ISSN
2395-6992

International Journal of Engineering Research & Science

www.ijoer.com
www.adpublications.org

Volume-8! Issue-12! December, 2022 www.ijoer.com ! info@ijoer.com

Preface

We would like to present, with great pleasure, the inaugural volume-8, Issue-12, December 2022, of a scholarly journal, *International Journal of Engineering Research & Science*. This journal is part of the AD Publications series *in the field of Engineering, Mathematics, Physics, Chemistry and science Research Development*, and is devoted to the gamut of Engineering and Science issues, from theoretical aspects to application-dependent studies and the validation of emerging technologies.

This journal was envisioned and founded to represent the growing needs of Engineering and Science as an emerging and increasingly vital field, now widely recognized as an integral part of scientific and technical investigations. Its mission is to become a voice of the Engineering and Science community, addressing researchers and practitioners in below areas

Chemical Engineering	
Biomolecular Engineering	Materials Engineering
Molecular Engineering	Process Engineering
Corrosion Engineering	
Civil Engineering	
Environmental Engineering	Geotechnical Engineering
Structural Engineering	Mining Engineering
Transport Engineering	Water resources Engineering
Electrical Engineering	
Power System Engineering	Optical Engineering
Mechanical Engineering	
Acoustical Engineering	Manufacturing Engineering
Optomechanical Engineering	Thermal Engineering
Power plant Engineering	Energy Engineering
Sports Engineering	Vehicle Engineering
Software Engineering	
Computer-aided Engineering	Cryptographic Engineering
Teletraffic Engineering	Web Engineering
System Engineering	
Mathematics	
Arithmetic	Algebra
Number theory	Field theory and polynomials
Analysis	Combinatorics
Geometry and topology	Topology
Probability and Statistics	Computational Science
Physical Science	Operational Research
Physics	
Nuclear and particle physics	Atomic, molecular, and optical physics
Condensed matter physics	Astrophysics
Applied Physics	Modern physics
Philosophy	Core theories

Chemistry	
Analytical chemistry	Biochemistry
Inorganic chemistry	Materials chemistry
Neurochemistry	Nuclear chemistry
Organic chemistry	Physical chemistry
Other Engineering Areas	
Aerospace Engineering	Agricultural Engineering
Applied Engineering	Biomedical Engineering
Biological Engineering	Building services Engineering
Energy Engineering	Railway Engineering
Industrial Engineering	Mechatronics Engineering
Management Engineering	Military Engineering
Petroleum Engineering	Nuclear Engineering
Textile Engineering	Nano Engineering
Algorithm and Computational Complexity	Artificial Intelligence
Electronics & Communication Engineering	Image Processing
Information Retrieval	Low Power VLSI Design
Neural Networks	Plastic Engineering

Each article in this issue provides an example of a concrete industrial application or a case study of the presented methodology to amplify the impact of the contribution. We are very thankful to everybody within that community who supported the idea of creating a new Research with IJOER. We are certain that this issue will be followed by many others, reporting new developments in the Engineering and Science field. This issue would not have been possible without the great support of the Reviewer, Editorial Board members and also with our Advisory Board Members, and we would like to express our sincere thanks to all of them. We would also like to express our gratitude to the editorial staff of AD Publications, who supported us at every stage of the project. It is our hope that this fine collection of articles will be a valuable resource for *IJOER* readers and will stimulate further research into the vibrant area of Engineering and Science Research.

Mukesh Arora

(Chief Editor)

Board Members

Dr. M. Varatha Vijayan

Annauniversity Rank Holder, Commissioned Officer Indian Navy, Ncc Navy Officer (Ex-Serviceman Navy), Best Researcher Awardee, Best Publication Awardee, Tamilnadu Best Innovation & Social Service Awardee From Lions Club.

Dr. Mohamed Abdel Fatah Ashabrawy Moustafa

PhD. in Computer Science - Faculty of Science - Suez Canal University University, 2010, Egypt.

Assistant Professor Computer Science, Prince Sattam bin AbdulAziz University ALkharj, KSA.

Prof.S.Balamurugan

Dr S. Balamurugan is the Head of Research and Development, Quants IS & CS, India. He has authored/co-authored 35 books, 200+ publications in various international journals and conferences and 6 patents to his credit. He was awarded with Three Post-Doctoral Degrees - Doctor of Science (D.Sc.) degree and Two Doctor of Letters (D.Litt) degrees for his significant contribution to research and development in Engineering.

Dr. Mahdi Hosseini

Dr. Mahdi did his Pre-University (12^{th}) in Mathematical Science. Later he received his Bachelor of Engineering with Distinction in Civil Engineering and later he Received both M.Tech. and Ph.D. Degree in Structural Engineering with Grade "A" First Class with Distinction.

Dr. Anil Lamba

Practice Head – Cyber Security, EXL Services Inc., New Jersey USA.

Dr. Anil Lamba is a researcher, an innovator, and an influencer with proven success in spearheading Strategic Information Security Initiatives and Large-scale IT Infrastructure projects across industry verticals. He has helped bring about a profound shift in cybersecurity defense. Throughout his career, he has parlayed his extensive background in security and a deep knowledge to help organizations build and implement strategic cybersecurity solutions. His published researches and conference papers has led to many thought provoking examples for augmenting better security.

Dr. Ali İhsan KAYA

Currently working as Associate Professor in Mehmet Akif Ersoy University, Turkey.

Research Area: Civil Engineering - Building Material - Insulation Materials Applications, Chemistry - Physical Chemistry – Composites.

Dr. Parsa Heydarpour

Ph.D. in Structural Engineering from George Washington University (Jan 2018), GPA=4.00.

Dr. Heba Mahmoud Mohamed Afify

Ph.D degree of philosophy in Biomedical Engineering, Cairo University, Egypt worked as Assistant Professor at MTI University.

Dr. Aurora Angela Pisano

Ph.D. in Civil Engineering, Currently Serving as Associate Professor of Solid and Structural Mechanics (scientific discipline area nationally denoted as ICAR/08"–"Scienza delle Costruzioni"), University Mediterranea of Reggio Calabria, Italy.

Dr. Faizullah Mahar

Associate Professor in Department of Electrical Engineering, Balochistan University Engineering & Technology Khuzdar. He is PhD (Electronic Engineering) from IQRA University, Defense View, Karachi, Pakistan.

Prof. Viviane Barrozo da Silva

Graduated in Physics from the Federal University of Paraná (1997), graduated in Electrical Engineering from the Federal University of Rio Grande do Sul - UFRGS (2008), and master's degree in Physics from the Federal University of Rio Grande do Sul (2001).

Dr. S. Kannadhasan

Ph.D (Smart Antennas), M.E (Communication Systems), M.B.A (Human Resources).

Dr. Christo Ananth

Ph.D. Co-operative Networks, M.E. Applied Electronics, B.E Electronics & Communication Engineering Working as Associate Professor, Lecturer and Faculty Advisor/ Department of Electronics & Communication Engineering in Francis Xavier Engineering College, Tirunelveli.

Dr. S.R.Boselin Prabhu

Ph.D, Wireless Sensor Networks, M.E. Network Engineering, Excellent Professional Achievement Award Winner from Society of Professional Engineers Biography Included in Marquis Who's Who in the World (Academic Year 2015 and 2016). Currently Serving as Assistant Professor in the department of ECE in SVS College of Engineering, Coimbatore.

Dr. PAUL P MATHAI

Dr. Paul P Mathai received his Bachelor's degree in Computer Science and Engineering from University of Madras, India. Then he obtained his Master's degree in Computer and Information Technology from Manonmanium Sundaranar University, India. In 2018, he received his Doctor of Philosophy in Computer Science and Engineering from Noorul Islam Centre for Higher Education, Kanyakumari, India.

Dr. M. Ramesh Kumar

Ph.D (Computer Science and Engineering), M.E (Computer Science and Engineering).

Currently working as Associate Professor in VSB College of Engineering Technical Campus, Coimbatore.

Dr. Maheshwar Shrestha

Postdoctoral Research Fellow in DEPT. OF ELE ENGG & COMP SCI, SDSU, Brookings, SD Ph.D, M.Sc. in Electrical Engineering from SOUTH DAKOTA STATE UNIVERSITY, Brookings, SD.

Dr. D. Amaranatha Reddy

Ph.D. (Postdocteral Fellow, Pusan National University, South Korea), M.Sc., B.Sc. : Physics.

Dr. Dibya Prakash Rai

Post Doctoral Fellow (PDF), M.Sc., B.Sc., Working as Assistant Professor in Department of Physics in Pachhuncga University College, Mizoram, India.

Dr. Pankaj Kumar Pal

Ph.D R/S, ECE Deptt., IIT-Roorkee.

Dr. P. Thangam

PhD in Information & Communication Engineering, ME (CSE), BE (Computer Hardware & Software), currently serving as Associate Professor in the Department of Computer Science and Engineering of Coimbatore Institute of Engineering and Technology.

Dr. Pradeep K. Sharma

PhD., M.Phil, M.Sc, B.Sc, in Physics, MBA in System Management, Presently working as Provost and Associate Professor & Head of Department for Physics in University of Engineering & Management, Jaipur.

Dr. R. Devi Priya

Ph.D (CSE), Anna University Chennai in 2013, M.E, B.E (CSE) from Kongu Engineering College, currently working in the Department of Computer Science and Engineering in Kongu Engineering College, Tamil Nadu, India.

Dr. Sandeep

Post-doctoral fellow, Principal Investigator, Young Scientist Scheme Project (DST-SERB), Department of Physics, Mizoram University, Aizawl Mizoram, India- 796001.

Dr. Roberto Volpe

Faculty of Engineering and Architecture, Università degli Studi di Enna "Kore", Cittadella Universitaria, 94100 – Enna (IT).

Dr. S. Kannadhasan

Ph.D (Smart Antennas), M.E (Communication Systems), M.B.A (Human Resources).

Research Area: Engineering Physics, Electromagnetic Field Theory, Electronic Material and Processes, Wireless Communications.

Mr. Amit Kumar

Amit Kumar is associated as a Researcher with the Department of Computer Science, College of Information Science and Technology, Nanjing Forestry University, Nanjing, China since 2009. He is working as a State Representative (HP), Spoken Tutorial Project, IIT Bombay promoting and integrating ICT in Literacy through Free and Open Source Software under National Mission on Education through ICT (NMEICT) of MHRD, Govt. of India; in the state of Himachal Pradesh, India.

Mr. Tanvir Singh

Tanvir Singh is acting as Outreach Officer (Punjab and J&K) for MHRD Govt. of India Project: Spoken Tutorial - IIT Bombay fostering IT Literacy through Open Source Technology under National Mission on Education through ICT (NMEICT). He is also acting as Research Associate since 2010 with Nanjing Forestry University, Nanjing, Jiangsu, China in the field of Social and Environmental Sustainability.

Mr. Abilash

MTech in VLSI, BTech in Electronics & Telecommunication engineering through A.M.I.E.T.E from Central Electronics Engineering Research Institute (C.E.E.R.I) Pilani, Industrial Electronics from ATI-EPI Hyderabad, IEEE course in Mechatronics, CSHAM from Birla Institute Of Professional Studies.

Mr. Varun Shukla

M.Tech in ECE from RGPV (Awarded with silver Medal By President of India), Assistant Professor, Dept. of ECE, PSIT, Kanpur.

Mr. Shrikant Harle

Presently working as a Assistant Professor in Civil Engineering field of Prof. Ram Meghe College of Engineering and Management, Amravati. He was Senior Design Engineer (Larsen & Toubro Limited, India).

