UNTAR Universitas Tarumanagara | MASSEY UNIVERSITY | UTHM Universiti Tun Hussein Onn Malaysia | fib Indonesia | Unika SOEGIJAPRANATA | UNS Universitas Sebelas Maret

2021 ICCIM

THE SECOND INTERNATIONAL CONFERENCE OF CONSTRUCTION, INFRASTRUCTURE, AND MATERIALS

CERTIFICATE

IS PROUDLY PRESENTED TO

Sunarjo Leman

IN RECOGNITION OF VALUABLE CONTRIBUTION AS THE AUTHOR OF

Analysis of Hollow Concrete Column with CFRP Wrapping Using Finite Element Method

26th July 2021
Universitas Tarumanagara
Jakarta - Indonesia

Dean of the Faculty of Engineering
Universitas Tarumanagara

UNIVERSITAS TARUMANAGARA DEKAN FAKULTAS TEKNIK

Harto Tanujaya, S.T., M.T., Ph.D.

Analysis of Hollow Concrete Column with CFRP Wrapping Using Finite Element Method

William Supardjo[1][0000-1111-2222-3333] and Sunarjo Leman[2][1111-2222-3333-4444]

[1] Undergraduate of Civil engineering Study Program, Tarumanagara University, Jl. Letjen S. Parman No.1 Jakarta
[2] Lecturer of Undergraduate Civil Engineering Study Program, Tarumanagara University, Jl. Letjen S. Parman No.1 Jakarta
williamsupardjo@gmail.com

Abstract. The use of concrete in construction is very common even though there are several problems such as structure massive self-weight and it causes the increment of the seismic load carried by structure. Therefore, engineers usually prefer the use of hollow cross-section in reinforced concrete since it gives higher structural efficiency. This research was done to analyze Hollow Concrete Column (HCC) using finite element method with the help of MIDAS FEA application to obtain an efficient and effective model ratio between the hollow-core variation which use CFRP (Carbon Fiber Reinforced Polymer) as wrapping. The analysis result shows that for the solid cross-section sample, the use of CFRP correlates to the needs of force resistance because the effectivity curve shows that the line intersects with one another at some variety of eccentricity. It also shows even though the effectivity *increases with* the increment of the hollow ratio, there is a capacity reduction of +5.5% for each 5% increment. From the analysis, it shows that the effectivity of the sample with CFRP wrapping exceeds the solid conventional sample where the best ratio is 30%.

Keywords: Carbon Fiber Reinforced Polymer, Hollow Concrete Column, Finite Element Method

1 Introduction

Part of vertical structure which function is to support axial load either with or without a moment is called a column [1]. The use of concrete in construction is very common even though there is some problem especially the massive self-weight that will affect the seismic load carried by structure. It can be illustrated with basic physics theory (F = m.a) which shows that forces will increase along with the increment of masses [1].

Since such a problem has arisen, the use of hollow cross-section has become more preferable in construction because it will give a better structural efficiency from the power or stiffness to masses ratio point of view [2]. Hollow Concrete Columns (HCCs) is one of the main choices in civil construction including bridge pile with expectation in reducing the overall weight and the cost since there will be less use of concrete in the column and pile construction [3]. Although the benefit of using HCC

has been explained, it has not been used extensively in seismic design practice because there is still not enough understanding about the confinement behavior and design guide [4].

This research was initiated to analyze the HCC using finite element method to obtain an effective and efficient ratio among variation of hollow-core with CFRP (Carbon Fiber Reinforced Polymer) as a wrapping and hopefully by using CFRP wrapping on the outside can gives better performance even though there is a hollow-core. Hence, the observed force in this paper will strictly be axial and moment only, the main purpose was to achieve maximum volume reduction with a minimum capacity decrease to produce higher sample effectivity than a conventional column. The effectivity mentioned in this paper will be about the ratio between the column whether moment or axial compared to the volume. The greater the ratio the better effectivity it will have since it will have less concrete but same capacity. The result hopefully also could be an additional literature in HCC practice application.

To predict and validate the result from MIDAS FEA, there will be a manual calculation to make a column interaction diagram as a method of approach for the tested samples which was based on the guidance in ACI 318-14 [5] and ACI 440 2R-17. For validation purposes as shown in Fig.1, only 3 conditions in the manual interaction diagram that corresponded with the compression-controlled failure will be used [6].

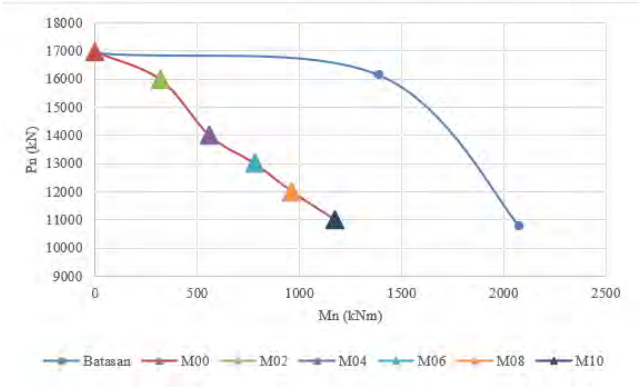


Fig. 1. Manual vs MIDAS strength analysis result comparison example

1.1 FRP (Fiber Reinforced Polymer)

Fiber Reinforced Polymer (FRP) is a composite-based material that was made with polymer matrix and strengthened by using fiber. Generally, fiber can be glass, carbon, or aramid even though another fiber sometimes being used such as paper, wood, or even asbestos. The commonly used polymer is epoxy, vinyl ester, or polyester thermosetting plastic, and phenol-formaldehyde resins. FRP applications are common in several industries such as aerospace, automotive, marine, and construction industries [7].

The reason this material very popular as a construction retrofitting option is a significantly higher addition in strength, especially in tension. Because as we all know,

concrete is very vulnerable to tension. The tension strength possessed by this material is very high around 20 - 100% higher or even more depends on the material properties. Table 1 shows that FRP has a relatively higher tensile strength depends on the fiber content in the FRP and Table 2 shows that carbon has better strength than others.

2 Research Methodology

2.1 Specimen ID

There are total of 7 specimen that will be tested and each one of them will have a unique ID to differentiate them from one another as shown in Fig. 2. The first sample will be SK which stands for Solid Conventional Column with Steel rebar. The rest of the sample will be a variation of HW which stands for Hollow Column with CFRP Wrapping. So, there will be 6 variations of HW and will be labeled by number such as HW, HW-1, HW-2, HW-3, HW-4, and HW-5. The number will represent the increment of 5% hollow-core ratio from a solid cross section.

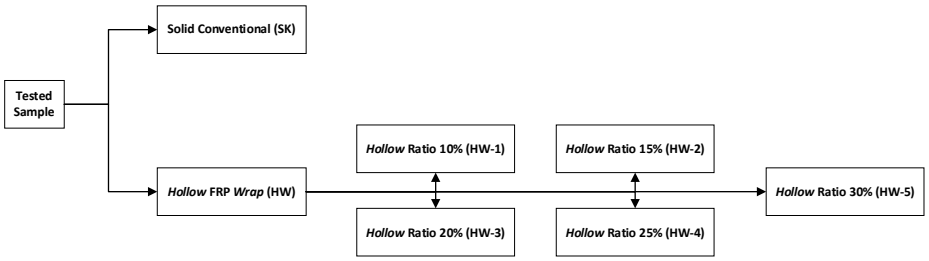


Fig. 2. Specimen ID Diagram

2.2 Properties Specification

The sample was modeled with 35 MPa of concrete compressive strength specification, 850 mm of outside diameter, and 4200 mm length. Conventional concrete with a solid cross-section and steel rebar (SK) is used as the control sample. It was modeled using rebar with 400 MPa yield strength and 550 MPa ultimate strength. As for the sample with CFRP wrapping (SW & HW), it was modeled with a 966 MPa tensile strength and 66190 MPa modulus of elasticity specification.

2.3 MIDAS FEA Modelling

Structural Geometry Modelling. Column modelling used the solid element for the concrete, 3D line element to make the rebar, and shell element in modelling the CFRP Wrapping.

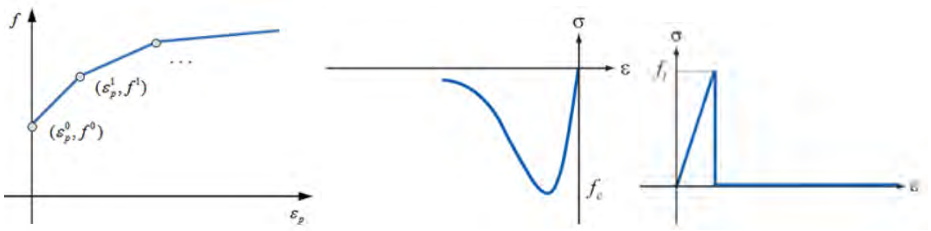
Table 1. Composite and steel tension strength comparison [8]

No.	Properties	Fiber Glass	Tensile Strength	
	Unit	%	10^3 psi	Mpa
	Test Method	D790	D638	
A.	Fiber Reinforced Thermoset			
1	Polyester (Pultrusion)	22	30	206.85
2	Polyester (Woven Roving)	50	37	255.115
3	Epoxy (Filament Winding)	80	80	551.6
B.	Fiber Reinforced Thermoplas			
1	Polypropylene	20	6.5	44.8175
2	Nylon 6	30	23	158.585
3	Polycarbonate	10	12	82.74
C.	Metal			
1	ASTM A-606 HSLA Cold Rolled Steel	-	65	448.175
2	AISI 304 Stainless Steel	-	80	551.6
3	2036-T4 Wrought Alumunium	-	49	337.855

Table 2. Basic material strength comparison [9]

	Glass Profile	Carbon Profile	Steel	Alumunium	PVC	Wood
Density (kg/m^3)	2100	1650	7900	2700	1380	520
Flexural Strength (MPa)	1000-1400	1400-2500	400-1200	180	44	150
Flexural Modulus (GPa)	45-56	120-300	196	70	2.4	10
Tensile Strength (MPa)	1000-1400	1400	400-1200	180	70	100
Tensile Modulus (GPa)	45	140	196	70	2.4	9
Thermal Conductivity (w/m.k)	0.5	1.4	47	209	0.24	0.47
Coefficient of linear thermal expansion (1/k)	10^{-5}	-0.2×10^{-6}	10^{-5}	2.3×10^{-5}	10	10
Specific heat Capacity (J/kg.K)	1880	950	461	921	1100	1700

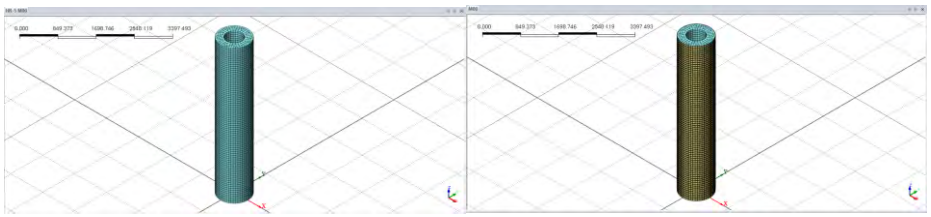
Material Modelling and Its Function. Every structural geometry that was made will have a different material and function. For rebar and CFRP Wrapping, hardening function was used and the parameter will be manually inputted such as material yield and ultimate strength according to the factory specification. For concrete, total strain crack function will be used. For the compressive behavior, the Thorenfeldt function was used. As for the tensile behavior, the brittle function was used.



[a] [b] [c]

Fig. 3. Material function [a] Rebar Hardening [b] Concrete Compression (Thorenfeldt) [c] Concrete Tension (Brittle)

Model Meshing. After all the structural and material modelling was done, then meshing needed to be done in order to merge the modelled geometry and material into 1 element.

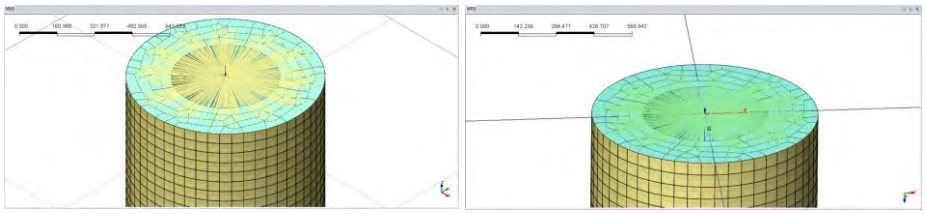


[a] [b]

Fig. 4. MIDAS FEA meshing view for [a] concrete and rebar; [b] CFRP Wrapping

Interface Modelling. Interface was needed in modelling the CFRP wrapping because the bonding between the wrapping and concrete must be made so that the condition can represent the real-time condition which the wrapping will give an effect to the structure and became one unity with the concrete. Interface was modelled using rigid parameter because it was assumed to have a perfect bonding between the CFRP and concrete.

Constraint and Load Modelling. Constraint and load were modelled using the help of rigid link option where it will made only 1 joint that is needed to be put load and constraint since it will represent the whole surface is loaded and can support the load evenly.



[a] [b]

Fig. 5. MIDAS FEA load view [a] and constraint view [b] with rigid link

Determining The Analysis Case. Analysis case needed to be set so the app will analyze the sample with nonlinear analysis. In analysis case, we also need to choose the iteration model and in this case the Newton-Raphson iteration was used. The number of load step and iteration can also be adjusted to obtain the best result.

Solving The Model. After all the structural modelling and analysis control was done, then everything is set to be analyzed using the solving option in MIDAS FEA. After the option was run, the app will analyze the sample using finite element method and produce the needed output

2.4 Data Compilation

Data were obtained using the MIDAS FEA application that calculates the crack and displacement pattern of nonlinear analysis with the finite element method. The load step and eccentricity which caused a reasonable crack pattern will be taken as the axial and moment value for analysis. Then the value will be divided with the sample volume so the ratio of axial to force and moment to force will be obtained. From the ratio comparison, it will show which sample gives the best ratio effectivity.

3 Analysis and Discussion

3.1 Solid Cross Section Column

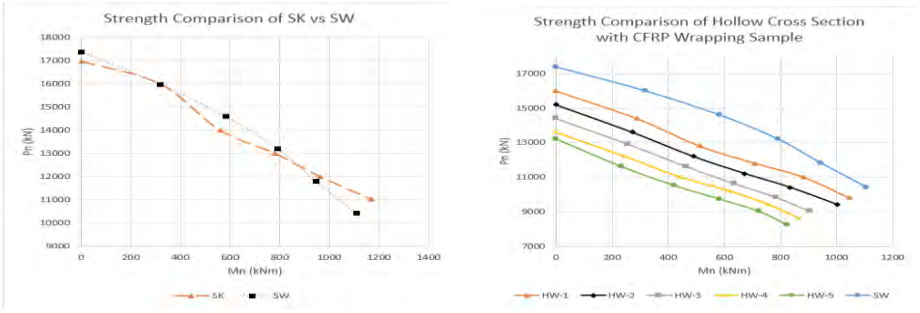
Based on the result comparison between all three of the solid cross-section sample as shown in Fig. 6a, it shows that the sample that has a good decreasing consistency in strength is SW and excels in several conditions as the moment increase but shows that it underperformed in strength especially when the sample was applied with the biggest moment. The sample which has the biggest strength when tested with the biggest eccentricity was SK.

From this result, it shows that sample selection to be used in construction practice depend on the force that needs to be carried by the element because SK will be the best choice if the carried moment and axial compression was above 900 kNm and under 12000 kN. But besides these two conditions, SW will be the best choice available.

3.2 Hollow Cross Section Column with CFRP Wrapping

The result shows that there are decreases in strength along with the increment of hollow-core ratio as shown in Fig. 6b. The decrease in strength has already been anticipated since the net cross-section area will decrease along with the increment of the hollow-core ratio. This statement is given based on the P-M Curve calculation theory.

The decrease in strength is not that big of a problem since what needs to be checked further is the strength to volume ratio (Effectivity Ratio). The checking was done to know whether a certain hollow-core sample effectivity can give a result that differs from a downward trend referring to P-M Curve theory.



[a] [b]

Fig. 6. Strength comparison of [a] SK vs SW; [b] Hollow cross section with CFRP wrapping sample

3.3 Sample Effeectivity

As shown in Fig. 7 and Fig. 8 it was obtained that HW gives a similar effectivity ratio with the SK from the 10-15% hollow-core ratio. When it was 20-25%, the effectivity slowly surpassing the SK effectivity and finally, at the 30% hollow-core ratio it shows that the HR effectivity surpasses the SK effectivity by + 7%.

4 Conclusion

Based on the modeling and analysis done with the MIDAS FEA application, the conclusion was:

1. It shows that there is a decrease in strength as big as + 5.5% for every 5% hollow ratio increment.
2. From the analysis result, it shows that the best hollow core ratio is 30%. It is because even though the sample experiencing a decrease in strength along with the hollow ratio increment, the sample effectivity increases both in axial and moment capacity,
3. The analysis result shows that none of the hollow samples with CFRP wrapping can give a higher strength compare to SK (Solid conventional sample with steel rebar).

4. From an effectivity point of view, it shows that there is some variation of HW which have an effectivity that exceeds SK.
5. MIDAS FEA application able to simulates crack pattern step by step from initial loading until it reaches collapse state as shown in Fig. 9.

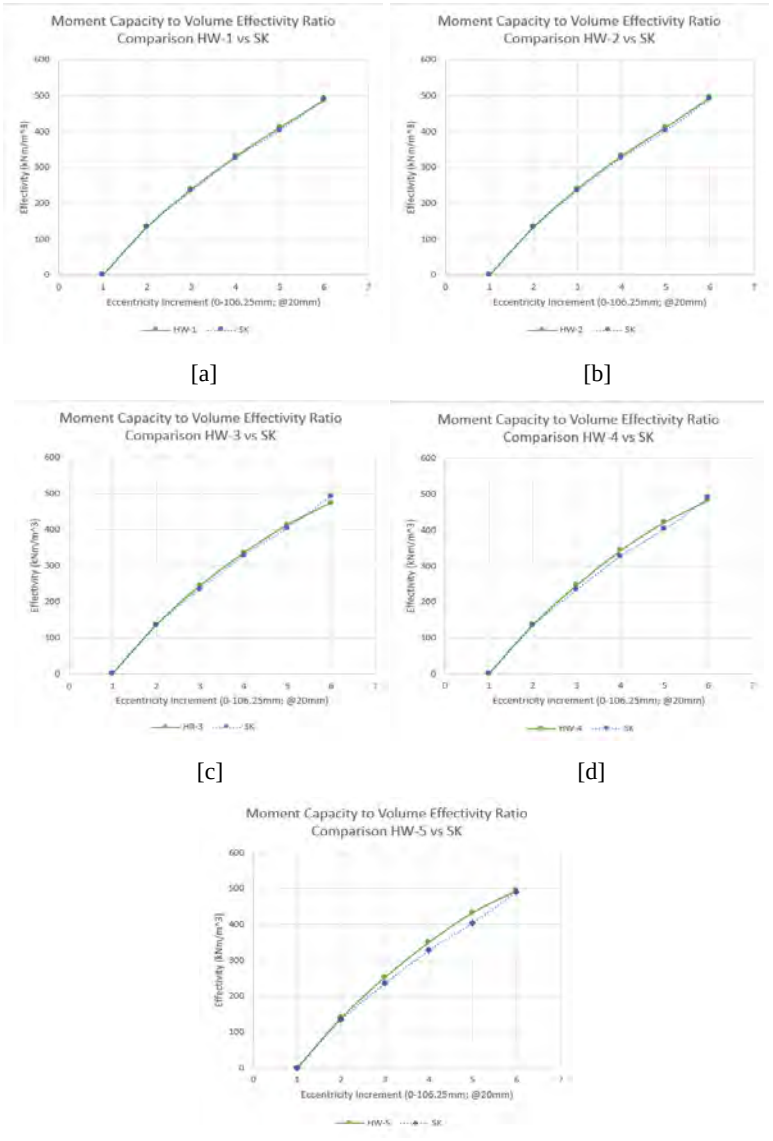


Fig. 7. Moment capacity to volume effectivity ratio comparison of (a) HW-1 vs SK; (b) HW-2 vs SK; (c) HW-3 vs SK; (d) HW-4 vs SK; (e) HW-5 vs SK

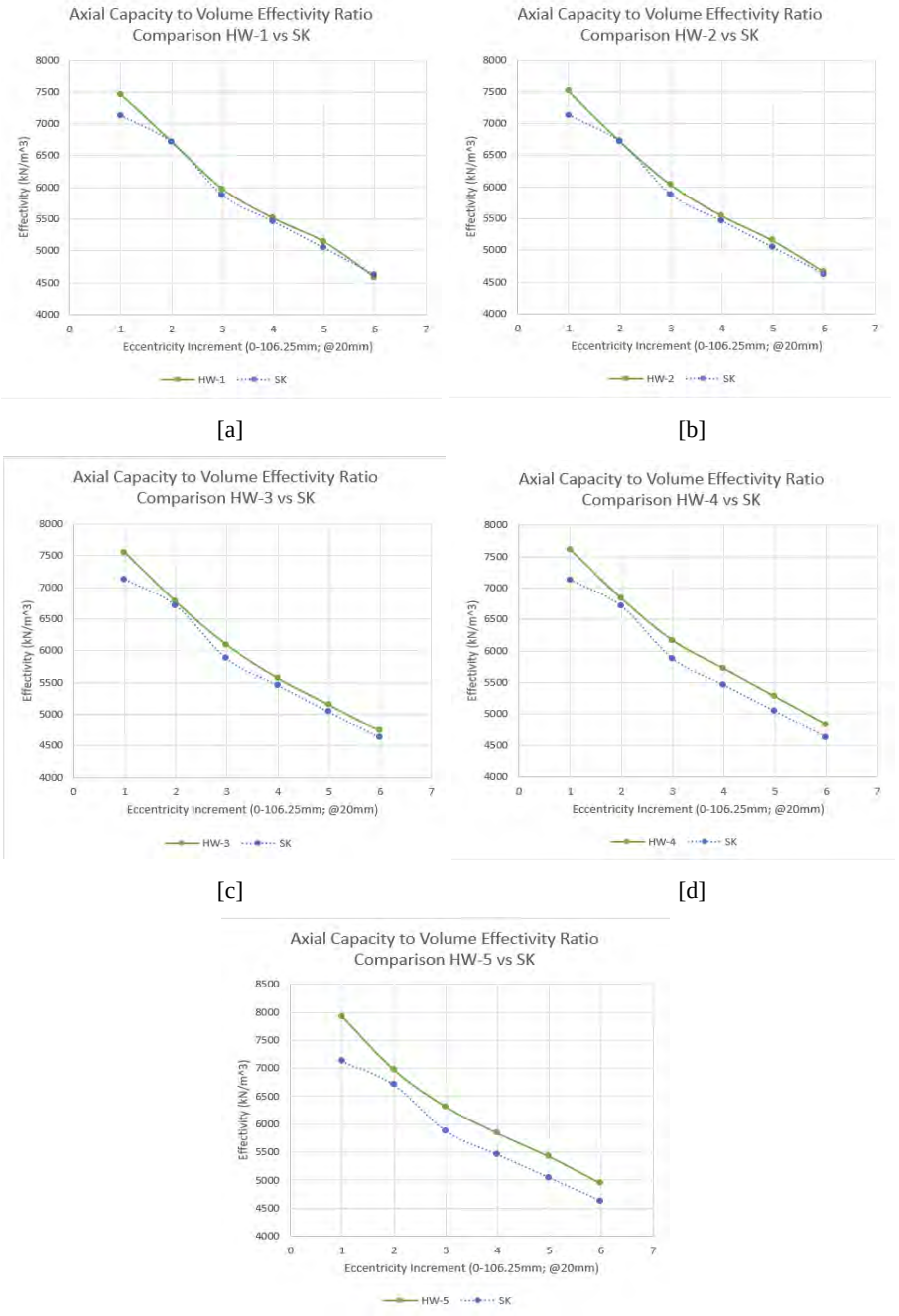


Fig. 8. Axial capacity to volume effectivity ratio comparison of (a) HW-1 vs SK; (b) HW-2 vs SK; (c) HW-3 vs SK; (d) HW-4 vs SK; (e) HW-5 vs SK

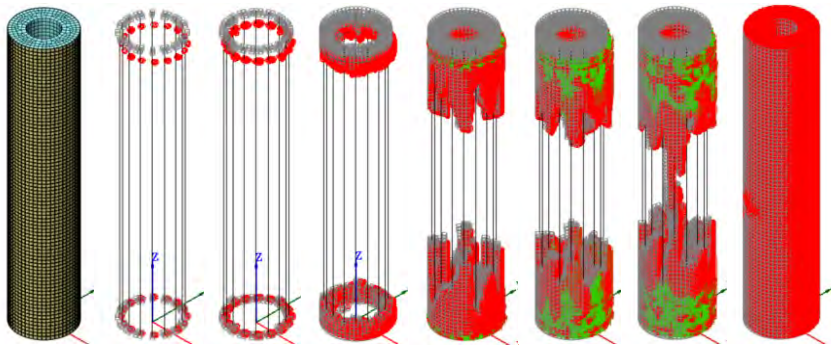


Fig. 9. Step by step cracking pattern output in MIDAS FEA

References

1. Wight, J. K., & Richart, F. E.: Reinforced Concrete Mechanics and Design. 7th edn. Pearson Education, New Jersey (2016)
2. Mo, Y., Wong, D., & Maekawa, K.: Seismic Performance of Hollow Bridge Column. ACI Structural Journal, 337-348 (2003)
3. AlAjarmeh, O. S., Manalo, A. C., & Benmokrane, B.: Effect of Spiral Spacing and Concrete Strength on Behavior of GFRP-Reinforced Hollow Concrete Columns. Journal of Composites for Construction, 04019054 (2020)
4. Liang, X., & Sritharan, S.: Effects of confinement in square hollow concrete column sections. Engineering Structures, 526-535 (2019)
5. Building Code Requirements for Structural Concrete. ACI 318-14. American Concrete Institute, Farmington Hills (2014)
6. Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures. ACI 440.2R-17. American Concrete Institute, Farmington Hills (2017)
7. Masuelli, M. A. Introduction of Fibre-Reinforced Polymers - Polymers and Composites: Concepts, Properties and Processes. Fiber Reinforced Polymers - The Technology Applied for Concrete Repair. In Tech (2013)
8. Designing with Fiber Reinforced Plactics / Composites. Molded Fiber Glass Company (2003)
9. Unicomposite Homepage, https://www.unicomposite.com/product/carbon-fiber-roller/, last accessed 2020/09/15

THE SECOND INTERNATIONAL CONFERENCE OF CONSTRUCTION, INFRASTRUCTURE, AND MATERIALS

ICCIM 2021

Research and Technology in Civil Engineering to Enhance the Sustainability of the Built Environment

PROGRAM BOOK

26th July 2021
Universitas Tarumanagara
Jakarta - Indonesia

UNTAR
Universitas Tarumanagara

Program Book

THE SECOND INTERNATIONAL CONFERENCE
Of Construction, Infrastructure, and Materials

Research and Technology in Civil Engineering
To Enhance the Sustainability of the Built Environment

26 July 2021

Universitas Tarumanagara

Jakarta – Indonesia

The Second
International Conference
of Construction, Infrastructure, and Materials

Contents

Forewords by
Rector of Universitas Tarumanagara

Good morning ladies and gentlemen. Thank you for having me on this online International Conference: ICCIM 2021.

First of all, I would like to give my thanks to all of keynote speakers: Prof. Roesdiman Soegiarso, Indonesia; Prof. Monty Sutrisna, New Zealand; Dr. Ing. Joewono Prasetijo, Malaysia; Dr. Tam Chat Tim, Singapore; to the moderator, to all speakers, to committee members and to all participants.

Welcome to the ICCIM 2021 with topic: Research and Technology in Civil Engineering to Enhance the Sustainability of the Built Environment. The topic is very interesting and very relevant to be discussed at our current condition.

We are currently going through a difficult situation, but don't forget that there are still opportunities for improvement and development in the future. Infrastructure development continues to be carried out in various countries including Indonesia, to improve the welfare of the community. This development requires research results and innovations in the field of civil engineering, which have been developed by researchers, lecturers, students, and practitioners. Therefore, ICCIM 2021 is very important to be implemented as a medium for publication and communication of various research results from the experts.

Through all keynote speakers, we can learn useful knowledge that can be implemented in our research and innovation.

I hope the discussion in this conference will make a breakthrough to contribute for good research and innovation for everyone. Thank you for the collaboration of universities from many countries. I hope this collaboration will continue in the future. To all my fellow students, lecturers, or participants, I hope you enjoy today's discussion, and don't forget to give your opinion or question at the end of the conference.

Thank you very much for your attention and contribution. Have a nice online conference.

Jakarta, July 2021
Rector,

Prof. Dr. Agustinus Purna Irawan

Forewords by Conference Chairs

Dear distinguished guests, ladies, and gentlemen,

It is indeed a great pleasure to welcome you to the Second International Conference of Construction, Infrastructure, and Materials (ICCIM 2021). The theme of ICCIM 2021 is "Research and Technology in Civil Engineering to Enhance the Sustainability of the Built Environment."

Seeing the participants' enthusiasm for The First International Conference of Construction, Infrastructure, and Materials (ICCIM 2019), the committee commits to continuing the Conference biennially.

ICCIM 2021 is organized by the Civil Engineering Undergraduate Study Program of Universitas Tarumanagara and supported by Massey University, New Zealand; Universiti Tun Hussein Onn Malaysia, Malaysia; Nihon University, Japan; fib Indonesia; Diponegoro University, Indonesia; Soegijapranata Catholic University, Indonesia; Universitas Sebelas Maret, Indonesia; and Universitas Atma Jaya Yogyakarta, Indonesia.

ICCIM 2021 has received papers from various countries, such as Indonesia, Japan, Thailand, the United Kingdom, the United States of America, the Philippines, India, Nigeria, and Bangladesh. We have diverse paper topics, including Structural Engineering, Construction Materials, Geotechnical Engineering, Transportation System and Engineering, Construction Management, Water Resources Engineering. And Infrastructure Development. Through the double-blind peer review processes by the reviewers from diverse expertise, we accept 57 papers for the presentation and publication in the Lecture Notes in Civil Engineering; a reputable Scopus indexed series published by Springer.

I am likewise grateful to the keynote speakers for bringing the exciting topics to ICCIM 2021: Prof. Roesdiman Soegiarso (Universitas Tarumanagara, Indonesia); Prof. Monty Sutrisna (Massey University, New Zealand); Dr.-Ing. Joewono Prasetijo (Universiti Tun Hussein Onn Malaysia, Malaysia); and Dr. Tam Chat Tim (National University of Singapore, Singapore)

I would also like to take this opportunity to extend my appreciation to the supporting institutions. Secondly, thank you to the sponsors for the utmost support and kind contribution: PT. Waskita Karya (Persero) Tbk, PT. Pamapersada Nusantara, and PT. Bank Negara Indonesia Tbk.

Forewords by Conference Chairs

Many people have worked very hard for the organization of this Conference. Special thanks are needed to the Organizing Committee, Steering Committee, Editorial Board, and Scientific Committee. All of whom have generously worked to make this Conference rich in content and pleasant for the attendees.

I hope you will take advantage of all the Conference has to offer throughout the day – time to be social and grow friendship, educational and knowledge exchange, research opportunities, and so much more.

I wish you all a wonderful experience through ICCIM 2021. Thank you.

ICCIM 2021 Chairman,

Prof. Ir. Chaidir Anwar Makarim, MSE., Ph.D.

Committees
Steering and Organizing Committee

Steering Committee

1. Prof. Han Ay Lie (Diponegoro University, Indonesia)
2. Prof. Buntara Sthenly Gan (Nihon University, Japan)
3. Dr. Najid (Universitas Tarumanagara, Indonesia)
4. Dr. Widodo Kusharomo (Universitas Tarumanagara, Indonesia)

Organizing Committee

1.	Chairman	:	Prof. Ir. Chaidir A. Makarim, MSE., Ph.D
2.	Vice Chairman	:	Anissa Noor Tajudin, S.T., M.Sc.
3.	Secretary	:	Yenny Untari, S.T., M.T.
4.	Treasurer	:	Ir. Dewi Linggarsari, M.T.
5.	Technical Paper	:	Prof. Ir. Leksmono Suryo Putranto, M.T., Ph.D
			Vittorio Kurniawan, S.T., M.Sc.
6.	Technical Conference	:	Ir. Aniek Prihatiningsih, M.M.
			Arif Sandjaya, S.T., M.T.
			Abdul Roji
			Slamet Riyadi
7.	Publication	:	Daniel Christianto, S.T., M.T.
8.	Sponsorship	:	Ir. Arianti Sutandi, M.Eng.
			Ir. Ni Luh Shinta E. S., M.T.
9.	Creative Team	:	Anugerah Tiffanyputri
			Matthew Ephraim
10.	Administrative Team	:	Saskia Calysta Zetira
			Channy Saka
			Jessica Clarita
			Prem Singh
			Federick Luanga
			Kenny Erick
			Maria Kevinia Sutanto

Scientific Committee

1. Prof. Dr. Leksmono Suryo Putranto (Universitas Tarumanagara, Indonesia)
2. Prof. Dr. Buntara Sthenly Gan (Nihon University, Japan)
3. Dr. Dimas Bayu Endrayana Dharmowijoyo (Universiti Teknologi Petronas, Malaysia)
4. Dr. Bashar S. Mohammed (Universiti Teknologi Petronas, Malaysia)
5. Andri Setiawan, Ph.D., DIC (Ecole Polytechnique Federale de Lausanne, Switzerland)
6. Fadhilah Muslim, Ph.D., DIC (Universitas Indonesia, Indonesia; Technical University of Munich, Germany)
7. Prof. Dr. Han Ay Lie (Universitas Diponegoro, Indonesia)
8. Prof. Dr. Chaidir Anwar Makarim (Universitas Tarumanagara, Indonesia)
9. Prof. Dr. Dewa Made Priyantha Wedagama (Universitas Udayana, Indonesia)
10. Prof. Dr. Sofyan M. Saleh (Universitas Syiah Kuala, Indonesia)
11. Prof. Dr.Eng. Joni Arliansyah (Universitas Sriwijaya, Indonesia)
12. Prof. Dr. Sakti Adji Adisasmita (Universitas Hassanuddin, Indonesia)
13. Prof. Dr. Siti Malkhamah (Universitas Gadjah Mada, Indonesia)
14. Prof. Dr. Krishna Mochtar (Institut Teknologi Indonesia, Indonesia)
15. Prof. Dr. Ade Sjafruddin (Institut Teknologi Bandung, Indonesia)
16. Prof. Dr. Ludfi Djakfar (Universitas Brawijaya, Indonesia)
17. Prof. Dr. Wimpy Santosa (Universitas Parahyangan, Indonesia)
18. Prof. Dr. Antonius (Universitas Islam Sultan Agung, Indonesia)
19. Prof. Dr. Erika Buchari (Universitas Sriwijaya, Indonesia)
20. Prof. Dr. Ria Asih Aryani Soemitro (Institut Teknologi Sepuluh November, Indonesia)

21. Prof. Dr. I Nyoman Arya Thanaya (Universitas Udayana, Indonesia)
22. Dr. Hermawan (Universitas Katolik Soegijapranata, Indonesia)
23. Dr. Maria Wahyuni (Universitas Katolik Soegijapranata, Indonesia)
24. Dr. Djoko Suwarno (Universitas Katolik Soegijapranata, Indonesia)
25. Dr. Bayu Martanto Adji (Universitas Andalas, Indonesia)
26. Dr. Aine Kusumawati (Institut Teknologi Bandung, Indonesia)
27. Dr. Bagus Hario Setiadji (Universitas Diponegoro, Indonesia)
28. Dr. Basuki Anondho (Universitas Tarumanagara, Indonesia)
29. Dr. Widodo Kushartomo (Universitas Tarumanagara, Indonesia)
30. Dr. Najid (Universitas Tarumangara, Indonesia)
31. Dr. Dewanti Marsoyo (Universitas Gadjah Mada, Indonesia)
32. Dr. Wati A. Pranoto (Universitas Tarumanagara, Indonesia)
33. Dr. Noor Mahmudah (Universitas Muhammadiyah Yogyakarta, Indonesia)
34. Dr.Eng. Muhammad Isran Ramli (Universitas Hassanuddin, Indonesia)
35. Dr.Eng. Imam Muthohar (Universitas Gadjah Mada, Indonesia)
36. Dr. Achmad Wicaksono (Universitas Brawijaya, Indonesia)
37. Dr. Caroline A. Sutandi (Universitas Parahyangan, Indonesia)
38. Dr. Hera Widyastuti (Institut Teknologi Sepuluh November, Indonesia)
39. Dr. R. Sony Sulaksono Wibowo (Institut Teknologi Bandung, Indonesia)
40. Dr. Resdiansyah (Polytechnic Enjinering Indorama, Indonesia)
41. Dr. Yosritzal (Universitas Andalas, Indonesia)
42. Dr. M. Asad Abdurrahman (Unversitas Hassanuddin, Indonesia)
43. Dr.Eng. M. Zudhy Irawan (Universitas Gadjah Mada, Indonesia)
44. Dr. Ir. Hitapriya Suprayitno, M.Eng. (Institut Teknologi Sepuluh November, Indonesia)
45. Dr. Ani Hairani (Universitas Muhammadiyah Yogyakarta, Indonesia)
46. Dr. Hendy Setiawan (Universitas Gadjah Mada, Indonesia)

47. Alfred Jonathan Susilo, Ph.D. (Universitas Tarumanagara, Indonesia)
48. Dr. Aksan Kawanda (Universitas Trisakti, Indonesia)
49. Nurul Fajar Januriyadi, Ph.D. (Universitas Pertamina, Indonesia)
50. Neil Andika, Ph.D. (Universitas Gadjah Mada, Indonesia)
51. Faizal Immaddudin Wira Rohmat, Ph.D. (Institut Teknologi Bandung, Indonesia)
52. Dr. Usman Wijaya (Universitas Kristen Krida Wacana, Indonesia)
53. Dr. Leni Sagita Riantini, Ph.D. (Universitas Indonesia, Indonesia)
54. Dr. Hendrik Sulistio (Universitas Tarumanagara, Indonesia)
55. Dr. Jane Sekarsari (Universitas Trisakti, Indonesia)

Editorial Board

1. Prof. Han Ay Lie (Diponegoro University, Indonesia)
2. Prof. Monty Sutrisna (Massey University, New Zealand)
3. Dr.-Ing. Joewono Prasetijo (Universiti Tun Hussein Onn Malaysia, Malaysia)
4. Prof. Bonaventura H. W. Hadikusumo (Asian Institute of Technology, Thailand)
5. Prof. Leksmono Suryo Putranto (Universitas Tarumanagara, Indonesia)

Supporting Partners and Sponsors

Supported by:

Sponsored by:

General Information & Guidelines

General Information

A. ICCIM 2021 will be held virtually using Zoom Meeting. ICCIM 2021 will have a host, keynote speakers, moderators, distinguished guests, session chairs, room admins, presenters, and participants.

B. Make sure to install Zoom on your computer or update it to the latest version (version 5.3.0 or higher).

C. The display name format in zoom meetings are listed below:

1. Presenters: **Presenter_Room Code_Paper ID_Full Name**.

   E.g., **Presenter_4.1_40_Anissa Noor Tajudin**. Your name must be the same as what you fill in the registration form.
2. Participants: **Participant_Full Name_Affiliation**.

   E.g., **Participant_Anugerah Tiffanyputri_Untar**. Your name must be the same as what you fill in the registration form.
3. Co-Author: **Author_Paper ID_Full Name**.

   E.g., **Author_40_Yenny Untari**. Your name must be the same as what you fill in the manuscript. The author is free to join the conference to accompany the registered presenter.
4. Plenary Moderators: **Moderator_Full Name**.
5. Keynote Speakers: **Keynote_Full Name**.
6. Parallel Session Chair: **Session Chair_Room Code_Full Name**.

D. Participants are required to attend the Plenary Session from start to finish to get E-Certificate as Participants.

E. Presenters are required to attend Plenary and Parallel sessions to get E-Certificate as Presenters.

F. While every attempt is made to ensure that all aspects of the symposium mentioned in this announcement will occur as scheduled, the Organizing Committee reserves the prerogative to make last-minute changes should the need arise without prior notice.

Plenary Session

1. The Host will start the Zoom Meeting at 07.30 WIB (UTC +7)
2. After you click the Zoom Meeting link or enter the Meeting ID and Passcode for ICCIM 2021, you will be moved forward to the waiting room.
3. Please wait for the committee to allow you to enter the conference. To speed up this process, make sure you already change your display name, as mentioned above.
4. The committee will record the plenary session. Please note that we automatically assume that all attendees accept being recorded throughout the Plenary Session.
5. A moderator will guide each keynote session. Each session is composed of 30 minutes live presentation and 10 minutes of live Q&A
6. Link for the attendance form and submitting your questions will be shared by the committee in the chat room.
7. Please set your microphone in mute mode throughout the whole plenary session.
8. Please activate your camera during the photo session.

Parallel Session

1. Each session will be conducted as a parallel session within the main Zoom meeting using Breakout Rooms.
2. The Host will designate breakout rooms for the parallel sessions at 12.30 WIB (UTC +7).
3. Once the breakout rooms are open, all attendees can select and enter a breakout room of their choice. All registered attendees can attend all parallel sessions and switch from session to session at will. [Note: Participants not joined with the desktop or mobile app (version 5.3.0 or higher) will not be able to self-select a breakout room and will need to be assigned by the Host].
4. Please familiarize yourself with how to use the breakout room in Zoom Meeting. The guidelines of it are attached below.
5. The Host will standby at the main room for those who have difficulties joining the breakout room. Please do not hesitate to chat with him in the chat room.
6. The Session Chairs, Presenters, and Room Admins are expected to join the room 10 minutes before the beginning of each session.
7. At the beginning of each presenter session, the session chair will introduce the presenter. Room Admin will play the presentation from the pre-recorded video.
8. Due to some situations, presenters who could not send the pre-recorded video can present their presentation live.
9. The duration of each paper presentation is 10 minutes for the video and 5 minutes for the Live Q&A.
10. The session chair may tell the Room Admin to stop playing the video if it exceeds 10 minutes.
11. The session chair may put the Q&A session at the end of all presentations if the presenters agree with it.
12. At the end of the session, the Session Chair will conclude the session. The room admin will take the photo.
13. After the end of the session, you can go back to the main room for the closing at 17.05 WIB (UTC+7).

Presenter Guidelines

1. Please join at least 10 minutes before your parallel session and be present during your video playback as well as the Q&A session. Test your audio and camera as you join.
2. Your microphone will be muted during the video playback. You are encouraged to keep your camera on during the video playback and Q&A.
3. During the replay of the presentation video, participant may ask questions related to the presentation through the chat room or by raising hand at the end of the presentation.
4. You are encouraged to keep an eye on the questions to answer them during the Q&A Session.
5. The session chair may tell the room admin to stop playing the video if it exceeds 10 minutes.
6. At the end of the pre-recorded presentation, the Host will unmute your microphone and spotlight your video. The Session Chair will then ask you to answer some of the questions in the sequence they were submitted and within the allotted Q&A time.
7. You should be virtually present for their entire session to answer questions and participate in the discussion.
8. You can ask questions to other presenters via chat room during the presentation or by using the raising hand tool at the end of the video playback. In the chat room, please use this format: Q_TypeYourQuestionHere.

Session Chairs Guidelines

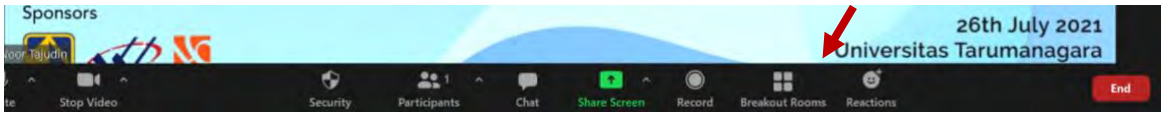
1. Please join the session at least 10 minutes in advance. Please test your microphone and video once joined so that the session can start on time.
2. One Room Admin will accompany you in the session. Feel free to ask for assistance when you need it.
3. Please always turn on your video during the introduction, Q&A, and closing session.
4. During the playback of the presentation video, please keep track of the questions in the chat room.
5. Please make sure to ask the questions submitted to the chat room according to the time they were first submitted. If there are not many questions, please check whether participants raise hands to ask questions.
6. Be prepared with a few opening questions to start a discussion, if necessary
7. Sometimes the audience may need to clarify their question. In that case, it is upon the discretion of the Session Chair to unmute the attendee who placed the question to make clarifications.
8. Please be mindful of the Q&A time limits.
9. If the video playback exceeds 10 minutes, it is upon the discretion of the Session Chair to tell the Room Admin to stop the video.
10. The session chair may put the Q&A session at the end of all presentations if the presenters agree with it.
11. At the end of the session, please ask all attendees to open the camera to take a picture together. The room admin will take the picture.

Participant Guidelines

1. You can join any session/room that interests you by using the breakout room button provided on the Zoom meeting.
2. During the playback of the presentation video, you are welcome to ask questions using the chat room. You can also use the raising hand tool at the end of the presentation.
3. The moderator or Session Chair will select and ask the questions during the Q&A session. We understand that there may not be time to ask all the questions. The Chair will make sure to ask complementary questions and hopefully according to the first submitted question.
4. The organizer will have the ability to unmute participants if this is needed to elaborate on their questions.

Guidelines for Using Zoom Breakout Room

1. Make sure to install Zoom on your computer or update it to the latest version (version 5.3.0 or higher).
2. Participants not joined with the desktop or mobile app (version 5.3.0 or higher) will not be able to self-select a breakout room and will need to be assigned by the Host.
3. To join the parallel session room of your choice:
4. Click **Breakout Rooms** in your meeting controls (menu bar below).



5. This will display the list of open breakout rooms (e.g., Room 1.1) created by the Host.
6. Hover your pointer over the number to the right of the breakout room you wish to join, click **Join**, then confirm by clicking Join.

7. Repeat as necessary to join other breakout rooms.
8. You can leave the breakout room and return to the main meeting room at any time, or you can leave the meeting entirely from the breakout room.
9. To leave the breakout room, click **Leave Breakout Room** and choose if you want to leave the breakout room or the entire meeting (if you're going to switch to a different parallel session, make sure to use the 'Leave Room' option to re-enter the main meeting room and join the other room).
10. When the Host ends the breakout rooms, you will be notified and given the option to return to the main room immediately or in 60 seconds.

Useful Links

If you need more information on how to use Zoom:

How to join a Zoom meeting

How to configure your audio and video

Participating in breakout rooms

Conference At a Glance

Time			Programme
WIB (UTC +7)	NZST (UCT +12)	MYT and SGT (UCT +8)	
07.30-08.00	12.30-13.05	08.30-09.00	Registration
08.05-08.45	13.05-13.45	09.05-09.45	Opening Ceremony
08.45-09.25	13.45-14.25	09.45-10.25	Keynote Speech 1 (Prof. Roesdiman Soegiarsa – Universitas Tarumanagara) Moderator: Andy Prabowo, S.T., M.T.
			QnA
09.25-10.05	14.25-15.05	10.25-11.05	Keynote Speech 2 (Prof. Monty Sutrisna – Massey University) Moderator: Dr. Basuki Anondho
			QnA
10.05-10.15	15.05-15.15	11.05-11.15	Campus Virtual Tour
10.15-10.55	15.15-15.55	11.15-11.55	Keynote Speech 3 (Dr. -Ing. Joewono Prasetijo – