padang Utara Sub- district. The results show that 5 shelters from 8 public shelters can be used as a place for evacuation, with an estimated capacity of approximately 21,000 people.

Keywords: *Decision Support System; Vertical Shelter Location; ELECTRE Method; Tsunami Mitigation*

1. INTRODUCTION

There have been many research carried out for years about the earthquake and tsunami which occurred in Padang. These were done by the possibility of large-scale earthquakes and tsunamis according to experts [1][2]. One of the research carried out is "The Tsunami Danger Analysis in the Future (Megathrust) in Padang" [3], which is supported by the research "Stochastic Analysis and Uncertainty of Tsunami Wave Height Using a Random Source Parameter Model that Targets a Tohoku-type Earthquake Faults" [4].

This research tries to find the potential tsunami danger of earthquake above 8.5 on the richter scale, then uses the stochastic tsunami simulation method to find the magnitude of the tsunami wave height that will occur. The results show that for a large earthquake in the future (Megathrust) in Padang the maximum height can reach 20 m. In addition, there is also the research about "Feasibility of the Tsunami Evacuation Path in Padang Utara sub-district, Padang" [5]. This research aims to analyze spatial structures related to the feasibility of tsunami evacuation lines in Padang Utara sub-district. The results show that the tsunami evacuation route in Padang Utara sub-district is classified as inappropriate as an evacuation route because there is a barrier point which will later cause congestion on each tsunami evacuation route. From these research, it is known that the tsunami height and evacuation route in Padang are references for the number of victims who will be affected by the earthquake and tsunami disaster. Therefore, an effort is needed in handling and mitigating to reduce the number of victims who will be affected by this earthquake and tsunami [6][7][8]. With no research ever found in determining the location of vertical shelters using decision makers, in the form of the Election et Choix Traduisant La Realite (ELECTRE) method by making a vertical shelter in Padang.

One of the ways is the creation of vertical shelter in Padang. The data is obtained from the Regional Disaster Management Agency [9]. From the data, there are 62 buildings that might be used as Vertical Shelter Location (VSL). These buildings are spread in various sub-districts in Padang.

2. METHODS

The ELECTRE method is used to prove the feasibility of the 62 buildings to be vertical shelter.

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This method is a decision makers method that performs ranking sequencing through pairwise comparisons between suitable alternatives and criteria [10][11][12]. This method is used in Padang Utara sub-district which has 8 buildings estimated to be used as Vertical Shelter Location (VSL).

The ELECTRE method consists of 7 steps in proving the worthiness of buildings to be VSL [13][14][15]. The steps are:

1. Comparing pairs of each alternative and criteria on a normalized scale.

$$N_{ij} = \frac{r_{ij}}{\sqrt{\Sigma_{i=1}^{a} r_{ij}^2}} \quad (1)$$

2. After normalizing, weights are determined for each criterion expressing its relative importance (w_j) in the form of a matrix.
3. Determine concordance and discordance of each pair.

$$C_{kl} = \{j | y_{kj} \geq y_{ij}\} \quad (2)$$

$$D_{kl} = \{j | y_{kj} < y_{ij}\} \quad (3)$$

4. Calculate the number of the elements in the concordance matrix by summing the weights in the concordance subset.

$$C_{kl} = \Sigma_{j \epsilon C_{kl}} w_j \quad (4)$$

To calculate the number of the discordance matrix element is by dividing the maximum difference in the criteria number included in the set of discordance parts with the maximum difference in the number of all existing criteria.

$$D_{kl} = \frac{\max\{|y_{kj} - y_{ij}|\} j \epsilon D_{kl}}{\max\{|y_{kj} - y_{ij}|\}_{\forall j}} \quad (5)$$

5. After calculating the concordance and the discordance, the dominant matrix is determined from concordance and discordance.
6. Determination of the aggregate dominant matrix as the E matrix.

The final step is done by alternative elimination, namely the E matrix gives the choice sequence of each alternative in which E_{kl}= 1 can be eliminated at least.

3. RESULT AND DISCUSSION

The ELECTRE method was tested in Padang Utara Subdistrict, with 8 buildings that were estimated to be used as shelter by the Padang Disaster Management Agency. These 8 buildings will be used as alternatives VSL which can be seen in Table 1.

