ASTONJADRO

pISSN 2302-4240
eISSN 2655-2086

Volume 15, Issue 4, December 2026, pp.01355-01366
DOI: http://dx.doi.org/10.32832/astonjadro.v15i4.24963 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Analysis of the Performance Effectiveness of Pedestrian Overpasses (JPO) on Pajajaran Street, Bogor City

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| Submitted: July 29, 2026 | Revised: October 22, 2026 | Accepted: October 26, 2026 |

| Published: October 28, 2026 |

ABSTRACT

The Pedestrian Overpass (JPO) is a vital infrastructure that plays an important role in separating pedestrian flows from vehicular traffic flows to minimize the risk of accidents. Jalan Pajajaran in Bogor City is a main corridor with high traffic volume, where JPO facilities are available but the phenomenon of at-grade street crossing is still frequently encountered. This study aims to analyze the effectiveness of JPO performance based on the real utilization rate in the field and evaluate the perception of comfort and safety from the user's perspective. The method used is descriptive quantitative through pedestrian crossing volume surveys (traffic counting) conducted for 6 days (4 weekdays and 2 weekends) in March 2026 and distributing questionnaires to 100 respondents. The analysis results show that the average JPO utilization effectiveness only reaches 30.07%, while 69.93% of pedestrians choose to cross directly on the roadway. Based on traffic management criteria, the performance of this JPO is classified as Ineffective (less than 40%). Nonetheless, the descriptive analysis of user perception using the Likert Scale produced an average index value of 3.925 (Agree/Positive category), with the highest score on the aspect of safety from traffic conflicts (4.35). The geometric evaluation results indicate that the physical structure of the JPO has met the technical specifications of the Directorate General of Bina Marga [1]. The low effectiveness is more influenced by user behavior factors that avoid the vertical distance of the stairs and the placement of locations that are less integrated with the centers of public activity generation.

Keywords: pedestrian overpass, performance effectiveness, pedestrian, likert scale, pajajaran street

INTRODUCTION

The Pedestrian Overpass (JPO) is a transportation infrastructure facility provided to give safe crossing routes for pedestrians on road segments with high vehicle flow [2]. The presence of JPO is expected to reduce conflicts between pedestrians and motor vehicles and decrease accident rates at major crossing points [3]. However, various studies over the past five years have shown that JPO performance in terms of utilization and safety has not been fully optimal. According to Putra and Rahmadi [4], JPO usage rates remain low in several urban areas because pedestrians tend to cross directly on the road even when JPO facilities are available. A similar finding was reported by Nugroho et al. [5] and Hidayat et al. [6], who found that the low effectiveness of JPOs is caused by a lack of comfort and accessibility of the facilities, including factors affecting the use of grade-separated pedestrian crossings on urban arterial roads, leading users to prefer faster but less safe alternatives.

Physical comfort is also an important aspect influencing pedestrian preference. According to Kurniawan [7], lighting conditions, cleanliness, and the availability of supporting facilities such as handrails and shelter significantly affect users' perception of JPOs. Research by Sari et al. [8] and Avissaputri et al. [9] added that steep staircase designs and a lack of facilities for vulnerable groups such as the elderly and people with disabilities are barriers to JPO use, consistent with evaluations of JPO usage based on user perception. Furthermore, recent studies by Ramadhan and Hartono [10] and Wahyuni et al. [11] found that safety and risk perception are among the dominant factors determining JPO utilization, as the sense of security strongly influences pedestrians' decision to use the available facility.

Pajajaran Street in Bogor City is one of the main arterial roads with high daily traffic volume and pedestrian mobility due to the presence of shopping centers, public facilities, and office areas in the vicinity. Although JPOs have been built at several points, the phenomenon of pedestrians still crossing directly on the road is frequently observed. This condition indicates a potential ineffectiveness of JPO function at this location that needs to be further investigated in the context of pedestrian safety and comfort.

This study aims to: (1) Identify the characteristics of respondents using the Pedestrian Overpass (JPO) on Pajajaran Street, Bogor City; and (2) Analyze the level of performance effectiveness of the Pedestrian Overpass (JPO) on Pajajaran Street, Bogor City based on pedestrian utilization rates.