Zairi Ismael Rizman

Senior Lecturer, Faculty of Electrical Engineering, Universiti Teknologi MARA (UiTM) (Terengganu) Malaysia Master (Science) in Microelectronics (2005), Universiti Kebangsaan Malaysia (UKM), Malaysia. Bachelor (Hons.) and Diploma in Electrical Engineering (Communication) (2002), UiTM Shah Alam, Malaysia.

Mr. Ronak

Qualification: M.Tech. in Mechanical Engineering (CAD/CAM), B.E.

Presently working as a Assistant Professor in Mechanical Engineering in ITM Vocational University, Vadodara. Mr. Ronak also worked as Design Engineer at Finstern Engineering Private Limited, Makarpura, Vadodara.

Table of Contents

Volume-8, Issue-12, December 2022

Tamcem 8R Normet Additive Addition in the use of Concrete Pumps

Musrifah[1], Viva Oktaviani[2*], Ardiman[3]

[1,2]Lecturer at the Faculty of Engineering, University of August 17, 1945, Samarinda
[3]Student of the Faculty of Engineering, University of 17 August 1945 Samarinda
*Corresponding Author

Received: 04 December 2022/ Revised: 12 December 2022/ Accepted: 18 December 2022/ Published: 31-12-2022

Abstract— *The aim of the study was to determine the use of the Additive Normen Tamcem 8R on the compressive strength of concrete and to determine the percentage of the compressive strength of concrete in normal concrete and in concrete with the Additive Normen Tamcem 8R.*

This research was conducted from March to June 2020 at the Laboratory of the Faculty of Engineering, University of 17 August 1945 Samarinda.

The stages of the research are as follows: literature study, preparation, taking samples or test materials in the field, preparing for laboratory testing, making mix designs, making concrete mixes, slump testing, making test materials, treating test objects, compressive strength testing, analysis, and reporting.

The results showed that (1) the average compressive strength of normal concrete was 275.99 kg/cm2 and the compressive strength of mixed concrete was 285.80 kg/cm2 and (2) the percentage ratio of compressive strength of concrete under normal conditions and the use of additive norms Tamcem 8R 400 ml is as big as 1.76%.

Keywords— Additive Normet Tamcem 8R, Concrete Pump, Concrete Compressive Strength.

I. INTRODUCTION

Concrete is a construction that is very important and most dominantly used in building structures. Buildings are constructed using concrete as the main construction material, both buildings, water structures, transportation infrastructure buildings and other buildings.

Concrete is in great demand because it has many advantages compared to others. Concrete technological innovation is always required to develop in order to answer the challenges of concrete needs, the concrete produced should have good qualities such as strength and durability without neglecting economic value (Aman, et al. 2017).

The concrete material used in construction projects consists of fine aggregate, coarse aggregate, cement and water (Mulyono, 2003), these materials are mixed with a certain composition ratio to produce a certain concrete strength.

High rise building construction projects are growing. This development will surely be followed by the implementation of more sophisticated equipment technology which will certainly help the implementation run smoothly. Widely used tool in the current construction project is a concrete pump (Limanto, 2009).

A concrete pump is a casting aid in the form of a pump and pipe that is installed in a vertical and horizontal or oblique combination to pump and distribute concrete to the beams and plates to be cast. Concrete pump is and its function is commonly referred to as a concrete pump. Is one of the heavy equipment that can facilitate the construction process and make work more efficient.

For construction, the contractor chose to use a concrete pump in the casting process. This is due to the large area of the project and the timeframe for completion of the project. In foundry work such as buildings, bridges, ports and others, the use of tools

in one project has advantages and disadvantages. In addition, there are many considerations in choosing the casting equipment used, so that it is expected to get productivity that is in accordance with the best completion time and cost of implementation.

The casting process for these two tools also pays attention to the concrete slump value which is related to the workability of the concrete required. Therefore the contractor uses a different slump value when casting using a concrete pump. The difference in the slump value will affect the proportion of the concrete mix design, so that the costs and quality of the concrete material released are also different.

Along with the development of technology, now there are many admixtures that can improve the quality and workability of concrete. According to Mulyono (2003) there are several advantages of using additives, namely improving concrete workability, reducing hydration heat, reducing concrete work costs, increasing concrete durability, increasing concrete compressive strength, increasing concrete life, reducing shrinkage, making concrete more watertight, and porosity and water absorption in low concrete. Furthermore, Tjokodimuljo (1996) stated that the added material is given in relatively small amounts with strict supervision so that it is not excessive which results in worsening the properties of the concrete.

The availability of materials that must be maintained to meet a certain quality/quality of concrete, apart from that, readymix services usually use materials such as Additive Normen Tamcem 8R / additional superplasticizers in order to maintain the quality/quality of concrete to the field.

The aim of the study was to determine the use of the Additive Normen Tamcem 8R on the compressive strength of concrete and to determine the percentage of the compressive strength of concrete in normal concrete and in concrete with the Additive Normen Tamcem 8R.

II. RESEARCH METHODS

2.1 Time and Location

This research was conducted from March to June 2020 at the Laboratory of the Faculty of Engineering, University of 17 August 1945 Samarinda, which is located at Jalan Ir. H. Juanda, Samarinda Ilir District, Samarinda Municipality, East Kalimantan Province.

FIGURE 1. Research Locations

2.2 Materials and tools

The materials used are: Cement Gresik with type 1 based on SNI 15-2049-2004, Ex hammer sand fine aggregate, Coarse aggregate used in this study is ex hammer stone ½, PDAM water, capping, and Additive Normen TamCem 60 RW. The tools used are: oven, Compression Testing Machine, concrete mixer, electric stove, concrete cylinder capping, soaking tub, Cylinder Forming, Abrams Cone, and measuring cup.

2.3 Research Stages

The stages of the research are as follows: literature study, preparation, taking samples or test materials in the field, preparation for laboratory testing, making mix designs, making concrete mixes, slump testing, making test materials, treating test objects, compressive strength testing, analysis, and reporting.

2.4 Data collection

Primary data collection consists of: cement inspection (SNI 15-2530-1991), water examination (SNI 03-2834-2000), examination of fine aggregate and coarse aggregate such as aggregate gradation, bulk density, specific gravity, aggregate absorption, aggregate wear, special aggregate impurities for fine aggregates.

III. RESULTS AND DISCUSSION

3.1 Test Results for Mixed Concrete Materials

The results of examination of the materials in the manufacture of concrete mixtures, namely Gresik cement and PDAM water are presented in Table 1.

TABLE 1
RESULTS OF TESTING CHARACTERISTICS OF CONCRETE MIXTURES

No	Characteristics	Specification	Results	Note
1	Cement fineness	Maximum 22%	4%	Comply
2	Water	SNI 03-2834-2000		Comply

Source: Calculation Results

Based on the results of tests that have been carried out on cement and water, it shows that the two materials meet the specified Indonesian National Standard (SNI) specifications.

3.2 Results of Testing the Characteristics of Fine Aggregate (Palu Sand)

The results of inspection of fine aggregate material (Ex. Palu sand) are presented in Table 2.

TABLE 2
RESULTS OF TESTING CHARACTERISTICS OF FINE AGGREGATE (EX. PALU SAND)

No	Characteristics	Specification	Results	Note
1	Content Weight	Min. 1,3 g/cm3	1.488 g/cm3	Comply
2	Specific gravity	Min. 2,5	2.647	Comply
3	Absorption	0,2% - 2%	0,783%	Comply
4	Water content	Max. 6%	2.79%	Comply
5	Sludge levels	Max. 5%	3.33%	Comply

Source: Calculation Results

Based on the test results of fine aggregate Ex hammer sand presented in Table 2 shows that the material meets the specified Indonesian National Standard (SNI) specifications, so that Ex hammer sand is suitable for use as a concrete mixture.

3.3 Coarse Aggregate Characteristics Test Results (Palu Stone 1/2")

The results of inspection of the coarse aggregate material (Ex. Palu Stone 1/2") are presented in the table 3.

TABLE 3
COARSE AGGREGATE CHARACTERISTICS TEST RESULTS (EX. PALU STONE ½")

No	Characteristics	Specification	Results	Note
1	Content Weight	Min. 1,3 gram/cm3	1,483gr/cm3	Comply
2	Specific gravity	Min. 2,54	2693	Comply
3	Absorption	0,2% - 4%	12.06	Comply
4	Water content	Max. 1,3%	16.04	Comply
5	abrasion	≤ 40%	20,04%	Comply
6	Sludge levels	Max. 1%	16.47	Does not Comply

Source: Calculation Results

Based on the test results on coarse aggregate in the form of hammer stone presented in Table 3, it shows that the material meets the specified Indonesian National Standard (SNI) specifications, except for the silt content which exceeds the maximum limit of 1%, so that before use the coarse aggregate must be washed first.

3.4 Concrete Mix Design

The planning/design of the concrete mixture is made based on the SNI 03-2834-2000 method. In this research, the compressive strength of concrete is planned 250 kg/cm^2. From the results of planning the concrete mixture, the results for the composition of the concrete mixture are presented in Table 4.

TABLE 4
JOB MIX FORMULA

No.	Description	Tables/Graphs / calculation	Description
1	Required compressive strength.	Defined	25 N/mm^2 at 28 days defective part 5 persen
2	standard deviation.	Defined known or PBI	6 N/Mm^2 or without data N/Mm2
3	Value added (margin)	(k = 1,64)	
4	The average strength to be achieved	Calculation	1,64 x 6.0 = 9,8 N/Mm^2
5	cement type..	Defined	25 + 9,8 = 34,8 N/Mm^2 normal cement Tonasa
6	Aggregate type: 1. Sand	Natural	Fine Ex. Palu
	2. Split	Broken	Split Ex. Palu ½
7	Free water-semen factor	Table 5	0,5
		Chart 5	0,6
8	Maximum cement water factor..	Defined	Slump 100 s/d 120 mm
		or PBI	38 mm
9	S l u m p ..	Defined	
		or PBI	
10	Maximum aggregate size	Defined	150 = 68,3 = 218,3 Kg/Cm^2
11	Free water content..	or PBI	218,3 :0,50 = 437 Kg/Cm^2
12	Cement content	Tabel 5	430
13	Maximum cement content.	11 : 8/7	0,5
14	Minimum cement content	Defined	218,3 :0,50 = 437 Kg/Cm^2
15	Adjusted cement water factor.	Defined	Grain Arrangement Zone Area
16	The arrangement of the fine aggregate grains	11 : 14	No
17	Percent of material finer than 4,8 mm	Chart 2.2 s/d 2.5	30 % Ex. Palu Sand
		Chart 5.6/	70 % Split Ex. Palu
18	Rail aggregate specific gravity (surface dry) ..	Calculation	(30 % x 2,647) + (70 % x 2,745)
			2385 Kg/Cm^2
19	Specific gravity of concrete	Chart 5 . 5	2385 – 218 - 437 = 1730,01 Kg/Cm^2
20	Combined aggregate content..	19 - 12 - 11	30 % x 1730.01 = 519,00 Kg/Cm^2
21	Fine aggregate content	Calculation	70 % x 1730.01 = 1211,01 Kg/Cm^2
22	Coarse aggregate content 1- 2		

Source: Calculation Results

Furthermore, the need for mixed materials for 1 cylinder, 3 cylinders and 60 cylinders is presented in the table 5

TABLE 5
NEEDS MIXED MATERIALS FOR 1, 3, AND 60 CYLINDER

Tancem Variation	Material Requirements for Each Variation for 1 Cylinder			
	Cement (kg)	Water (kg)	Stone ½" (kg)	Sand (kg)
0	3,066	1,500	8,566	3,783
14 cc / ml	3,066	1,500	8,566	3,783
Variasi Tancem	**Material Requirements for Each Variation for 3 Cylinder**			
	Cement (kg)	Water (kg)	Stone ½" (kg)	Sand (kg)
0	9,177	4,462	25,663	11,349
40 cc / ml	9,177	4,462	25,663	11,349
	Material Requirements for Each Variation for 60 Cylinder			
	Cement (kg)	Water (kg)	Stone ½" (kg)	Sand (kg)
0	184,000	90,000	227,00	514,000
400 cc / ml	184,000	90,000	227,000	514,000

Source: Calculation Results

3.5 Making Test Differences and Test Slumps and Treatment of Test Differences

After the design of the concrete mix has been made, then the test object is made in the form of a cylinder measuring 15 cm x 30 cm based on the design. In this study, the planned slump was (10 ± 2) mm, using a cement water factor (fas) = 0.47. The results of the slump value test can be seen in the following table: The results of the slump test and concrete specific gravity are presented in Table 6.

TABLE 6
CONCRETE TEST RESULTS AND SLUMP TEST VALUES

No	Variation	Slump (cm)					Average
		3 days	7 days	14 days	21 days	28 days	
1	0	8	9	10	11	13	10
2	80 cc / ml	10	11	8	10	8	9

In this study, the curing of the test specimens was carried out by immersion, the concrete curing aims to ensure the cement hydration process can take place perfectly, so that cracks on the concrete surface can be avoided and the desired concrete quality can be achieved. In addition, the humidity of the concrete surface can also increase the resistance of concrete to weather influences and is more watertight. Treatment (curing) is carried out after the concrete is 1 day old until the day before the compressive strength test is carried out.

3.6 Concrete Compressive Strength Test Results

The compressive strength test of concrete is carried out at the age of the concrete in accordance with predetermined days. The results of testing the compressive strength of concrete under normal conditions and the compressive strength of concrete with the addition of the tancem additive of 40 cc are presented in Tables 7 and 8.

TABLE 7
DATA ON NORMAL CONCRETE COMPRESSIVE STRENGTH TEST RESULTS

No	Normal concrete manufacture date	Normal concrete inspection date	Strength Press	Amount Overall compressive strength Strength (kg/cm2)	*f'c* (MPa)
1	01 June 2021	4 June 2021**(date changed)**	101.345	305.255	25.336
2	01 June 2021	4 June 2021	95.683	288.202	23.921
3	01 June 2021	4 June 2021	107.006	322.308	26.752
4	01 June 2021	4 June 2021	101.345	305.255	25.336
5	01 June 2021	4 June 2021	95.683	288.202	23.921
6	01 June 2021	4 June 2021	107.006	322.308	26.752
7	02 June 2021	9 June 2021	137.297	254.488	21.123
8	02 June 2021	9 June 2021	131.522	243.784	20.234
9	02 June 2021	9 June 2021	143.071	265.193	22.011
10	02 June 2021	9 June 2021	137.297	254.488	21.123
11	02 June 2021	9 June 2021	148.846	275.897	22.899
12	02 June 2021	9 June 2021	160.396	297.306	24.676
13	03 June 2021	17 June 2021	189.271	259.133	21.508
14	03 June 2021	17 June 2021	189.271	259.133	21.508
15	03 June 2021	17 June 2021	195.046	267.040	22.164
16	03 June 2021	17 June 2021	200.821	274.947	22.821
17	03 June 2021	17 June 2021	200.821	274.947	22.821
18	03 June 2021	17 June 2021	183.496	251.227	20.852
19	04 June 2021	25 June 2021	218.146	276.659	22.963
20	04 June 2021	25 June 2021	212.371	269.335	22.355
21	04 June 2021	25 June 2021	212.371	269.335	22.355
22	04 June 2021	25 June 2021	218.146	276.659	22.963
23	04 June 2021	25 June 2021	212.371	269.335	22.355
24	04 June 2021	25 June 2021	218.146	276.659	22.963
25	05 June 2021	3 July 2021	218.146	262.826	21.815
26	05 June 2021	3 July 2021	223.921	269.784	22.392
27	05 June 2021	3 July 2021	229.696	276.742	22.970
28	05 June 2021	3 July 2021	218.146	262.826	21.815
29	05 June 2021	3 July 2021	229.696	276.742	22.970
30	05 June 2021	3 July 2021	235.471	283.700	23.547
Amount / Average				275.99	22.90

Source: Calculation Results

TABLE 8
COMPRESSIVE STRENGTH TEST RESULT DATA WITH ADDITION ADDITIVE NORMET TANCEM 8R

No	Concrete Manufacturing Date	Concrete Inspection Date	Strength Press	Amount Overall compressive strength Strength (kg/cm2)	f'c (MPa)
1	05 June 2021	08 June 2021	112.668	339.362	28.167
2	05 June 2021	08 June 2021	112.668	339.362	28.167
3	05 June 2021	08 June 2021	107.006	322.308	26.752
4	05 June 2021	08 June 2021	101.345	305.255	25.336
5	05 June 2021	08 June 2021	95.683	288.202	23.921
6	05 June 2021	08 June 2021	107.006	322.308	26.752
7	06 June 2021	13 June 2021	148.846	275.897	22.899
8	06 June 2021	13 June 2021	148.846	275.897	22.899
9	06 June 2021	13 June 2021	154.621	286.601	23.788
10	06 June 2021	13 June 2021	154.621	286.601	23.788
11	06 June 2021	13 June 2021	148.846	275.897	22.899
12	06 June 2021	13 June 2021	160.396	297.306	24.676
13	07 June 2021	21 June 2021	200.821	274.947	22.821
14	07 June 2021	21 June 2021	200.821	274.947	22.821
15	07 June 2021	21 June 2021	206.596	282.853	23.477
16	07 June 2021	21 June 2021	212.371	290.760	24.133
17	07 June 2021	21 June 2021	200.821	274.947	22.821
18	07 June 2021	21 June 2021	206.596	282.853	23.477
19	08 June 2021	29 June 2021	218.146	276.659	22.963
20	08 June 2021	29 June 2021	212.371	269.335	22.355
21	08 June 2021	29 June 2021	212.371	269.335	22.355
22	08 June 2021	29 June 2021	218.146	276.659	22.963
23	08 Juni 2021	29 June 2021	212.371	269.335	22.355
24	08 June 2021	29 June 2021	218.146	276.659	22.963
25	09 June 2021	07 July 2021	218.146	262.826	21.815
26	09 June 2021	07 July 2021	223.921	269.784	22.392
27	09 June 2021	07 July 2021	229.696	276.742	22.970
28	09 June 2021	07 July 2021	223.921	269.784	22.392
29	09 June 2021	07 July 2021	229.696	276.742	22.970
30	09 June 2021	07 July 2021	235.471	283.700	23.547
Amount / Average				285.80	23.721

Source: Calculation Results

In this study the quality of the design concrete is k-250 kg/cm^2 or equivalent to *f'c* 20,75 MPa. The results of the concrete compressive strength test are collected and arranged in sequence, the compressive strength of concrete is considered eligible if the following two things are met: (1) there is no compressive strength value (the average of the compressive strength of 2 cylinders) which is smaller than f'c - 3.5 MPa. (SNI 2847 Chapter 7.6.3.3) and (2) there is no average compressive strength value of 3 consecutive compressive tests which is less than f'c. The results of the concrete compressive strength test measurements both under normal conditions and with the addition of the Additive Normet Tancem 8R are presented in Table 9. The comparison of normal concrete compressive strength and additive concrete strength is 49.12% : 50.88%, the difference is F'c= 0.82 Mpa or 1.76%

TABLE 9
COMPRESSIVE STRENGTH TEST REQUIREMENTS FULFILLED

No	Concrete Type	Average Concrete Compressive Strength (Mpa)					Average	SNI requirements (chapter 7.6.3.3	
		3 Hari	7 Hari	14 Hari	21 hari	28 Hari		(1)	(2)
1	Normal Concrete	25.34	22.01	21.95	22.66	22.59	22.9	17,25 (Fulfill)	20,75 (Fulfill)
2	Concrete with additives	26.52	23.49	23.26	22.66	22.68	23.72	17,25 (Fulfill)	20,75 (Fulfill)

Source: Calculation Results

Based on the measurement results of the concrete compressive strength test, it shows that in normal concrete it produces an average concrete compressive strength of 22.90 kg/cm^2 and in concrete with the addition of Additive Normet Tancem 8R it produces an average concrete compressive strength of 23,72 kg/cm^2. The two concrete teapot strengths meet the requirements of SNI article 7.6.3.3. Based on the data above, it shows that the use of Additive Normet Tancem 8R can increase the compressive strength of concrete. The results of this study are in line with those reported by Dony (2018), namely the compressive strength of concrete at 28 days of age tends to increase with the addition of 0.1% Tamcem 60 RA of +10.73%, 0.3% Tamcem 60 RA of +9.02 %, and 0.5% Tamcem 60 RA of +4.44%, the addition of 0.7% Tamcem 60 RA decreased the compressive strength of up to 26.60% compared to normal concrete. Judging from the slump value, the higher the percentage of Tamcem 60 RA, the higher the slump value obtained. Mulyono (2003) explained that the use of additives can improve concrete workability, reduce concrete hydration heat, reduce concrete work costs, increase resistance to sulfate attack, increase concrete age, and reduce shrinkage. Added material (Admixture) is a material or material other than water, cement and aggregate added to the concrete during mixing. Admixture is used to modify the properties and characteristics of concrete.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Based on the test results on normal concrete with a total of 60 cylinders measuring 15 cm x 30 cm, with a design compressive strength of k-250 kg/cm^2 or the equivalent of f'c 20.75 MPa, it is concluded that:

1. The percentage of concrete compressive strength in normal conditions and the use of Additive Normet Tamcem 8R 400 ml is 1.76%.
2. The average compressive strength of normal concrete is 275.99 kg/cm^2 and the compressive strength of mixed concrete is 285.80 kg/cm^2.

4.2 Suggestion

1. In the process of making concrete mixes, especially when mixing, the concrete ingredients must be thoroughly mixed so that the resulting concrete is of high quality.
2. We recommend that the concrete curing process should be checked every day, especially the immersion part, because water can affect the compressive strength of concrete if the water is contaminated with other substances.
3. Further research is needed regarding the compressive strength of concrete by using a normet additive before making a test object.

4. Accuracy is needed in selecting and analyzing samples before being applied to the field.
5. It is recommended not to use manual mixing to avoid an uneven or inhomogeneous mixture that can affect the compressive strength of the concrete.

REFERENCES

[1] Arman, S. Haris dan A. Kartika. 2017. Experimental Study of Setting Time of High Quality Concrete Using Additives Fospoc SP 337 and Fosfoc Complast R. Momentum Journal 19 (2) : 57-61

[2] Dony, R. 2018. *Use of Tamcem 60 Ra Additive For High Quality Concrete Using Quarry Manggilang Aggregate.* Other thesis, Universitas Islam Riau.

[3] Ilham, A, 2004, The Effect of Reducing Water Content and Adding Superplasticizers to the Composition of Concrete Mixtures with Compressive Strength of 30 and 40 MPa, Journal of the Department of Civil Engineering UII, Yogyakarta.

[4] Limanto, S. 2009. Analysis of Concrete Pump Productivity in High-rise Building Projects. Paper in the National Civil Engineering Conference 3 (KoNTekS 3) Jakarta, 6 – 7 Mei 2009 Pelita Harapan University – Atma Jaya University Yogyakarta.

[5] Mulyono, T. 2003. Concrete Technology. Andi Offset, Yogyakarta.

[6] Mursito, 1997, Effect of Superplasticizer and Setretarder Additives on Concrete Compressive Strength, Slump Value and Setting Time in Concrete Mixture, Final Stage S-1 Project, FTSP UII, Yogyakarta.

[7] SK SNI 03-6468-2000 (Pd T-18-19999-03), Procedure for Calculation of High Strength Concrete Mixture, Foundation for Investigators of Building Issues, Bandung.

[8] Tjokrodimuljo, K., 1996, Concrete Technology, Department of Civil Engineering, Faculty of Engineering. Gadjah Mada University, Yogyakarta

Traffic Impact Analysis Due to the Construction of Type B Terminals in Paser Regency Traffic Impact Analysis due to the Construction of Type B Terminal in Paser Regency

Tukimun[1*]; Rosa Agustaniah[2]

Lecturers of Civil Engineering Study Program, Faculty of Engineering, University of August 17, 1945 Samarinda, Indonesia
*Corresponding Author

Received: 08 December 2022/ Revised: 15 December 2022/ Accepted: 20 December 2022/ Published: 31-12-2022

Abstract— *This study aims to get an overview of the impact of traffic caused by the construction of type B terminals in Paser Regency on existing conditions and construction period. Based on Law number 22 of 2009 article 99 paragraph 1, it is stated that "Any plan to build a center of activity, settlements, and infrastructure that will cause disturbances in security, safety, order, and smooth running of traffic and road transport must be carried out a traffic impact analysis". The results of the disclaimer on activities based on the Regulation of the Minister of Transportation No. 17 of 2021 are included in the category of moderate rise. The results of the analysis of the performance of 11 road sections show that the condition of the road service level in the existing condition is the same as the condition during the construction period, namely having an LOS value = A to C which means that there are no problems with the condition of the existing road sections, both in existing conditions and in construction conditions. Meanwhile, the results of the performance assessment at the intersection are 2 intersections, showing the existing conditions and construction period conditions of the LOS value of the intersection is B, which means that there is no disturbance in the existing intersection conditions. The recommendation of this study is that it is necessary to regulate the circulation and maneuvering of construction vehicles so as not to cause traffic disturbances on sections and intersections around the site of type B terminal construction activities in Paser Regency*.

Keywords— Traffic Impact Analysis, Terminal Type B, Paser Regency.

I. INTRODUCTION

The construction of an infrastructure in general can have a certain impact on the movement of traffic around it. The magnitude of the impact on traffic that occurs needs to be carried out a study so that problems that have the potential to occur can be handled wisely. This traffic study was carried out on the Paser Type B Passenger Terminal Development plan to predict the impact resulting from these activities at each stage.

The impact of traffic that occurs is the impact of the emergence of new journeys that originate from each stage of activity, changes in the flow of movement at each stage of activity, as well as from the traffic flow that increases every year. Therefore, it is necessary to conduct a comprehensive study on traffic aspects for these operational plan activities by collecting primary and secondary data to find out how the impact of the operation of Paser Type B Passenger Terminal on the traffic network around the study site.

Based on Law number 22 of 2009 article 99 paragraph 1, it is stated that "Every plan to build activity centers, settlements, and infrastructure that will cause disturbances in security, safety, order, and smooth running of traffic and road transportation must be carried out a traffic impact analysis".

Based on the Regulation of the Minister of Transportation No. 17 of 2021, it is stated that the minimum limit of activities required to be carried out a Traffic Impact Analysis Study is carried out. In line with the laws and regulations that have been mentioned, the construction of Paser Type B Passenger Terminal with a total area of 10,148 m2 requires a Traffic Impact Analysis study (hereinafter referred to as Andalalin) in order to support everything related to safety, order and smooth traffic from road users around the activity site.

Traffic management arrangements and infrastructure supporting the smooth accessibility and mobility of road users that must be made are the responsibility of the builders/initiators who demonstrate the fulfillment of substantial contributions as a

consequence of what has been built (Polluter pays principle, Rio Declaration 1992) with the principle of externality that development prioritizes a "Cost Effective" agenda to know that handling and prevention is the cheapest price, compared to correcting mistakes that can occur later. After the preparation of the Andalalin document, the expected output is the formation of a traffic impact handling plan as a reference for taking action for the construction of project activities.

The purpose of this study was to conduct a study on the analysis of traffic impacts due to the construction of Type B Passenger Terminal in Paser Regency. With the construction of the type B terminal, of course, it will cause traffic impacts around the construction site, so it is necessary to have a study and solution of the traffic problem.

II. LITERATURE REVIEW

According to Murwono (2003), the phenomenon of traffic impact is caused by the construction and operation of activity centers that cause a considerable traffic revival, such as shopping center offices, terminals, and others. It further said that the traffic impact occurs in 2 (two) stages, namely: Construction / construction stage. At this stage there will be a resurgence of traffic due to material transportation and mobilization of heavy equipment that burdens road sections on material routes and post-construction stages / when operating. At this stage, there will be a revival of traffic from visitors, employees and sellers of transportation services that will burden certain road sections, as well as the emergence of a revival of vehicle parking..

Traffic impact analysis is basically an analysis of the effect of land use development on the system of movement of traffic flows - traffic around it caused by the rise of new traffic, diverted traffic, and by vehicles in and out of / to the land (Dikun and Arif 1993).

Traffic impact analysis is basically an analysis of the effect of land use development on the surrounding traffic flow movement system resulting from the rise of new traffic, diverted traffic, and by vehicles in and out of/to the land (Tamin 2000).

The purpose of analysis of traffic impacts is to: (1) predict the impact of an area development; (2) determine the form of improvement/improvement necessary to accommodate changes that occur as a result of new development; (3) align decisions on land use with traffic conditions, the number and location of access, and alternatives to improvement; (4) identify issues that may affect the developer's decision to proceed with the proposed project; and (5) as a tool for supervision and evaluation of the implementation of traffic management and engineering (Dikun and Arif 1993).

There are 5 factors / elements that will have an impact if the land use system interacts with traffic - the five elements are: 1. Awakening / Travel Pull Elements, which are influenced by factors of type and class of designation, intensity and location of the rally; 2. Road Section Network Performance Elements, which include the performance of road sections and intersections; 3. Access Element, with respect to the number and location of access; 4. Parking Space Elements; 5. Environmental Elements, especially with regard to the impact of pollution and noise (Djamal1993):

The objectives of analysis of traffic impacts are: (1) assessment and formulation of traffic impacts caused by new development areas on the surrounding road network / external road network, especially road sections that form the main network system; (2) Efforts to synchronize government policies in relation to the provision of road infrastructure, especially the plan to improve road infrastructure and intersections around major developments which are expected to reduce conflicts, congestion and traffic barriers; (3) provision of solutions that can minimize traffic congestion caused by the impact of new development, as well as the preparation of indicative proposals for additional facilities needed to reduce the impact caused by traffic generated by the new development, including efforts to maintain the level of service of existing road network system infrastructure; (4) preparation of recommendations for the regulation of internal road network systems, access points to and from the land built, the need for parking space facilities and the provision of as much as possible for ease of access to the land to be built (Dikun and Arif 1993).

III. RESEARCH METHODS

3.1 Time and Location

The research location is KM 8 Sempulang Village or Kuaro - Tanah Grogot Street (Section Name: Tanah Grogot City Boundary - Lolo; Section No. : 002; Status : National Road; Function: Primary Artery), Janju Village, Tanah Grogot sub-District, Paser Regency, East Kalimantan Province, with location coordinates 1°51'19.6"S 116°10'00.6"E. This study was conducted from August to October 2022.

3.2 Research Activities

The research activities carried out are as follows: preparation, literature review, observation / survey, data collection, data analysis, reporting. Research flow chart presented in **Figure 1.**

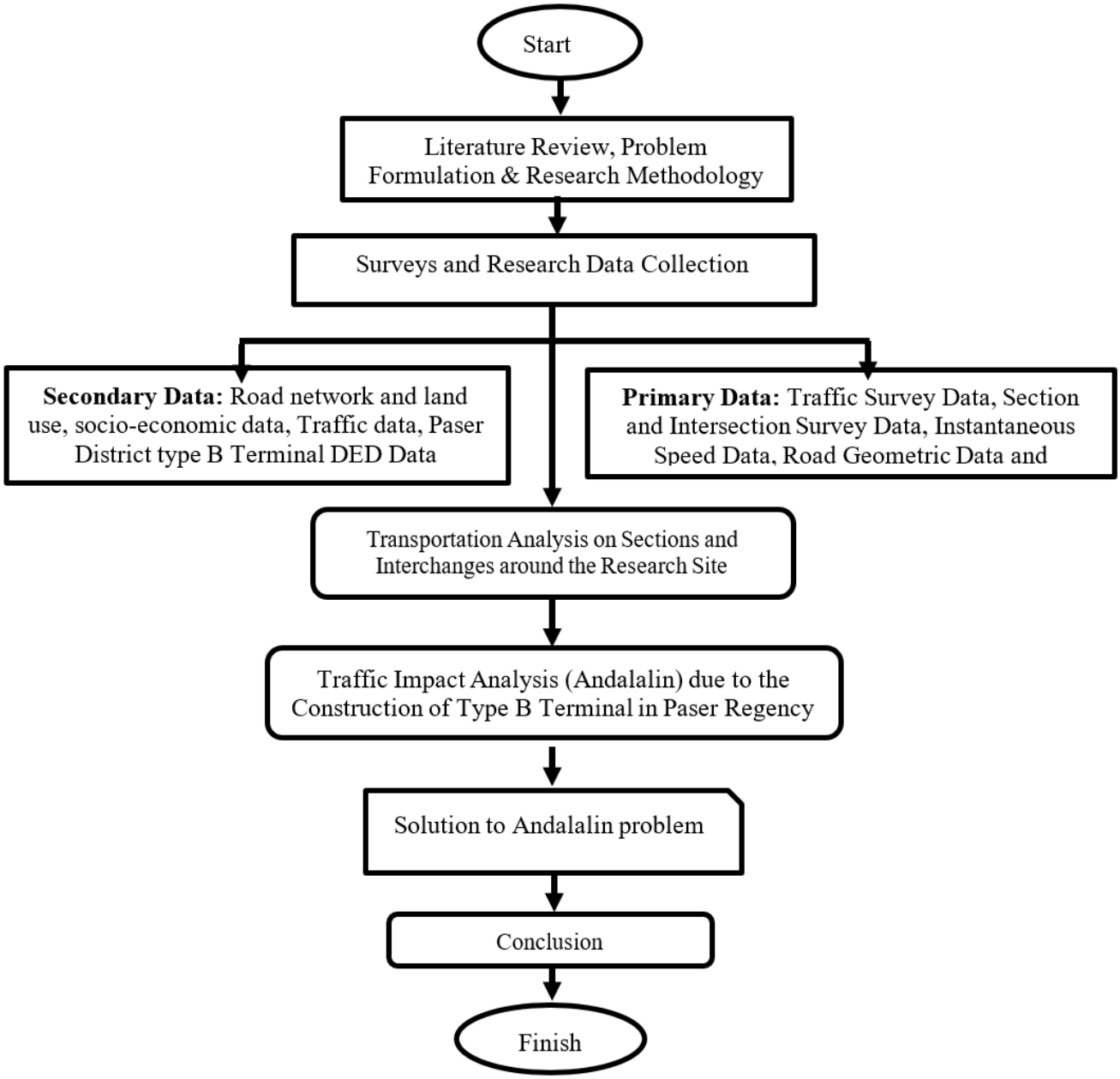


FIGURE 1: Research Flowchart

3.3 Data Analysis

The analysis method used is Traffic Impact Analysis Due to the Construction of type B Passenger Terminal in Paser Regency using the 1997 MKJI Method and 4-Stage Modeling (Tamin Ofyar, Z. 2000).

IV. RESULTS AND DISCUSSION

4.1 Road Network Inventory

The results of the inventory of road networks within the study area as presented in Table 1 below:

TABLE 1
RESULTS OF THE ROAD NETWORK INVENTORY OF THE RESEARCH LOCATION

No	Road Section Name	Types of Road Sections	Wide Effectivity f (m) (Wc)	Number of Lanes	Width per lane (m)	Median Width of the Road (m)	Effective Shoulder Width (Wc) (m)		Side Obstacles
							Left	Right	
1	Kuaro - Tanah Grogot Street (1)	2/2UD	10	2	5	-	1	1	Low
2	Kuaro - Tanah Grogot Street (2)	2/2UD	10	2	5	-	2	2	Low
3	Kuaro - Tanah Grogot Street (3)	4/2D	14	4	3.5	1.5	0.2	0.2	Low
4	Kuaro - Tanah Grogot Street (4)	4/2D	14	4	3.5	1.5	2	2	Low
5	Kuaro - Tanah Grogot Street (5)	2/2UD	5.5	2	2.75	-	3	3	Low
6	Kuaro - Tanah Grogot Street (6)	4/2D	14	4	3.5	1.5	0.2	0.2	Low
7	Pelopor Street	2/2UD	6	2	3	-	-	-	Low
8	Trans. Janju Street	2/2UD	7	2	3.5	-	1.5	1.5	Low

Source: Field Survey Results, 2022

4.2 Road Section Traffic Volume

In accordance with PM 96 of 2015, from the data from the traffic survey results, the highest volume of flow will be selected, which is referred to as the Design Hourly Volume (VJP). Based on the data in Table 1 above, it is obtained that the VJP for each road section within the scope of the study area is presented in **Table 2** below:

TABLE 2
PEAK HOUR VOLUME (VJP) EXISTING CONDITIONS

No	Street Names and Traffic Directions	Type	Peak Hour Volume (smp/jam)		
			Morning	Noon	Afternoon
1	Kuaro - Tanah Grogot Street (1)	2/2UD	977	1026	1216
a	direction of east		549	560	637
b	direction of west		428	466	579
2	Kuaro - Tanah Grogot Street (2)	2/2UD	944	953	1131
a	direction of east		550	539	615
b	direction of west		395	414	516
3	Kuaro - Tanah Grogot Street (3)	4/2D	944	953	1131
a	direction of east		550	539	615
b	direction of west		395	414	516
4	Kuaro - Tanah Grogot Street (4)	4/2D	944	953	1131
a	direction of east		550	539	615
b	direction of west		395	414	516
5	Kuaro - Tanah Grogot Street (5)	2/2UD	944	953	1131
a	direction of south		550	539	615
b	direction of north		395	414	516
6	Kuaro - Tanah Grogot Street (6)	4/2D	856	898	1118
a	direction of north		364	423	499
b	direction of south		492	485	619
7	Pelopor Street	2/2UD	318	318	250
a	direction of west		146	133	135
b	direction of east		172	237	238
8	Trans. Janju Street	2/2UD	215	237	238
a	direction of north		115	237	238
b	direction of south		99	109	111

Source: Results of Survey Data Compilation (2022)

4.3 Free Current Speed and Road Section Capacity

The road section studied is an urban road so the formula used from MKJI 1997 is the formula for urban roads. Based on these guidelines, the urban/semi-urban road segment in question is a road that has a permanent and continuous development along all or almost all of the road, at least on one side of the road. The results of the analysis of the speed of free current under existing conditions are presented in **Table 3.**

TABLE 3
FREE CURRENT SPEED EXISTING CONDITIONS

No	Road Section Name	Type	FV_0	FV_w	$FV^0 + FV_w$	FFV_{sf}	FFV_{cs}	FV
1	Kuaro - Tanah Grogot Street (1)	2/2UD	42	6	48	0.98	0.9	42.34
2	Kuaro - Tanah Grogot Street (2)	2/2UD	42	6	48	1	0.9	43.2
3	Kuaro - Tanah Grogot Street (3) direction of east	1-Feb	55	0	55	0.98	0.9	48.51
4	Kuaro - Tanah Grogot Street (3) direction of west	1-Feb	55	0	55	1.02	0.9	50.49
5	Kuaro - Tanah Grogot Street (4) direction of east	1-Feb	55	0	55	1.03	0.9	50.99
6	Kuaro - Tanah Grogot Street (4) direction of west	1-Feb	55	0	55	1.03	0.9	50.99
7	Kuaro - Tanah Grogot Street (5)	2/2UD	42	-4	38	1	0.9	34.2
8	Kuaro - Tanah Grogot Street (6) direction of north	1-Feb	55	0	55	0.98	0.9	48.51
9	Kuaro - Tanah Grogot Street (6) direction of south	1-Feb	55	0	55	0.98	0.9	48.51
10	Pelopor Street	2/2UD	42	-3	39	0.96	0.9	33.7
11	Trans. Janju Street	2/2UD	42	0	42	0.99	0.9	37.42

Source: Analysis Results, 2022

Based on pda data from Table 3 above, the average condition of free current speed (FV) on road sections around the study site was obtained, namely there were 11 road sections based on inventory results in the field and had a speed of 44.44 Km / Hour. Furthermore, the results of the analysis of the capacity of road sections (C) are the largest volume that can be served by a road section are presented in **Table 4** below:

TABLE 4
CAPACITY OF ROAD SECTIONS EXISTING CONDITIONS

No	Road Section Name	Type	C_0	Fc_w	FCsp	FC_{sf}	FC_{cs}	C
1	Kuaro - Tanah Grogot street (1)	2/2UD	2900	1.29	1	0.94	0.86	3024
2	Kuaro - Tanah Grogot street (2)	2/2UD	2900	1.29	1	1	0.86	3217
3	Kuaro - Tanah Grogot street (3) direction of east	1-Feb	3300	1	1	0.94	0.86	2668
4	Kuaro - Tanah Grogot street (3) direction of west	1-Feb	3300	1	1	1	0.86	2838
5	Kuaro - Tanah Grogot street (4) direction of east	1-Feb	3300	1	1	1.02	0.86	2895
6	Kuaro - Tanah Grogot street (4) direction of west	1-Feb	3300	1	1	1.02	0.86	2895
7	Kuaro - Tanah Grogot street (5)	2/2UD	2900	0.72	1	1	0.86	1783
8	Kuaro - Tanah Grogot street (6) direction of north	1-Feb	3300	1	1	0.94	0.86	2668
9	Kuaro - Tanah Grogot street (6) direction of south	1-Feb	3300	1	1	1.02	0.86	2895
10	Pelopor street	2/2UD	2900	0.87	1	0.92	0.86	1996
11	Trans. Janju street	2/2UD	2900	1	1	1	0.86	2494

Source: Analysis Results, 2022

Based on the results of the analysis of field data, the results of the capacity calculation of 11 sections around the study site showed the average value of the smallest road capacity on the Kuaro-Tanah Grogot road section (5) with a capacity of 1,783 SMP / Hour, and the largest capacity on the Jl. Kuaro-Tanah Grogot (2) road section of 3,217 SPM / Hour. The results of the calculation of the level of road service (LOS) are presented in **Table 5** below:

TABLE 5
PERFORMANCE OF EXISTING CONDITION ROAD SECTIONS

No	Road Section Name	Type	C	Q	Q/C	LOS (1)	V	LOS (2)
1	Kuaro - Tanah Grogot street (1)	2/2UD	3024	1216	0.4	B	26.78	C
2	Kuaro - Tanah Grogot street (2)	2/2UD	3217	1131	0.35	B	27.75	C
3	Kuaro - Tanah Grogot street (3) direction of east	1-Feb	2668	615	0.23	B	32.27	C
4	Kuaro - Tanah Grogot street (3) direction of west	1-Feb	2838	516	0.18	A	34.06	C
5	Kuaro - Tanah Grogot street (4) direction of east	1-Feb	2895	615	0.21	B	34.11	C
6	Kuaro - Tanah Grogot street (4) direction of west	1-Feb	2895	516	0.18	A	34.39	C
7	Kuaro - Tanah Grogot Street (5)	2/2UD	1783	1131	0.63	C	20.02	C
8	Kuaro - Tanah Grogot street (6) direction of north	1-Feb	2668	499	0.19	A	32.63	C
9	Kuaro - Tanah Grogot street (6) direction of south	1-Feb	2895	619	0.21	B	32.45	C
10	Pelopor street	2/2UD	1996	250	0.13	A	23.04	C
11	Trans. Janju street	2/2UD	2494	238	0.1	A	25.79	C

Source: Analysis Results, 2022

Based on the data in Table 5, it is obtained that based on the Degree of Saturation (DS) or Volume per Road Section Capacity (V/C Ratio) obtained:

1. **LOS(1) A**, which means that the free flow with low traffic volume and the driver can maintain his desired speed without or with little delay;
2. **LOS(1) B**, which means that the flow is stable with moderate traffic volume and the driver still has enough freedom to choose his speed and the path of the road he wants;
3. **LOS(1) C**, which means that the current is stable but the movement of the vehicle is controlled by a higher volume of traffic as well as the driver is restricted in choosing the speed, changing lanes or ahead of;

4.4 Interchange Performance

There are 2 (two) intersections that are included in the scope of this study, the intersections are as follows:

1. Simpang 1 : Simpang JANJU : Jl. Kuaro – Tanah Grogot – Jl. Trans Janju (Simpang Tidak Bersinyal); and
2. Interchange 2: PELOPOR Interchange: Jl. Kuaro – Tanah Grogot – Jl. Pelopor (Uncited Interchange).

The results of calculating the performance of existing intersections from Simpang Janju and Simpang Pioneer adjacent to the research location are presented in **Table 6** and **Table 7** below:

TABLE 6
SIMPANG 1 PERFORMANCE (SIMPANG JANJU)

Road flow	Degree of Saturation	Travel Delays					Queuing Opportunities	Service Level Interchange
		Traffic	Main Street	Minor Roads	Geometric Roads	Interchange		
Q	DS	DT_1	DT_{MA}	DT_{MI}	DG	D	QP%	LOS
1274	**0.55**	**5.61**	**4.19**	**19.27**	**3.79**	**9.4**	**12.95-28.17**	**B**

Source: Analysis Results, 2022

TABLE 7
SIMPANG 2 PERFORMANCE (SIMPANG PELOPOR)

Road flow	Degree of Saturation	Travel Delays					Queuing Opportunities	Service Level Interchange
		Traffic	Main Street	Minor Roads	Geometric Roads	Interchange		
Q	DS	DT_1	DT_{MA}	DT_{MI}	DG	D	QP%	LOS
1256	**0.37**	**3.78**	**2.82**	**11.62**	**3.82**	**7.6**	**6.7 - 17.13**	**B**

Source: Analysis Results, 2022

4.5 Trip Generation Analysis

Based on the results of the 2022 (existing) bounce and pull analysis, it was obtained based on the peak hour volume from the traffic survey data in **Table 8** as follows:

TABLE 8
ANALYSIS OF AWAKENING AND PULLING OF TRAVEL IN EXISTING CONDITIONS

Zone	Coverage Area	Rise (smp/hour)	Pull (smp/hour)	Calibration Results	
				Rise (smp/Hour)	Pull (smp/Hour)
1	Direction from/to Mako Brimob	135	114	137	113
2	Direction from/to Mtanah Grogot	499	619	504	614
3	Direction from/to Trans Janju	127	111	128	110
4	Direction from/to Kuaro	637	579	643	574
5	Terminal Location Plan	0	0	0	0
TOTAL		1398	1424	1411	1411

Source: Analysis Results, 2022

In the analysis of the Rise and pull in the planned year, it is predicted that there will be an increase (addition) of travel as a result of population growth and other factors affecting the number of trips. In the analysis of the rise and pull in this plan year, it is assumed that it will increase by 2 percent each year. This is based on the Population Growth Rate in Paser Regency (Th. 2010 – 2020) of ± 1.75% per year, and the Motor Vehicle Growth Rate in Paser Regency (Th. 2015 – 2020) of ± 1.02% per year, as well as the Motor Vehicle Growth Rate in East Kalimantan Province (Th. 2015 – 2020) of ± 1.06% per year.

Based on the results of the analysis, it can be predicted that the rise and pull of travel as a result of the mobility of operational equipment of construction / project vehicles and the mobility of construction workers / projects as presented in **Table 9** below:

TABLE 9
PREDICTION OF ADDITIONAL RISE AND PULL OF CONSTRUCTION PERIOD TRAVEL

No	Vehicle Type	Vehicle Entry			Vehicle Exit		
		Sum	EMP	Volume (smp/hour)	Sum	EMP	Volume (smp/hour)
1	Construction Vehicles						
	a. Mixer Truck	2	2	4	2	2	4
	b. Big Trucks	2	1.3	3	2	1.3	3
	c. Medium Trucks	4	1.2	5	4	1.2	5
	d. Pick-up Cars	4	1	4	4	1	4
2	Construction Worker Vehicles						
	a. Vehicles	9	1	9	2	1	2
	b. motorbike	37	0.4	15	8	0.4	4
SUM		58		40	20		22

Source: Analysis Results, 2022

In the analysis of the rise and pull during the operational period is based on data on the number of Vehicles and Passengers In and Out of the Existing Terminal (Tepi Batang): Year 2027 (construction) = 19 smp / hour and In 2033 predicted to be = 24 smp / hour.

4.6 Road Section Performance Simulation

The results of simulated ride and pull of travel, travel distribution (Matrix OD), as well as the performance of road sections consisting of Degree of Saturation or V/C Ratio, Speed (V), and Level of Service in 2027 (Construction) are presented in the **Table 10, 11 dan 12**:

TABLE 10
THE RISE AND PULL OF THE YEAR JOURNEY 2027 (CONSTRUCTION)

Zone	Coverage Area	Rise (smp/hour)	Pull (smp/hour)	Calibration Results	
				Rise (smp/Jam)	Pull (smp/Jam)
1	Direction from/to Mako Brimob	149	126	151	125
2	Direction from/to Mtanah Grogot	551	683	556	677
3	Direction from/to Trans Janju	140	123	141	122
4	Direction from/to Kuaro	703	639	709	633
5	Terminal Location Plan	19	19	19	19
TOTAL		1563	1591	1577	1577

Source: Analysis Results, 2022

TABLE 11
OD MATRIX IN 2027 (CONSTRUCTION)

O/D	1	2	3	4	5	0i	Oi	Ei	Ai
1	0	92	3	55	1	151	151	1	0.00128
2	71	0	21	458	6	556	556	1	0.002899
3	3	28	0	110	1	141	141	1	0.00104
4	51	549	98	0	11	709	709	1	0.004031
5	1	7	1	11	0	19	19	1	0.001024
dd	125	677	122	633	19	1577			
Dd	125	677	122	633	19		1577		
Ed	1	1	1	1	1			1	
Bd	0.52146	1.046976	0.393833	1.654322	0.397368				

Source: Analysis Results, 2022

TABLE 12
ROAD SECTION PERFORMANCE IN 2027 (CONSTRUCTION)

No	Road Section Name	Type	C	Q	Q/C	LOS (1)	V	LOS (2)
1	Kuaro - Tanah Grogot street (1)	2/2UD	3024	1343	0.44	B	26.44	C
2	Kuaro - Tanah Grogot street (2)	2/2UD	3217	3217	0.37	B	27.58	C
3	Kuaro - Tanah Grogot street (3) direction of east	1-Feb	2668	2668	0.24	B	32.18	C
4	Kuaro - Tanah Grogot street (3) direction of west	1-Feb	2838	2838	0.19	A	33.96	C
5	Kuaro - Tanah Grogot street (4) direction of east	1-Feb	2895	2895	0.22	B	34.01	C
6	Kuaro - Tanah Grogot street (4) direction of west	1-Feb	2895	2895	0.19	A	34.3	C
7	Kuaro - Tanah Grogot street (5)	2/2UD	1783	1783	0.66	C	19.79	C
8	Kuaro - Tanah Grogot street (6) direction of north	1-Feb	2668	2668	0.21	B	32.45	C
9	Kuaro - Tanah Grogot street (6) direction of south	1-Feb	2895	2895	0.23	B	32.27	C
10	Pelopor street	2/2UD	1996	1996	0.14	A	22.98	C
11	Trans. Janju street	2/2UD	2494	2494	0.11	A	25.72	C

Source: Analysis Results, 2022

Based on the simulation, during the construction period (2027) the construction of the Paser Type B Passenger Terminal, it can be seen that the performance of the road section within the scope of the study area, is still in good condition, which is indicated by the highest Level of Service (LOS) being in LOS C, which means that traffic flow is still stable with a moderate level of density.

4.7 Simulated Intersection Performance

The results of the simulation of interchange performance in 2027 (Construction Period), where in the year of the plan, the traffic flow at the intersection has increased due to traffic growth is presented in Table 13 and Table 14 below:

TABLE 13
INTERCHANGE PELOPOR 1 (SIMPANG JANJU) 2027 (CONSTRUCTION PERIOD)

Traffic flow	Degree of Saturation	Travel Delays					Queuing Opportunities	Simpang Service Level
		Traffic	Main Street	Minor stresst	Geometric Roads	Interchange		
Q	DS	DT_1	DT_{MA}	DT_{MI}	DG	D	QP%	LOS
1423	**0.62**	**6,36**	**4,74**	**22.27**	**3.83**	**10.19**	**16.03-33.55**	**B**

Source: Analysis Results, 2022

TABLE 14
INTERCHANGE PELOPOR 2 (SIMPANG PELOPOR) 2027 (CONSTRUCTION PERIOD)

Traffic flow	Degree of Saturation	Travel Delays					Queuing Opportunities	Simpang Service Level
		Traffic	Main Street	Minor stresst	Geometric Roads	Interchange		
Q	DS	DT_1	DT_{MA}	DT_{MI}	DG	D	QP%	LOS
1378	**0.4**	**4.08**	**3.05**	**12.67**	**3.83**	**7.91**	**7.58 - 18.75**	**B**

Source: Analysis Results, 2022

Based on the results of the analysis above, it is known that the Saturation Degree (DS) is 0.62 and the Delay is 10.19 seconds / smp, so it is included in the LOS B category which indicates that the condition of Simpang JANJU / Simpang 1 traffic flow is still stable and there are only a few obstacles. Likewise, intersection 2 resulting in a Saturation Degree (DS) value is 0.40 and the Delay is 7.91 seconds / smp, so it is included in the LOS B category, which indicates that the condition of Simpang PIONEER / Simpang 2 traffic flow is still stable and there are few obstacles.

V. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of the analysis and discussion it can be concluded as follows:

1. Based on Law number 22 of 2009 article 99 paragraph 1 it states that "Every plan for the development of activity centers, settlements and infrastructure that will cause disturbances to security, safety, order and the smooth running of traffic and road transportation must be carried out a traffic impact analysis".
2. Based on Minister of Transportation Regulation No. 17 of 2021 it is stated that the construction of the type B terminal in Paser Regency is in the medium generation category.
3. The results on the performance of the sections and the performance of the intersections around the terminal construction site, do not show a significant level of traffic disturbance, meaning that it is only necessary to regulate the circulation of project vehicles carrying out activities in the field with recommendations from the results of the Andalanin assessment. This can be seen from the calculation of the existing LOS and LOS Construction results in the LOS C category and the intersection performance of the existing LOS B condition is the same as the calculation results during the construction period which shows the value of LOS B as well.

5.2 Suggestion

With an estimate of the impact of problems that will occur during the construction period, the steps for prevention or handling are as follows:

1. Closing the project area with a closed fence, so that construction activities are not visible from the outside, apart from for security purposes it can also avoid the attention of motorists or drivers due to slowing down the vehicle.
2. Mobilization of heavy equipment (such as: Machinery *Bored Pile*, *Hydraulic Static Pile Driver* (HSPD), *Tower Crane*, *Concrete Pump*, *Mobile Crane*, *Escavator*, dll), it is advisable to enter or go to the work location at night, with the escort of traffic officers;
3. Install road safety facilities in the project activity area.
4. Assign special officers to guide vehicles in and out, with standard equipment, namely brightly colored vests and traffic flashlights.
5. The transportation of project materials is carried out by covering the tarpaulin and tying it properly, so that the project material does not spill onto the road.
6. Provide a place to clean material vehicle tires in the project area.
7. Create a security post to monitor project activities and the surrounding environment.
8. Repairing roads around the construction site that were damaged due to the process of transporting materials (construction) during the construction process.
9. Install CCTV cameras at strategic project locations to monitor field activities for security both inside and outside the project.

Use a fixed road network to route land transport vehicles by coordinating with the authorized agency/officer in advance.

REFERENCES

[1] Anonim, 1996. Transportation Planning, LPM ITB in collaboration with KBK Transportation Engineering, ITB, Bandung.
[2] Anonim, 1997. Indonesian Road Capacity Manual (MKJI), Directorate General of Highways, Ministry of Public Works, Jakarta
[3] Anonim, 1997. Transportation System Modeling, LPM ITB in collaboration with KBK Transportation Engineering, ITB, Bandung.

[4] Dikun, S. and Arief, D., 1993. Strategy for Solving Building Area and Traffic Problems, Seminar Materials Impact of land use intensity of tall buildings/Superblocks in Jakarta on the surrounding traffic, Taruma Negara University in collaboration with the Government of DKI Jakarta.

[5] Josef Sumajouw., 2013. Traffic Impact Analysis (Andalalin) Sam Ratulangi University Campus Area, MEDIA ENGINEERING Scientific Journal Vol. 3, No. 2, July 2013 ISSN 2087-9334 (133-143).

[6] Morlok E. K., 1991. Introduction to Transportation Engineering and Planning, Erlangga Publisher, Jakarta

[7] Murwono., 2003. Transportation Planning, Jakarta : Erlangga

[8] Ortuzar and Williumsen, 1990. Modelling Transport, John Willey & Sons Ltd, England.

[9] Minister of Transportation Regulation No 17 of 2021, regarding the Implementation of a Traffic Impact Analysis, Jakarta

[10] Rio Declaration on Environment and Development., www.cbd.int, 3 November 2006.

[11] Tanti, Y., 2018. Study of the Relationship Between Volume, Speed and Density on Jalan Slamet Riyadi Samarinda. *KURVA MAHASISWA*, *1*(1), 945-953.

[12] Law number 22 of 2009, concerning Road Traffic and Transportation, Jakarta

[13] Tamin Ofyar, Z. 2000. Transport Planning and Modeling, Second Edition. ITB Bandung

Route and Flight Schedule at the Airport Hub in East Kalimantan Province with MADAM

Tukimun

Department of Civil Engineering, 17 Agustus 1945 University, Indonesia

Received: 08 December 2022/ Revised: 15 December 2022/ Accepted: 20 December 2022/ Published: 31-12-2022

Abstract— *Arrangements for routes and flight schedules are needed to provide effective and efficient services to passengers using air transportation services, especially in metropolitan areas with two or more airports. The concept is known as the Multi Airport System, which provides the following advantages: (1) reducing density at primary airports while increasing the capacity of regional air transportation systems. (2) Maintaining the quality of services, especially in primary airports, breaks down and reduces the effects of disruptions that may occur in airport operations. (3) Providing alternative travel options for people in the metropolis to minimize the distance and travel time to the airport. (4) Generating economic activities in the surrounding area, such as increased employment, tax revenue, attracting new companies, and others. (5) Reducing the impact of a service monopoly which could appear at any time in a single airport system. The research finds differences in flight frequencies between exiting conditions and simulation at SAMS airport of Sepinggan Balikpapan by using the Multiple Airport Demand Allocation Model (MADAM). In the existing conditions, it is found that there is 82 flights/day while the simulation results show 86 flights/day. There is an error of 4.9%, which means that the frequency of flights needs to be increased four times. Whereas at the APT airport. Pranoto, there is no difference between existing routes and schedules and the simulation results, which are 20 flights/day. It means that in terms of both the landside and airside, the capacity is optimum. Also, the simulation results of the movement of passengers to the APT. Pranoto Airport and SAMS. Sepinggan Airport Balikpapan shows the movement of 176 passengers from the APT. Pranoto Airport to SAMS Sepinggan Airport of Balikpapan. There are several passengers at APT. Pranoto cannot be transported according to route modeling and flight schedules due to the airport's overload capacity.*

Keywords— Airport Hub, MADAM, East Province.

I. INTRODUCTION

East Kalimantan Province is the fourth largest province in Indonesia, with an area of 127,346.92 km2. In general, topographic conditions in East Kalimantan are hilly with altitudes ranging from 0-2,500 meters above sea level. Astronomically, East Kalimantan (East Kalimantan) is located between 1130 35'31 "- 1190 12'48" East and 20 34'23 "LU - 20 44'14" LS. Based on the results of the 2010 Population Census (SP), the total population in East Kalimantan was 3,047,479 inhabitants. The projected population of East Kalimantan was 3,575,449 people, with a male population percentage of 52.44 percent in 2017. The population growth rate in East Kalimantan in 2017 was 2.12 percent per year (BPS East Kalimantan, 2019) [3].

As a province that has a hilly topography, the mode of air transportation plays an important role in connecting transportation access from one region to another. Determination of candidates for the State Capital in the Province of East Kalimantan has a very significant impact on the air transportation sector in supporting flight operations.

East Kalimantan Province has 12 airports spread across several areas, including three airport hubs, namely AM Airport. Sulaiman Sepinggan (BPN) in Balikpapan, APT. Pranoto Airport (SRI) Sei Siring in Samarinda, and Kalimarau Airport (BEJ) in Berau. BPN and SRI are located in big cities (metropolitan), namely Balikpapan, as an industrial city, and Samarinda, as the Provincial Capital, with a distance of ± 100 Km. Both towns have hinterlands that intersect, causing prospective aircraft passengers to choose which airports can fly them to their destinations (O-D).

The presence of the new capital of the country that is located between the two hub airports will increase the competition between the two airports, especially in serving the same potential routes as Jakarta, Surabaya, Makassar, and Jogjakarta. It is

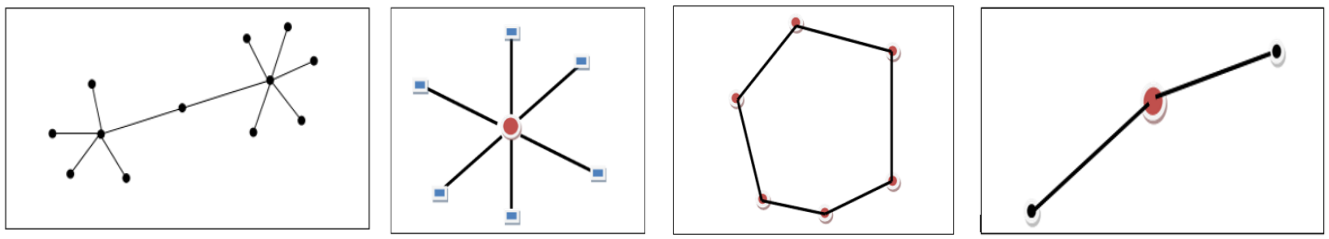
necessary to arrange the routes and flight schedules at the two hub airports using the Multiple Airport Demand Allocation Model (MADAM) to overcome the problems.

II. LITERATURE REVIEW

According to Law No. 1 of 2009, regarding Aviation, Airports are land areas and waters with certain limits that are used as airplanes to land and take off, passenger boarding and unloading, loading, and unloading of goods, and places of transfer between modes of transportation. The airport is also equipped with aviation safety and security facilities, basic facilities, and other supporting facilities. [9]

The air transportation network system consists of airport arrangements and air space for flight. Airport arrangements include of public airports and special airports. Whereas air space consists of air space above the airport, which is used directly for airport activities, air space around the airport, which is used for flight operations, and air space determined as flight path/route. (Adisamita, 2014) [2]

The determination of the form of the flight network route pattern is done to provide an efficient and effective way of the route network. The current domestic flight network is still a combination of hub and spoke patterns, grip patterns, line patterns, and combined patterns. (Adisamita, 2011) [1].



(a) **(b)** **(c)** **(d)**

FIGURE 1: Pattern of Flight network route (Adisamita, 2011)

Flight Schedule is a flight that is carried out regularly with fixed routes and schedules. Usually, guardianship is related to the allocation of existing resources over a certain period. (Pinedo, 2002) [5]

To accelerate regional / island growth through enhancing the role of the Urban/Metropolitan National Strategic Area, the Indonesian government established the Metropolitan Area through Government Regulation of the Republic of Indonesia Number 13 of 2017, concerning Amendment to Government Regulation Number 26 of 2008, concerning National Spatial Planning. The Metropolitan area is an urban area consisting of a single, independent urban area, or a core urban area with a surrounding urban area with functional interconnections. The area is linked to an integrated regional infrastructure network system, with a total population of at least 1,000,000 (one million) people. There are 13 metropolitan areas determined by the Indonesian government, one of which is the Metropolitan Area in East Kalimantan Province, which includes the Balikpapan-Tenggarong-Samarinda-Bontang Metropolitan Areas. [6]

Multi Airport System is a collection of airports that serve air traffic in a metropolitan area, two or more airports can provide services in an urban area. (De Neufville, 1995) [4].

The application of a multi-airport system has several advantages, including (1) reducing density at primary airports while increasing the capacity of regional air transportation systems. (2) Maintaining the quality of service, especially in primary airports, breaks down and reduces the effects of disruptions that may occur in airport operations. (3) Providing alternative travel options for people in the metropolis can reduce the distance and travel time to the airport. (4) Generating economic activities in the surrounding area, such as increasing employment, tax revenue, attracting new companies, and others. (5) Reducing the impact of a service monopoly which could appear at any time in a single airport system.

III. RESEARCH METHOD

Analysis of route settings and flight scheduling is done by using the Multiple Airport Demand Allocation Model (MADAM).

The research flowchart is as follows:

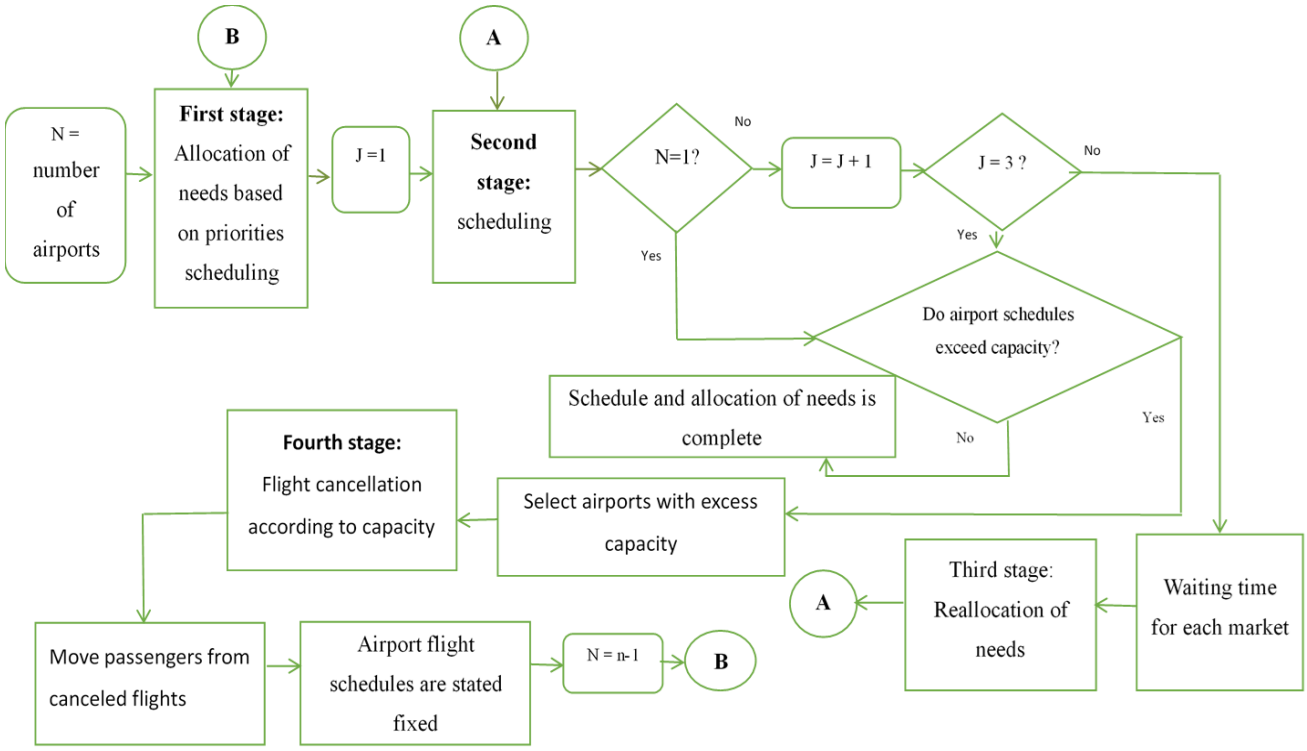


FIGURE 2: RESEARCH FLOW CHART

IV. RESULTS AND DISCUSSION

4.1 Research Data

The Province of East Kalimantan consists of 12 cities. A code is given to each region to simplify the simulation. Regions and codes in the Province of East Kalimantan can be seen in the following table:

TABLE 1
REGIONAL DIVISIONS

No	City	Code
1	Samarinda	501
2	Balikpapan	502
3	Samboja	503
4	Penajam	504
5	IKN	505
6	Tanjung Redep	506
7	Sangatta	507
8	Tenggarong	508
9	Melak	509
10	Bontang	510
11	Tanah Grogot	511
12	Wahau	512

Source: GIS data processing

Of the 13 Metropolitan Areas established by the Indonesian government, one of them is the Metropolitan Area in East Kalimantan Province, which includes the Balikpapan-Tenggarong-Samarinda-Bontang Metropolitan Area. There are two hub

airports in the metropolitan area, namely SAMS Sepinggan Airport Balikpapan and APT Pranoto Airport. To model routes and flight schedules with the concept of a multi-airport system, distance data between regions and the two Hub airports are needed.

TABLE 2
REGIONAL DIVISIONS

No	City	APT Pranoto SMD Airport (KM)	SAMS Balikpapan Airport (KM)
1	Samarinda	23.9	115
2	Balikpapan	132	11.4
3	Samboja	108	46.6
4	Penajam	183	30.7
5	IKN	151	104
6	Tanjung Redep	497	629
7	Sangatta	143	278
8	Tenggarong	52.7	139
9	Melak	348	433
10	Bontang	95	228
11	Tanah Grogot	319	203
12	Wahau	296	429

Source: GIS data processing

4.2 Flight Schedule Modeling

From flight data at the airport of APT. Pranoto Airport, researchers took data in the largest month of December 2019. The departure passengers were 32,356 people with the aircraft movements of 300 times. The number of passengers per day is 1,079 people, with the flow of planes per day is ten times.

The flight data at the airport of SAMS Sepinggan Airport Balikpapan, taken in November 2019, showed the departure passengers of 191,399 people, with the aircraft movements of 2,442 times. There were 6,380 passengers per day, with the flight movement per day of 82 times.

The data above is used in simulating flight modeling and flight schedules using the Multiple Airport Demand Allocation Model (MADAM).

Data on flight routes available at APT Pranoto Airport and SAMS Sepinggan Airport Balikpapan is needed to model flight schedules. The flight routes at the two airports are coded in the form of numbers to simplify each flight route's modeling.

TABLE 3
FLIGHT ROUTES OF APT PRANOTO AIRPORT SAMARINDA

No	Flight Route	Code
1	Jakarta (CGK)	1
2	Jakarta (HLP)	2
3	Surabaya (SUB)	3
4	Makasar (UPG)	4
5	Denpasar (DPS)	5
6	Yogyakarta (YIA)	6
7	Kalimarau Berau (BEJ)	12
8	Tanjung Selor (TJS)	17
9	Melak/Melahan (GHS)	19

Source: APT Pranoto Airport Authority

The flight routes are domestic and regularly scheduled routes. The aircraft types used are ATR72, CRJ1000, B734, B735, B738, B739, and A320.

TABLE 4
SAMS. SEPINGGAN AIRPORT BALIKPAPAN FLIGHT ROUTES

No	Flight Routes	Code
1	Jakarta (CGK)	1
2	Jakarta (HLP)	2
3	Surabaya (SUB)	3
4	Makasar (UPG)	4
5	Denpasar (DPS)	5
6	Yogyakarta (YIA)	6
7	Manado (MDC)	7
8	Semarang (SRG)	8
9	Banjarmasin (BDJ)	9
10	Tarakan (TRK)	10
11	Palangkaraya (PKY)	11
12	Kalimarau Berau (BEJ)	12
13	Pontianak (PNK)	13
14	Palu (PLW)	14
15	Banyuwangi (BWX)	15
16	Kertajati (KJT)	16
17	Tanjung Selor (TJS)	17
18	Mamuju (MJU)	18
19	Melak/Melahan (GHS)	19
20	Malinau (LNU)	20

Source: SAMS. Sepinggan Airport Balikpapan Authority

Flight frequency data obtained from airport authorities at APT. Pranoto Airport Samarinda and SAMS. Sepinggan Airport Balikpapan is as follows:

TABLE 5
FLIGHT FREQUENCY OF SAMS. SEPINGGAN AIRPORT BALIKPAPAN

No	Flight Route	Frequency
1	Jakarta (CGK)	19
2	Jakarta (HLP)	
3	Surabaya (SUB)	11
4	Makasar (UPG)	8
5	Denpasar (DPS)	1
6	Yogyakarta (YIA)	5
7	Manado (MDC)	1
8	Semarang (SRG)	1
9	Banjarmasin (BDJ)	7
10	Tarakan (TRK)	6
11	Palangkaraya (PKY)	2
12	Kalimarau Berau (BEJ)	9
13	Pontianak (PNK)	1
14	Palu (PLW)	3
15	Banyuwangi (BWX)	1
16	Kertajati (KJT)	1
17	Tanjung Selor (TJS)	1
18	Mamuju (MJU)	1
19	Melak/Melahan (GHS)	3
20	Malinau (LNU)	1

Source: SAMS. Sepinggan Airport Balikpapan Authority

TABLE 6
FLIGHT FREQUENCY OF SAMS. SEPINGGAN AIRPORT BALIKPAPAN

No	Flight Route	Frequency
1	Jakarta (CGK)	7
2	Jakarta (HLP)	
3	Surabaya (SUB)	4
4	Makasar (UPG)	1
5	Denpasar (DPS)	1
6	Yogyakarta (YIA)	3
12	Kalimarau Berau (BEJ)	2
17	Tanjung Selor (TJS)	1
19	Melak/Melahan (GHS)	1

Source: APT Pranoto Airport Authority

4.3 Modeling limits

In modeling flight schedules, it is important to consider the limits of both airports, namely the maximum number of aircraft movements per hour, flight service hours, load factors, and the departure terminal capacity.

TABLE 7
MODELING LIMITS

No	Limits	APT Pranoto Airport	SAMS Sepinggan Airport Balikpapan
1	Flight movement	7 times	10 times
2	Airport operations	15 hours	15 hours
3	Load factor	40%	40%
4	Departure terminal capacity	500 people	1405 people

Source: Secondary data & interviews

4.4 Simulation Results

Simulation results of the modeling of data and limitation criteria at APT. Pranoto Airport Samarinda and SAMS. Sepinggan Airport Balikpapan, by using the Multiple Airport Demand Allocation Model (MADAM) shows the following results:

TABLE 8
SIMULATION RESULTS OF ROUTE MODELING AND NUMBER OF FLIGHTS AT APT PRANOTO AIRPORT SAMARINDA

No	Flight Route	Flight Route	
		Existing	Simulation
1	Jakarta (CGK)	7	7
2	Jakarta (HLP)		
3	Surabaya (SUB)	4	4
4	Makasar (UPG)	1	1
5	Denpasar (DPS)	1	1
6	Yogyakarta (YIA)	3	3
12	Kalimarau Berau (BEJ)	2	2
17	Tanjung Selor (TJS)	1	1
19	Melak/Melahan (GHS)	1	1

Source: data processing

The simulation results with MADAM show no differences in the frequency of flights between the existing conditions and the simulation results of 20 flights/day. It means that in terms of both the landside and airside capacity, the capacity is optimum. The condition allows the transfer of passengers from APT Pranoto Airport Samarinda to SAMS. Sepinggan Airport Balikpapan.

TABLE 9
SIMULATION RESULTS OF ROUTE AND NUMBER OF FLIGHT MODELING AT SAMS. SEPINGGAN AIRPORT BALIKPAPAN

No	Rute Penerbangan	Flight Frequency	
		Existing	Simulation
1	Jakarta (CGK)	19	17
2	Jakarta (HLP)		2
3	Surabaya (SUB)	11	10
4	Makasar (UPG)	8	8
5	Denpasar (DPS)	1	1
6	Yogyakarta (YIA)	5	5
7	Manado (MDC)	1	1
8	Semarang (SRG)	1	1
9	Banjarmasin (BDJ)	7	7
10	Tarakan (TRK)	6	6
11	Palangkaraya (PKY)	2	2
12	Kalimarau Berau (BEJ)	9	9
13	Pontianak (PNK)	1	1
14	Palu (PLW)	3	4
15	Banyuwangi (BWX)	1	1
16	Kertajati (KJT)	1	1
17	Tanjung Selor (TJS)	1	2
18	Mamuju (MJU)	1	2
19	Melak/Melahan (GHS)	3	4
20	Malinau (LNU)	1	2

Source: data processing

The simulation results with MADAM show that there are differences in the frequency of flights between the existing conditions and the simulation results. There are 82 flights in the current circumstances. Meanwhile, the simulation results show 86 flights/day. There is an error of 4.9%, which means that there is a need to add four more frequencies.

The movement of passengers to both airports shows the combined simulation results as follows:

TABLE 10
THE RESULTS OF A SIMULATION OF PASSENGER MOVEMENTS

No	Simulation Data	Balikpapan Airport			APT Pranoto Airport		
		Fixed (people)	Move (people)	Traveling time (minute)	Tetap (people)	Berpindah (people)	Traveling time (minute)
1	Existing Data	6400	0	35.3	924	176	37.9

Source: data processing

The above table shows the movement of 176 passengers from the APT. Pranoto Airport to SAMS Sepinggan Airport Balikpapan. Several passengers in the APT. Pranoto Airport could not be transported, according to existing flight modeling and flight schedules, due to the overload capacity of the airport.

V. CONCLUSION

The research finds differences in flight frequencies between exiting conditions and simulation at SAMS airport of Sepinggan Balikpapan by using the Multiple Airport Demand Allocation Model (MADAM). In the existing conditions, it is found that there is 82 flights/day while the simulation results show 86 flights/day. There is an error of 4.9%, which means that the

frequency of flights needs to be increased four times. Whereas at the APT airport. Pranoto, there is no difference between existing routes and schedules and the simulation results, which are 20 flights/day. It means that in terms of both the landside and airside, the capacity is optimum. Also, the simulation results of the movement of passengers to the APT. Pranoto Airport and SAMS. Sepinggan Airport Balikpapan shows the movement of 176 passengers from the APT. Pranoto Airport to SAMS Sepinggan Airport of Balikpapan. There are several passengers at APT. Pranoto cannot be transported according to route modeling and flight schedules due to the airport's overload capacity.

RECOMMENDATIONS

1. Further research needs to be done by simulating a model for forecasting the number of passengers to the ultimate capacity condition by including central issues, such as the new national capital.
2. Evaluate the airport's capacity and flight schedules for route management with the concept of a multi-airport system.

ACKNOWLEDGEMENTS

Thanks to all those who helped in this research, especially to fellow lecturers at the University of 17 August 1945 Samarinda.

REFERENCES

[1] Adisasmita, S.A., 2011, The Network of Transportation Theory and Analysis, First Edition. Yogyakarta: Graha Science.
[2] Adisasmita, S.A., 2014), Airport Arrangement, First Edition. Yogyakarta: Graha Science.
[3] BPS Kaltim, 2019, East Kalimantan in the Numbers, Indonesia
[4] De Neufville, 1995, Management of multi-airport systems: A development strategy, Elsevier
[5] Pinedo, Michael., 2002, Scheduling Theory, Algorithms, and System, Third Edition. New York: Prentice Hall, Inc.
[6] Government Regulation of the Republic of Indonesia Number 13 of 2017 concerning National Spatial Planning, Indonesia
[7] Minister of Transportation Regulation No. 69 of 2013 concerning National Airport Order, Indonesia
[8] Taaffe, EJ, Gauthier, HL & O'Kelly ME., 1996, Geography of Transportation (2nd ed), New Jersey: Prentice-Hall
[9] Law of the Republic of Indonesia No. 1 of 2009 concerning Aviation, Indonesia.

AD Publications
Sector-3, MP Nagar, Bikaner,
Rajasthan, India
www.adpublications.org, info@adpublications.org