Table 1: The Building which is Estimated Could Cite VSL (Sub-District: North Padang)

Shelter	Evacuation time	Estimated Distance from Shelter from the Seaside (m)	Floors of Building	Shelter Capacity	Building Accessibility
East Tawar Water Shelter	60-80 min	1800	4	200	√
SMAN 1 Padang	40-60 min	800	4	2000	√
State Vocational School 5	40-60 min	400	4	2000	√
UNP Faculty of Education	60-80 min	700	5	1500	√
Postgraduate Of Padang State University	60-80 min	700	6	1000	√
UNP Library	60-80 min	700	6	1000	√
Basko Hotel & Plaza	40-60 min	1000	8	3500	√
Great Mosque of West Sumatra	20-40 min	750	2	15000	√

Source: Regional Disaster Management Agency Padang City

Criteria are determined as a reference in decision making. There are 4 factors in determining VSL, they are: C1 = Shelter distance from the beach, C2 = Shelter capacity, C3 = Shelter height measured by the number of building floors, C4 = Evacuation time needed.

After that, determine the criteria that will be a reference in decision making. There are 4 criteria for VSL. They are: 1 = Very bad, 2 = Bad, 3 = Enough, 4 = Good, 5 = Very good. While the level of importance which will be used as preference weight for each criterion will also be assessed, with the following provisions: 1 = Very low, 2 = Low, 3 = Sufficient, 4 = High, 5 = Very high.

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From the 8 buildings that can be used as VSL, match rating data is obtained in Table 2.

Table 2: VSL Match Rating Data

Alternative / Criteria	Location				
	C1	C2	C3	C4	C4
A1	5	1	3	2	2
A2	4	5	3	2	3
A3	2	5	3	2	3
A4	3	4	4	2	2
A5	3	3	4	2	2
A6	3	3	4	2	2
A7	4	5	5	2	3
A8	3	4	2	2	4

Table 2 is a compatibility rating of the selected VSL alternatives with existing criteria. The highest number of the VSL compatibility rating is assumed to be the best number. Decision makers are given to weight the preferences of each criterion symbolized by w. w is 5,4,3,2.

Based on Table 2 it is obtained the number of matrix X which can be seen as follows:

$$X = \begin{bmatrix} 5 & 1 & 3 & 2 \\ 4 & 5 & 3 & 3 \\ 2 & 5 & 3 & 3 \\ 3 & 4 & 4 & 2 \\ 3 & 3 & 4 & 2 \\ 3 & 3 & 4 & 2 \\ 4 & 5 & 5 & 3 \\ 3 & 4 & 2 & 4 \end{bmatrix}$$

To complete the matrix using ELECTRE method, the first step is by normalizing the decision matrix X.

$$N_{11} = \frac{r_{11}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{5}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{5}{9.85} = 0.51$$

$$N_{12} = \frac{r_{12}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{1}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{1}{11.22} = 0.09$$

$$N_{13} = \frac{r_{13}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{3}{10.20} = 0.29$$

$$N_{14} = \frac{r_{14}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{2}{7.68} = 0.26$$

$$N_{21} = \frac{r_{21}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{4}{9.85} = 0.41$$

$$N_{22} = \frac{r_{22}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{5}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{5}{11.22} = 0.45$$

$$N_{23} = \frac{r_{23}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{3}{10.20} = 0.29$$

$$N_{24} = \frac{r_{24}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{3}{7.68} = 0.39$$

$$N_{31} = \frac{r_{31}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{4}{9.85} = 0.20$$

$$N_{32} = \frac{r_{32}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{5}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{5}{11.22} = 0.45$$

$$N_{33} = \frac{r_{33}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{3}{10.20} = 0.29$$

$$N_{34} = \frac{r_{34}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{3}{7.68} = 0.39$$

$$N_{41} = \frac{r_{41}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{3}{9.85} = 0.30$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

$$N_{42} = \frac{r_{42}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{4}{11.22} = 0.36$$

$$N_{43} = \frac{r_{43}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{4}{10.20} = 0.39$$

$$N_{44} = \frac{r_{44}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{2}{7.68} = 0.26$$

$$N_{51} = \frac{r_{51}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{3}{9.85} = 0.30$$

$$N_{52} = \frac{r_{52}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{3}{11.22} = 0.27$$

$$N_{53} = \frac{r_{53}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{4}{10.20} = 0.39$$

$$N_{54} = \frac{r_{54}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{2}{7.68} = 0.26$$

$$N_{61} = \frac{r_{61}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{3}{9.85} = 0.30$$

$$N_{62} = \frac{r_{62}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{3}{11.22} = 0.27$$

$$N_{63} = \frac{r_{63}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{4}{10.20} = 0.39$$

$$N_{64} = \frac{r_{64}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{2}{7.68} = 0.26$$

$$N_{71} = \frac{r_{71}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{4}{9.85} = 0.41$$

$$N_{72} = \frac{r_{72}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{5}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{5}{11.22} = 0.45$$

$$N_{73} = \frac{r_{73}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{5}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{5}{10.20} = 0.49$$

$$N_{74} = \frac{r_{74}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{3}{7.68} = 0.39$$

$$N_{81} = \frac{r_{81}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{3}{\sqrt{5^2+4^2+2^2+3^2+3^2+3^2+4^2+3^2}} = \frac{3}{9.85} = 0.30$$

$$N_{82} = \frac{r_{82}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{1^2+5^2+5^2+4^2+3^2+3^2+5^2+4^2}} = \frac{4}{11.22} = 0.36$$

$$N_{83} = \frac{r_{83}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{2}{\sqrt{3^2+3^2+3^2+4^2+4^2+4^2+5^2+2^2}} = \frac{2}{10.20} = 0.20$$

$$N_{84} = \frac{r_{84}}{\sqrt{\Sigma_{i=1}^{a} r_{i1}^2}} = \frac{4}{\sqrt{2^2+3^2+3^2+2^2+2^2+2^2+3^2+4^2}} = \frac{4}{7.68} = 0.52$$

The same thing is done from the second row to the eighth row, which starts from the first column to the last column. From the calculation process, the normalization matrix number is called the N matrix.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

$$N = \begin{bmatrix} 0.51 & 0.09 & 0.29 & 0.26 \\ 0.41 & 0.45 & 0.29 & 0.39 \\ 0.20 & 0.45 & 0.29 & 0.39 \\ 0.30 & 0.36 & 0.39 & 0.26 \\ 0.30 & 0.27 & 0.39 & 0.26 \\ 0.30 & 0.27 & 0.39 & 0.26 \\ 0.41 & 0.45 & 0.49 & 0.39 \\ 0.30 & 0.36 & 0.20 & 0.52 \end{bmatrix}$$

After getting the N matrix, the next step is to do the weighting by multiplying the number in the N matrix with the specified preference number (w). Matrix V = N. w.

$$V = \begin{bmatrix} 2.54 & 0.36 & 0.88 & 0.52 \\ 2.03 & 1.78 & 0.88 & 0.78 \\ 1.02 & 1.78 & 0.88 & 0.78 \\ 1.52 & 1.43 & 1.18 & 0.52 \\ 1.52 & 1.07 & 1.18 & 0.52 \\ 1.52 & 1.07 & 1.18 & 0.52 \\ 2.03 & 1.78 & 1.47 & 0.78 \\ 1.52 & 1.43 & 0.59 & 1.04 \end{bmatrix}$$

The weighting that has been done is continued by determining concordance and discordance index by way of comparing matrix V on line 1 and row 2. To determine the set of concordance (C) and discordance (D) index can be seen in Table 3 until Table 57.

Table 3: Comparison of V Matrix at Line 1 and 2

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V2	2.03	1.78	0.88	0.78
Results	C	D	C	D

Table 4: Comparison of V Matrix at Line 1 and 3

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V3	1.02	1.78	0.88	0.78
Results	C	D	C	D

Table 5: Comparison of V Matrix at Line 1 and 4

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V4	1.52	1.43	1.18	0.52
Results	C	D	C	C

Table 6: Comparison of V Matrix at Line 1 and 5

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V5	1.52	1.07	1.18	0.52
Results	C	D	D	C

Table 7: Comparison of V Matrix at Line 1 and 6

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V6	1.52	1.07	1.18	0.52
Results	C	D	D	C

Table 8: Comparison of V Matrix at Line 1 and 7

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V7	2.03	1.78	1.47	0.78
Results	C	D	D	D

Table 9: Comparison of V Matrix at Line 1 and 8

Matrix	1	2	3	4
V1	2.54	0.36	0.88	0.52
V8	1.52	1.43	0.59	1.04
Results	C	D	C	D

Table 10: Comparison of V Matrix at Line 2 and 1

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

Table 11: Comparison of V Matrix at Line 2 and 3

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V3	1.02	1.78	0.88	0.78
Results	C	C	C	C

Table 12: Comparison of V Matrix at Line 2 and 4

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V4	1.52	1.43	1.18	0.52
Results	C	C	D	C

Table 13: Comparison of V Matrix at Line 2 and 5

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V5	1.52	1.07	1.18	0.52
Results	C	C	D	C

Table 14: Comparison of V Matrix at Line 2 and 6

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V6	1.52	1.07	1.18	0.52
Results	C	C	D	C

Table 15: Comparison of V Matrix at Line 2 and 7

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

V7	2.03	1.78	1.47	0.78
Results	C	C	D	C

Table 16: Comparison of V Matrix at Line 2 and 8

Matrix	1	2	3	4
V2	2.03	1.78	0.88	0.78
V8	1.52	1.43	0.59	1.04
Results	C	C	C	D

Table 17: Comparison of V Matrix at Line 3 and 1

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

Table 18: Comparison of V Matrix at Line 3 and 2

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V2	2.03	1.78	0.88	0.78
Results	D	C	C	C

Table 19: Comparison of V Matrix at Line 3 and 4

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V4	1.52	1.43	1.18	0.52
Results	D	C	D	C

Table 20: Comparison of V Matrix at Line 3 and 5

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V5	1.52	1.07	1.18	0.52
Results	D	C	D	C

Table 21: Comparison of V Matrix at Line 3 and 6

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V6	1.52	1.07	1.18	0.52
Results	D	C	D	C

Table 22: Comparison of V Matrix at Line 3 and 7

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V7	2.03	1.78	1.47	0.78
Results	D	C	D	C

Table 23: Comparison of V Matrix at Line 3 and 8

Matrix	1	2	3	4
V3	1.02	1.78	0.88	0.78
V8	1.52	1.43	0.59	1.04
Results	D	C	C	D

Table 24: Comparison of V Matrix at Line 4 and 1

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

Table 25: Comparison of V Matrix at Line 4 and 2

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V2	2.03	1.78	0.88	0.78
Results	D	D	C	D

Table 26: Comparison of V Matrix at Line 4 and 3

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V3	1.02	1.78	0.88	0.78
Results	C	D	C	D

Table 27: Comparison of V Matrix at Line 4 and 5

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V5	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 28: Comparison of V Matrix at Line 4 and 6

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V6	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 29: Comparison of V Matrix at Line 4 and 7

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V7	2.03	1.78	1.47	0.78
Results	D	D	D	D

Table 30: Comparison of V Matrix at Line 4 and 8

Matrix	1	2	3	4
V4	1.52	1.43	1.18	0.52
V8	1.52	1.43	0.59	1.04
Results	C	C	C	D

Table 31: Comparison of V Matrix at Line 5 and 1

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

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Table 32: Comparison of V Matrix at Line 5 and 2

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V2	2.03	1.78	0.88	0.78
Results	D	D	C	D

Table 33: Comparison of V Matrix at Line 5 and 3

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V3	1.02	1.78	0.88	0.78
Results	C	D	C	D

Table 34: Comparison of V Matrix at Line 5 and 4

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V4	1.52	1.43	1.18	0.52
Results	C	D	C	C

Table 35: Comparison of V Matrix at Line 5 and 6

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V6	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 36: Comparison of V Matrix at Line 5 and 7

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V7	2.03	1.78	1.47	0.78
Results	D	D	D	D

Table 37: Comparison of V Matrix at Line 5 and 8

Matrix	1	2	3	4
V5	1.52	1.07	1.18	0.52
V8	1.52	1.43	0.59	1.04
Results	C	D	C	D

Table 38: Comparison of V Matrix at Line 6 and 1

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

Table 39: Comparison of V Matrix at Line 6 and 2

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V2	2.03	1.78	0.88	0.78
Results	D	D	C	D

Table 40: Comparison of V Matrix at Line 6 and 3

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V3	1.02	1.78	0.88	0.78
Results	C	D	C	D

Table 41: Comparison of V Matrix at Line 6 and 4

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V4	1.52	1.43	1.18	0.52
Results	C	D	C	C

Table 42: Comparison of V Matrix at Line 6 and 5

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V5	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 43: Comparison of V Matrix at Line 6 and 7

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V7	2.03	1.78	1.47	0.78
Results	D	D	D	D

Table 44: Comparison of V Matrix at Line 6 and 8

Matrix	1	2	3	4
V6	1.52	1.07	1.18	0.52
V8	1.52	1.43	0.59	1.04
Results	C	D	C	D

Table 45: Comparison of V Matrix at Line 7 and 1

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V1	2.54	0.36	0.88	0.52
Results	D	C	C	C

Table 46: Comparison of V Matrix at Line 7 and 2

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V2	2.03	1.78	0.88	0.78
Results	C	C	C	C

Table 47: Comparison of V Matrix at Line 7 and 3

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V3	1.02	1.78	0.88	0.78
Results	C	C	C	C

Table 48: Comparison of V Matrix at Line 7 and 4

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V4	1.52	1.43	1.18	0.52
Results	C	C	C	C

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Table 49: Comparison of V Matrix at Line 7 and 5

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V5	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 50: Comparison of V Matrix at Line 7 and 6

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V6	1.52	1.07	1.18	0.52
Results	C	C	C	C

Table 51: Comparison of V Matrix at Line 7 and 8

Matrix	1	2	3	4
V7	2.03	1.78	1.47	0.78
V8	1.52	1.43	0.59	1.04
Results	C	C	C	D

Table 52: Comparison of V Matrix at Line 8 and 1

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V1	2.54	0.36	0.88	0.52
Results	D	C	D	C

Table 53: Comparison of V Matrix at Line 8 and 2

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V2	2.03	1.78	0.88	0.78
Results	D	D	D	C

Table 54: Comparison of V Matrix at Line 8 and 3

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V3	1.02	1.78	0.88	0.78
Results	C	D	D	C

Table 54: Comparison of V Matrix at Line 8 and 4

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V4	1.52	1.43	1.18	0.52
Results	C	C	D	C

Table 55: Comparison of V Matrix at Line 8 and 5

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V5	1.52	1.07	1.18	0.52
Results	C	C	D	C

Table 56: Comparison of V Matrix at Line 8 and 6

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V6	1.52	1.07	1.18	0.52
Results	C	C	D	C

Table 57: Comparison of V Matrix at Line 8 and 7

Matrix	1	2	3	4
V8	1.52	1.43	0.59	1.04
V7	2.03	1.78	1.47	0.78
Results	D	D	D	C

Then, the comparison of the V matrix is continued with rows 1 and row 3 until all rows are fulfilled. Then the next step is to add the number of each good set of concordance. The concordance set is taken from the number of the set W so that the results can be seen in Table 58.

Table 58: Concordance Set

W	5	4	3	2	Total
CK	1	2	3	4	
C12	5		3		8
C13	5		3		8
C14	5		3	2	10
C15	5			2	7
C16	5			2	7
C17	5				5
C18	5		3		8
C21		4	3	2	9
C23	5	4	3	2	14
C24	5	4	3		12
C25	5	4		2	11
C26	5	4		2	11
C27	5	4		2	11
C28	5	4	3		12
C31		4	3	2	9
C32		4	3	2	9
C34		4		2	6
C35		4		2	6
C36		4		2	6
C37		4		2	6
C38		4	3		7
C41		4	3	2	9
C42	5	4		2	11
C43	5		3		8
C45	5	4	3	2	14
C46	5	4	3	2	14
C47					0
C48	5	4	3		12
C51		4	3	2	9
C52			3		3
C53	5		3		8
C54	5		3	2	10
C56	5	4	3	2	14
C57					0

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C58	5		3		8
C61		4	3	2	9
C62			3		3
C63	5		3		8
C64	5		3	2	10
C65	5	4	3	2	14
C67					0
C68	5		3		8
C71		4	3	2	9
C72	5	4	3	2	14
C73	5	4	3	2	14
C74	5	4	3	2	14
C75	5	4	3	2	14
C76	5	4	3	2	14
C78	5	4	3		12
C81		4		2	6
C82				2	2
C83	5			2	7
C84	5	4		2	11
C85	5	4		2	11
C86	5	4		2	11
C87				2	2

Thus the concordance matrix is obtained as follows:

$$\begin{bmatrix} - & 8 & 8 & 10 & 7 & 7 & 5 & 8 \\ 9 & - & 14 & 12 & 11 & 11 & 11 & 12 \\ 9 & 9 & - & 6 & 6 & 6 & 6 & 7 \\ 9 & 11 & 8 & - & 14 & 14 & 0 & 12 \\ 9 & 3 & 8 & 10 & - & 14 & 0 & 8 \\ 9 & 3 & 8 & 10 & 14 & - & 0 & 8 \\ 9 & 14 & 14 & 14 & 14 & 14 & - & 12 \\ 6 & 2 & 7 & 11 & 11 & 11 & 2 & - \end{bmatrix}$$

For the discordance set, the steps are as follows:

$$D_{12} = \frac{\max\{|0.36-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.42}{1.42} = 1$$

$$D_{13} = \frac{\max\{|0.36-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.42}{1.52} = 0.93$$

$$D_{14} = \frac{\max\{|0.36-1.43|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.07}{1.07} = 1$$

$$D_{15} = \frac{\max\{|0.36-1.07|;|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{1.02} = 0.70$$

$$D_{16} = \frac{\max\{|0.36-1.07|;|0.88-1.47|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{1.02} = 0.70$$

$$D_{17} = \frac{\max\{|0.36-1.78|;|0.88-1.47|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.42}{1.42} = 1$$

$$D_{18} = \frac{\max\{|0.36-1.43|;|0.52-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.07}{1.07} = 0.1$$

$$D_{21} = \frac{\max\{|2.03-2.54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.51}{1.42} = 0.36$$

$$D_{23} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{1.01} = 0$$

$$D_{24} = \frac{\max\{|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.3}{0.51} = 0.59$$

$$D_{25} = \frac{\max\{|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.3}{0.71} = 0.42$$

$$D_{26} = \frac{\max\{|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.3}{0.71} = 0.42$$

$$D_{27} = \frac{\max\{|0.88-\ .47|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.59}{0.59} = 1$$

$$D_{28} = \frac{\max\{|0.78-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.26}{0.51} = 0.51$$

$$D_{31} = \frac{\max\{|1.02-2.54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.52}{1.52} = 1$$

$$D_{32} = \frac{\max\{|1.02-2.03|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.01}{1.01} = 1$$

$$D_{34} = \frac{\max\{|1.02-1.52|;|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.5}{0.5} = 1$$

$$D_{35} = \frac{\max\{|1.02-1.52|;|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.5}{0.71} = 0.70$$

$$D_{36} = \frac{\max\{|1.02-1.52|;|0.88-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.5}{0.71} = 0.70$$

$$D_{37} = \frac{\max\{|1.02-2.03|;|0.88-1.47|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.01}{1.01} = 0.70$$

$$D_{38} = \frac{\max\{|1.02-1.52|;|0.78-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.5}{0.5} = 1$$

$$D_{41} = \frac{\max\{|1.52-2.54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.02}{1.07} = 0.95$$

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$$D_{42} = \frac{\max\{|1.52-2.03|;|1.43-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.51}{0.51} = 1$$

$$D_{43} = \frac{\max\{|1.43-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.35}{0.50} = 0.70$$

$$D_{45} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.36} = 0$$

$$D_{46} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.36} = 0$$

$$D_{47} = \frac{\max\{|1.52-2.03|;|1.43-1.78|;|1.18-1.47|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.51}{0.51} = 1$$

$$D_{48} = \frac{\max\{|0.52-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.52}{0.59} = 0.88$$

$$D_{51} = \frac{\max\{|1.52- .54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.02}{1.02} = 1$$

$$D_{52} = \frac{\max\{|1.52-2.03|;|1.07-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{53} = \frac{\max\{|1.07-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{54} = \frac{\max\{|1.07-1.43|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.36}{0.36} = 1$$

$$D_{56} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0} = 0$$

$$D_{57} = \frac{\max\{|1.52-2.03|;|1.07-1.78|;|1.18-1.47|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{58} = \frac{\max\{|1.07-1.43|;|0.52-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.52}{0.59} = 0.88$$

$$D_{61} = \frac{\max\{|1.52-2.54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.02}{1.02} = 1$$

$$D_{62} = \frac{\max\{|1.52-2.03|;|1.07-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{63} = \frac{\max\{|1.07-1.78|;|0.52-0.78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{64} = \frac{\max\{|1.07-1.43|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.36}{0.36} = 1$$

$$D_{65} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0} = 0$$

$$D_{67} = \frac{\max\{|1.52-2.03|;|1.07-1.78|;|1.18-1.47|;|0.52- .78|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.71}{0.71} = 1$$

$$D_{68} = \frac{\max\{|1.07-1.43|;|0.52-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.52}{0.59} = 0.88$$

$$D_{71} = \frac{\max\{|2.03-2.54|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.51}{1.42} = 0.36$$

$$D_{72} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.59} = 0$$

$$D_{73} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{1.01} = 0$$

$$D_{74} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.51} = 0$$

$$D_{75} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.71} = 0$$

$$D_{76} = \frac{0}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0}{0.71} = 0$$

$$D_{78} = \frac{\max\{|0.7-1.04|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.26}{0.88} = 0.30$$

$$D_{81} = \frac{\max\{|1.53-2.54|;|0.59-0.88|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{1.02}{1.07} = 0.95$$

$$D_{82} = \frac{\max\{|1.53-2.03|;|1.43-1.78|;|0.59-0.88|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.51}{0.51} = 1$$

$$D_{83} = \frac{\max\{|1.43-1.78|;|0.59-0.88|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.35}{0.50} = 0.70$$

$$D_{84} = \frac{\max\{|0.59-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.59}{0.59} = 1$$

$$D_{85} = \frac{\max\{|0.59-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.59}{0.59} = 1$$

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$$D_{86} = \frac{\max\{|0.59-1.18|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.59}{0.59} = 1$$

$$D_{87} = \frac{\max\{|1.53-2.03|;|1.43-1.78|;|0.59-1.47|\}}{\max\{|y_{kj}-y_{ij}|\}} = \frac{0.88}{0.88} = 1$$

Finding the discordance set is continued by the next line so that all lines are fulfilled which can be seen in Table 59.

Table 59: Discordance Set

W	5	4	3	2	Total
DK	1	2	3	4	
D12		4		2	6
D13		4		2	6
D14		4			4
D15		4	3		7
D16		4	3		7
D17		4	3	2	9
D18		4		2	6
D21	5				5
D23					0
D24				2	2
D25			3		3
D26			3		3
D27			3		3
D28				2	2
D31	5				5
D32	5				5
D34	5		3		8
D35	5		3		8
D36	5		3		8
D37	5		3		8
D38	5			2	7
D41	5				5
D42			3		3
D43		4		2	6
D45					0
D46					0
D47	5	4	3	2	14
D48				2	2
D51	5				5
D52	5	4		2	11
D53		4		2	6
D54		4			4
D56					0
D57	5	4	3	2	14
D58		4		2	6
D61	5				5
D62	5	4		2	11
D63		4		2	6
D64		4			4
D65					0
D67	5	4	3	2	14
D68		4		2	6
D71	5				5
D72					0
D73					0
D74					0
D75					0
D76					0
D78				2	2
D81	5		3		8
D82	5	4	3		12
D83		4	3		7
D84			3		3
D85			3		3
D86			3		3
D87	5	4	3		12

The discordance matrix is obtained as follows:

$$\begin{bmatrix} - & 1.00 & 0.93 & 1.00 & 0.70 & 0.70 & 1.00 & 1.00 \\ 0.36 & - & 0.00 & 0.59 & 0.42 & 0.42 & 1.00 & 0.51 \\ 1.00 & 1.00 & - & 1.00 & 0.70 & 0.70 & 1.00 & 1.00 \\ 0.95 & 1.00 & 0.70 & - & 0.00 & 0.00 & 1.00 & 0.88 \\ 1.00 & 1.00 & 1.00 & 1.00 & - & 0.00 & 1.00 & 0.88 \\ 1.00 & 1.00 & 1.00 & 1.00 & 0.00 & - & 1.00 & 0.88 \\ 0.36 & 0.00 & 0.00 & 0.00 & 0.00 & 0.00 & - & 0.30 \\ 0.95 & 1.00 & 0.70 & 1.00 & 1.00 & 1.00 & 1.00 & - \end{bmatrix}$$

The next step is to find the dominant matrix from concordance and discordance by way of a matrix concordance compared with the threshold number ($\underline{c}$). First, the threshold number is got from the sum of all concordance number divided by the number of rows and multiplied by the number of rows of matrix minus 1.

$$\underline{c} = \frac{495}{8(8-1)} = 8.84$$

After knowing the threshold number, it is compared with the number of the matrix concordance. If $C_{12} \geqslant \underline{c}$, a number of 1 is given in the matrix F, while the opposite is given a number of 0. Continue the steps so that all rows of the matrix are met, and the F matrix number is obtained:

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$$F = \begin{bmatrix} - & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & - & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & - & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & - & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & - & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & - & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & - & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & - \end{bmatrix}$$

Continue to look for the dominant discordance matrix.

$$\underline{d} = \frac{39.63}{8(8-1)} = 0.71$$

After that, compare with the number of the discordance matrix. If $D_{12} \geqslant \underline{d}$, it is given a number of 1 in the matrix G, while the opposite is given a number of 0. Continue the steps so that all rows of the matrix are met, and the matrix G number is obtained as follows:

$$G = \begin{bmatrix} - & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & - & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & - & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & - & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & - & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 & - & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & - & 0 \\ 1 & 1 & 0 & 1 & 1 & 1 & 1 & - \end{bmatrix}$$

The sixth step looks for the aggregate dominance matrix by multiplying the matrix F_{kl} with the G_{kl} matrix so that the E_{kl} matrix is obtained.

$$E = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 \end{bmatrix}$$

From the E matrix, if the alternative matrix $E_{ij} = 1$ the alternative A_{ij} is better alternative than A_j. If there is E matrix that is $E_{ij} = 1$ at least, elimination can be done. From elimination, it is found that lines 1, 2, and 7 get the least number of E_{ij}. Thus, the results are alternatives 3, 4, 5, 6, and are better alternatives.

4. CONCLUSIONS

Based on the results and discussion which have been done, it can be concluded that the ELECTRE method is one of methods that can be used in choosing the best alternative in solving Vertical Shelter Location (VSL) problems. As a result, 5 of the 8 vertical shelter publics in the sub-district of Padang Utara are the best locations to be used as tsunami evacuation with an estimated capacity of approximately 21,000 people.

ACKNOWLEDGMENT

On this occasion, we would like to thank the Amal Bakti Muslimin Foundation, STMIK Indonesia Padang, for providing financial support in writing this journal to completion, in accordance with contract number 039 / KA / LPPM / STMIK-I / 2018.

REFRENCES:

[1] A. R. Barakbah, T. Harsono, and A. Sudarsono, "Automatic Cluster-oriented Seismicity Prediction Analysis of Earthquake Data Distribution in Indonesia," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 9, no. 2, p. 587, 2019.

[2] - Munirwansyah, R. P. Munirwan, and H. Yunita, "Geotechnical Engineering Aspect Related to Pidie Jaya–Aceh Earthquake Disaster and Mitigation," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 8, no. 3, p. 870, 2018.

[3] A. Muhammad, "Tsunami hazard analysis of Future Megathrust sumatra earthquakes in Padang , indonesia Using stochastic Tsunami simulation," *Front. Built Environ.*, vol. 2, no. December, pp. 1–19, 2016.

[4] Y. Fukutani, A. Suppasri, and F. Imamura, "Stochastic analysis and uncertainty assessment of tsunami wave height using a random source parameter model that targets a Tohoku-type earthquake fault," *Stoch. Environ. Res. Risk Assess.*, pp. 1763–1779, 2015.

[5] A. Syam, "Kelayakan Jalur Evakuasi Tsunami Di Kecamatan Padang Utara Kota Padang," *J. Kepemimp. DAN Pengur. Sekol.*, vol. I, no. 1, pp. 11–22, 2016.

[6] E. Wahyuni, D. Iranata, B. Suswanto, C. B. Nurcahyo, and W. Sutrisno, "Assessment of Vulnerable Buildings Due to Earthquake Loading Using Rapid Visual Screening Smartphone Application," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 8, no. 2, p. 567, 2018.

[7] E. Suhelmidawati, F. Adibroto, S. Hanwar,

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

and M. Numada, "Experimental Test of Masonry Wallets Retrofitted by ABACA Fiber Reinforced Mortar," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 9, no. 3, pp. 929–935, 2019.

[8] R. Suryanita, M. Mardiyono, and H. Maizir, "Damage Level Prediction of Pier using Neuro-Genetic Hybrid," *Int. J. Adv. Sci. Eng. Inf. Technol.*, vol. 8, no. 6, p. 2393, 2019.

[9] F. Ashar, D. Amaratunga, and R. Haigh, "The Analysis of Tsunami Vertical Shelter in Padang City," *Procedia Econ. Financ.*, vol. 18, no. September, pp. 916–923, 2014.

[10] R. Fitrios, A. Susanto, R. Soemantri, and H. Suharman, "The influence of environmental uncertainty on the accounting information system quality and its impact on the accounting information quality," *J. Theor. Appl. Inf. Technol.*, vol. 96, no. 21, pp. 7164–7175, 2018.

[11] N. O. R. A. Ahmad, N. U. R. Azaliah, and A. B. U. Bakar, "Moderating Effect Of Organisation Size In Measuring The Technology Organisation Environment And Pressure (TOEP) In Enterprise," *J. Theor. Appl. Inf. Technol.*, vol. 97, no. 14, pp. 3892–3910, 2019.

[12] M. Z. I. D. B. AHMAD, "a Systematic Literature Review on Enterprise Architecture Development in Various Industry Domains," *J. Theor. Appl. Inf. Technol.*, vol. 97, no. 3, pp. 897–917, 2019.

[13] F. Ikorasaki and M. B. Akbar, "Utilization ELECTRE Method with Decision Support System in Select Locations Warehouse Production," *2018 6th Int. Conf. Cyber IT Serv. Manag.*, no. Citsm, pp. 1–4, 2018.

[14] S. E. Wijayanti and A. D. Putra, "Penerapan Metode Electre Untuk Menentukan," *Semin. Nas. Teknol. Inf. dan Multimed. 2015*, pp. 6–8, 2015.

[15] A. Praba, R. Pinem, and P. T. Pungkasanti, "Application Elimination Et Choix Traduisant La REalité (ELECTRE) On Decission Support System," *TRANSFORMATIKA*, vol. 15, no. 2, pp. 106–113, 2018.