Comfortable crossing facilities should provide sufficient space, safe surfaces, clear visibility, and convenient access for people of different ages and physical abilities. Pedestrian crossings, sidewalks, pedestrian overpasses (JPOs), and underpasses should be designed to minimize physical effort, reduce conflicts with vehicles, and support smooth pedestrian movement. Adequate lighting, weather protection, handrails, ramps, and clear directional signs can further improve comfort, particularly for older adults, children, and people with disabilities [17].

For pedestrians crossing the street, comfort is influenced by crossing distance, waiting time, traffic speed, vehicle volume, and the availability of safe crossing facilities. Long stairs, excessive walking distances, steep ramps, and poorly maintained surfaces may discourage pedestrians from using designated facilities. Meanwhile, other pedestrians benefit from unobstructed sidewalks, sufficient walking width, and minimal interference from street vendors, parked vehicles, and other obstacles [18], [19].

Improving pedestrian comfort requires integrating accessibility, safety, convenience, and environmental quality into infrastructure design. Regular maintenance, appropriate traffic control, and public awareness programs can encourage compliance with designated crossing facilities. Ultimately, comfortable pedestrian environments promote walking, reduce pedestrian–vehicle conflicts, improve mobility for vulnerable road users, and contribute to safer, more inclusive, and sustainable urban transportation systems [20].

RESEARCH METHOD

This study applies a quantitative approach with a descriptive analytical method based on field observation [12]. The study location is focused on JPO facilities along Pajajaran Street, Bogor City, West Java Province. The research was conducted from February 2026 to August 2026, with data collection over 6 days, each day from 07.15 to 19.15 Western Indonesia Time (WIB).

Data Collection

Primary data collection was carried out in March 2026 through two main methods. First, a Pedestrian Crossing Volume Survey (Traffic Counting) was conducted over 6 observation days, covering 4 weekdays (Monday–Thursday) and 2 weekend days (Saturday–Sunday). Recording was done during morning and afternoon peak hours to compare the number of pedestrians using the JPO with those crossing directly below the JPO on the roadway. Second, a Perception Questionnaire Survey was distributed to 100 pedestrian respondents in the vicinity of the study area. Indicators of comfort, safety, accessibility, and location were measured using a 5-point Likert Scale instrument (1 = Strongly Disagree to 5 = Strongly Agree).

Sample Determination

The population in this study is the number of residents in Tanah Sareal District, Bogor City, totaling 235,780 people (Department of Population and Civil Registration of Bogor City). The sample size was determined using the Slovin formula [13] with an error rate (e) of 10%, resulting in 100 respondents. Slovin Formula: $n = N / (1 + N.e^2) = 235,780 / (1 + 235,780 \times 0.01) = 235,780 / 2,358.8 = 100$ respondents.

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eISSN 2655-2086
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Data Analysis

The mathematical formulation for determining the percentage of JPO usage effectiveness is: Effectiveness (%) = (Σ JPO Users / Σ Total Road Crossers) × 100%. The effectiveness criteria are classified based on standard classifications: ≥ 60% (Effective), 40%–59% (Moderately Effective), and < 40% (Ineffective). This categorization approach is based on the principles of transportation service evaluation referring to facility utilization rates [14], [15]. Furthermore, the conformity of JPO physical parameters was evaluated comparatively with reference to the Technical Guidelines for Pedestrian Facilities No. 02/SE/M/2018 issued by the Directorate General of Bina Marga [1].

Table 1. JPO Usage Effectiveness Level Criteria

Usage Percentage	Category
≥ 60%	Effective
40% - 59%	Moderately Effective
< 40%	Ineffective

Source: [14]

Table 2. Research Variables

Target	Variable	Data	Analysis Technique	Collection Technique
Evaluation of JPO Performance Effectiveness on Pajajaran Street, Bogor City	Respondent Characteristics	Gender, Age, Education, Occupation	Descriptive Analytical	Questionnaire
	JPO Usage Effectiveness	Number of JPO Users, Non-Users, Total Crossers, Percentage	Descriptive Quantitative (Percentage)	Field Observation

RESULTS AND DISCUSSION

Analysis of JPO User Characteristics

Data collected from 100 respondents were analyzed using descriptive statistics to determine the user profile and the level of agreement among road crossers regarding JPO service quality. Respondent characteristics include gender, age, last education, occupation, frequency of use, and travel purpose.

Table 3. Respondent Characteristics by Gender

No.	Gender	Total
1	Male	79
2	Female	21
	Total	**100**

Based on Table 3, JPO user respondents are predominantly male, totaling 79 persons (79%), while females account for 21 persons (21%).

Table 4. Respondent **Characteristics by Age**

No.	Age Group	Total
1	<15 years	3
2	15 – 20 years	15

No.	Age Group	Total
3	20 – 30 years	65
4	30 – 40 years	14
5	40 – 50 years	3
6	>50 years	0
	Total	**100**

Based on Table 4, the majority of JPO user respondents are in the 20–30 age group with 65 respondents (65%), followed by the 15–20 age group with 15 respondents (15%), 30–40 years with 14 respondents (14%), under 15 and 40–50 years with 3 respondents each (3%), and no respondents over 50 years of age.

Table 5. Respondent Characteristics by Education

No.	Last Education	Total
1	Elementary School	0
2	Junior High School	3
3	Senior High School / Vocational	43
4	Diploma (D1/D2/D3)	32
5	Bachelor / Master / Doctorate	22
	Total	**100**

Based on Table 5, JPO user respondents are dominated by high school/vocational school graduates at 43 persons (43%), followed by diploma graduates (D1/D2/D3) at 32 persons (32%), bachelor/master/doctoral graduates at 22 persons (22%), and junior high school at 3 persons (3%).

Table 6. Respondent Characteristics by Occupation

No.	Main Occupation	Total
1	Student / University Student	47
2	Civil Servant (PNS)	3
3	Entrepreneur / Self-employed	15
4	Employee (State/Private)	31
5	Military / Police	1
6	Housewife	3
	Total	**100**

Based on Table 6, JPO user respondents are dominated by students/university students at 47 persons (47%), followed by state/private company employees at 31 persons (31%), entrepreneurs/self-employed at 15 persons (15%), civil servants and housewives at 3 persons each (3%), and military/police at 1 person (1%).

Table 7. Respondent Characteristics by Usage Frequency

No.	Usage Frequency	Total
1	Every day	14

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No.	Usage Frequency	Total
2	3 – 5 times per week	21
3	1 – 2 times per week	28
4	Rarely	26
5	Very Rarely	11
	Total	**100**

Based on Table 7, the most common JPO usage frequency is 1–2 times per week with 28 respondents (28%), followed by rarely with 26 respondents (26%), 3–5 times per week with 21 respondents (21%), every day with 14 respondents (14%), and very rarely with 11 respondents (11%).

Table 8. Respondent Characteristics by Travel Purpose

No.	Travel Purpose	Total
1	School / University	15
2	Work	24
3	Business	15
4	Shopping	46
	Total	**100**

Based on Table 8, the most common travel purpose of crossing pedestrians is shopping at 46%, followed by work at 24%, school/university and business each at 15%.

Respondent Perception Analysis (Likert Scale)

Respondent perception analysis toward the Pedestrian Overpass (JPO) was conducted using a five-point Likert Scale method (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). This assessment aims to determine respondents' responses regarding the safety, comfort, and physical condition aspects of the JPO at the research location.

Table 9. Respondent Perception toward JPO

No.	Statement	Average Score	Interpretation
1	Using JPO is safer	4.35	Strongly Agree
2	Safe from criminal acts	3.85	Agree
3	Safety fence condition is good	4.12	Agree
4	Cleanliness is maintained	3.78	Agree
5	Protected from heat and rain	4.05	Agree
6	Strategic location	3.45	Neutral-Agree
7	Additional facilities (ramp/handrail)	3.92	Agree
8	Prefer JPO over direct crossing	3.68	Agree
9	Overall effective	3.95	Agree
10	Helps reduce congestion	4.10	Agree
	Overall Average	**3.925**	**Agree**

Based on Table 9, the average perception index value from all variables reached 3.925, indicating that the public generally rates the JPO infrastructure as in an Agree/Good condition. The statement

with the highest value is on the aspect of JPO usage safety (score 4.35), indicating that respondents strongly believe that using the JPO is safer than crossing directly on the road. Meanwhile, the aspect of less strategic location received the lowest score (3.45), indicating that the placement of the JPO has not fully aligned with the needs of main pedestrian crossing points. The cleanliness aspect (3.78) and the preference for JPO use over direct crossing (3.68) also emerged as important notes indicating room for improvement.

JPO Usage Rate Survey Results

Observations were conducted over 6 days, consisting of 2 weekend days (Saturday–Sunday) and 4 weekdays (Monday–Thursday) in March 2026, with observation times from 07.15 to 19.15 WIB. The data obtained show the JPO usage rate relative to the total number of crossing pedestrians.

Table 10. Effectiveness Analysis Results – Saturday, 7 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	4	22.22	14	77.78
07.30 – 07.45	5	25.00	15	75.00
07.45 – 08.00	6	26.09	17	73.91
08.00 – 08.15	5	26.32	14	73.68
08.15 – 08.30	7	25.00	21	75.00
08.30 – 08.45	6	24.00	19	76.00
08.45 – 09.00	5	23.81	16	76.19
09.00 – 09.15	4	22.22	14	77.78
17.15 – 18.15	11	28.21	28	71.79
17.30 – 18.30	13	26.53	36	73.47
17.45 – 18.45	15	27.27	40	72.73
18.00 – 19.00	13	30.23	30	69.77
18.15 – 19.15	10	32.26	21	67.74
Average		**26.09**		**73.91**

Table 11. Effectiveness Analysis Results – Sunday, 8 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	3	21.43	11	78.57
07.30 – 07.45	4	25.00	12	75.00
07.45 – 08.00	5	23.81	16	76.19
08.00 – 08.15	4	28.57	10	71.43
08.15 – 08.30	6	25.00	18	75.00
08.30 – 08.45	5	22.73	17	77.27
08.45 – 09.00	4	22.22	14	77.78
09.00 – 09.15	3	21.43	11	78.57
17.15 – 18.15	10	29.41	24	70.59

pISSN 2302-4240
eISSN 2655-2086
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Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
17.30 – 18.30	12	25.00	36	75.00
17.45 – 18.30	14	26.42	39	73.58
18.00 – 19.00	12	30.00	28	70.00
18.15 – 19.15	9	33.33	18	66.67
Average		**25.72**		**74.28**

Table 12. Effectiveness Analysis Results – Monday, 9 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	11	32.35	23	67.65
07.30 – 07.45	14	34.15	27	65.85
07.45 – 08.00	20	39.22	31	60.78
08.00 – 08.15	17	31.48	37	68.52
08.15 – 08.30	8	25.00	24	75.00
08.30 – 08.45	13	38.24	21	61.76
08.45 – 09.00	11	33.33	22	66.67
09.00 – 09.15	9	39.13	14	60.87
17.15 – 18.15	24	36.36	42	63.64
17.30 – 18.30	29	38.67	46	61.33
17.45 – 18.45	33	38.82	52	61.18
18.00 – 19.00	21	30.43	48	69.57
18.15 – 19.15	17	34.69	32	65.31
Average		**34.76**		**65.24**

Table 13. Effectiveness Analysis Results – Tuesday, 10 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	10	31.25	22	68.75
07.30 – 07.45	13	33.33	26	66.67
07.45 – 08.00	18	37.50	30	62.50
08.00 – 08.15	16	32.00	34	68.00
08.15 – 08.30	9	25.71	26	74.29
08.30 – 08.45	12	34.29	23	65.71
08.45 – 09.00	10	31.25	22	68.75
09.00 – 09.15	8	33.33	16	66.67
17.15 – 18.15	22	34.38	42	65.63

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
17.30 – 18.30	27	36.49	47	63.51
17.45 – 18.45	31	38.27	50	61.73
18.00 – 19.00	20	29.85	47	70.15
18.15 – 19.15	16	33.33	32	66.67
Average		**33.15**		**66.85**

Table 14. Effectiveness Analysis Results – Wednesday, 11 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	12	34.29	23	65.71
07.30 – 07.45	15	36.59	26	63.41
07.45 – 08.00	19	38.78	30	61.22
08.00 – 08.15	17	34.69	32	65.31
08.15 – 08.30	10	27.03	27	72.97
08.30 – 08.45	14	35.00	26	65.00
08.45 – 09.00	11	33.33	22	66.67
09.00 – 09.15	9	34.62	17	65.38
17.15 – 18.15	23	35.38	42	64.62
17.30 – 18.30	28	37.33	47	62.67
17.45 – 18.45	32	39.02	50	60.98
18.00 – 19.00	22	31.88	47	68.12
18.15 – 19.15	18	34.62	34	65.38
Average		**34.81**		**65.19**

Table 15. Effectiveness Analysis Results – Thursday, 12 March 2026

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
07.15 – 07.30	11	32.35	23	67.65
07.30 – 07.45	14	34.15	27	65.85
07.45 – 08.00	18	36.73	31	63.27
08.00 – 08.15	16	32.65	33	67.35
08.15 – 08.30	9	26.47	25	73.53
08.30 – 08.45	13	34.21	25	65.79
08.45 – 09.00	11	33.33	22	66.67
09.00 – 09.15	9	34.62	17	65.38
17.15 – 18.15	24	36.36	42	63.64

pISSN 2302-4240
eISSN 2655-2086
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DOI: http://dx.doi.org/10.32832/astonjadro.v15i4.24963 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Survey Time	JPO Users	% JPO	Direct Road Crossers	% Road
17.30 – 18.30	30	38.46	48	61.54
17.45 – 18.45	34	40.00	51	60.00
18.00 – 19.00	22	31.43	48	68.57
18.15 – 19.15	17	34.00	33	66.00
Average		**34.21**		**65.79**

Table 16. Summary of JPO Usage Rates

No.	Day	Date	Avg. JPO Users (%)	Avg. Direct Crossers (%	Effectiveness Category
1	Saturday	7 March 2026	26.09	73.91	Ineffective
2	Sunday	8 March 2026	25.72	74.28	Ineffective
3	Monday	9 March 2026	34.76	65.24	Ineffective
4	Tuesday	10 March 2026	33.15	66.85	Ineffective
5	Wednesday	11 March 2026	34.81	65.19	Ineffective
6	Thursday	12 March 2026	34.21	65.79	Ineffective
	Total				**Ineffective**
	Average		**30.07**	**69.93**	**Ineffective**

Based on Table 16, the observation results over six days show that the average JPO usage is only 30.07%, while direct crossers account for 69.93%. This indicates that the majority of pedestrians still choose to cross directly on the road rather than using the JPO facility. Usage rates are higher on weekdays (average 34.23%) compared to weekends (average 25.91%). This indicates that on weekdays there are more pedestrians with routine travel purposes such as work and school that require the use of JPO, while on weekends pedestrians tend to prefer the fastest route for shopping activities.

Based on the effectiveness criteria used, all observation days showed the Ineffective category (less than 40%). The lowest usage rate was recorded on Sunday (25.72%) and the highest on Wednesday (34.81%). Time patterns also show that JPO usage tends to be higher in the afternoon compared to the morning, which can be associated with an increase in pedestrian volume approaching the end of the work day.

Physical Condition Evaluation of the Pedestrian Overpass (JPO)

To assess the physical adequacy of the Pedestrian Overpass (JPO), an evaluation was carried out on several technical parameters referring to the pedestrian facility planning standards set by the Directorate General of Bina Marga [1]. Field observation results were then compared with the applicable technical standards.

Table 17. Summary of JPO Physical Condition Evaluation

No.	Parameter	Existing Condition	Technical Standard	Status
1	Vertical clearance	5.5 m	≥ 4.6 m	Compliant
2	Railing/fence height	1.35 m	≥ 1.35 m	Compliant
3	Ramp/stair width	1.20 m	≥ 1.20 m	Compliant
4	Platform width	2.30 m	≥ 2.0 m	Compliant
5	Ramp slope	8%	Max. 8–10%	Compliant
6	Lighting	Available	Adequate	Compliant
7	Protective roof	Present	Recommended	Compliant

Source: Field Observation Results, March 2026

Based on Table 17, all physical parameters of the JPO have met the technical standards required by the Directorate General of Bina Marga [1]. The vertical clearance of 5.5 meters exceeds the minimum limit of 4.6 meters, making it safe for vehicular traffic below. Structural dimensions such as stair width (1.20 m), platform width (2.30 m), and fence height (1.35 m) are in accordance with the provisions. The ramp slope of 8% is also within the maximum tolerance limit of 10%. Lighting facilities are available and a protective roof has been installed to provide weather protection for users.

These findings confirm that the low effectiveness of JPO is not caused by physical inadequacy of the infrastructure, but is more influenced by user behavior factors that avoid the physical effort of climbing stairs and the placement of locations that are less integrated with public activity generation centers along the Pajajaran Street corridor. These results are consistent with the research of Putra and Rahmadi [4] who stated that pedestrians tend to choose the shortest route (desire line) even if it means crossing heavy vehicle traffic, and research by Sari et al. [8] and Yulianti [16] who identified physical fatigue due to stair geometry and similar effectiveness gaps as the main barriers to JPO use.

CONCLUSION

Based on the results of the study on the performance effectiveness analysis of the Pedestrian Overpass (JPO) on Pajajaran Street, Bogor City, the following conclusions were obtained: First, the analysis of respondent characteristics shows that JPO users are dominated by the 20–30 age group (65%) with student/university student status (47%) and state/private company employees (31%). The majority of respondents use the JPO 1–2 times per week (28%), with the main purposes of shopping (46%) and work (24%). Overall, respondents have a positive perception of the JPO with an average Likert Scale value of 3.925 (Agree category). The highest rated aspect is safety from traffic conflicts (4.35), while the aspect of less strategic location received the lowest score (3.45). Second, the average JPO usage rate is only 30.07% of the total crossing pedestrians, which falls into the Ineffective category (less than 40%) based on traffic management criteria. A total of 69.93% of pedestrians still choose to cross directly on the road. Usage rates are higher on weekdays (average 34.23%) compared to weekends (average 25.91%). Third, the physical condition evaluation of JPO shows that all technical parameters evaluated have met the standards required by the Directorate General of Bina Marga [1], including vertical clearance (5.5 m), railing height (1.35 m), ramp/stair width (1.20 m), platform width (2.30 m), ramp slope (8%), and the availability of lighting and a protective roof. The low effectiveness of JPO is not caused by poor physical conditions, but is more influenced by user behavior factors that avoid the vertical distance of the stairs and the placement of locations that are less integrated with public activity generation centers. Review efforts on JPO placement and accessibility are needed to better suit the needs of pedestrians, as well as improvement of facility maintenance such as cleanliness, lighting, and comfort to support increased JPO utilization rates in the future.

pISSN 2302-4240
eISSN 2655-2086
Volume 15, Issue 4, December 2026, pp.01355-01366
DOI: http://dx.doi.org/10.32832/astonjadro.v15i4.24963 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

ACKNOWLEDGEMENTS

The authors would like to express their deepest gratitude to Prof. Dr. Ir. Syaiful, S.T., M.T. as the Main Supervisor and Ir. M. Hasan Wicaksono as the Co-Supervisor for their guidance, direction, and support in the implementation of this research. Gratitude is also extended to Dr. Feril Hariati, S.T., M.Eng. as Dean of the Faculty of Engineering and Science, and Ir. Hj. Nurul Chayati, M.T. as Head of the Civil Engineering Study Program at Ibn Khaldun University Bogor for the institutional support provided.

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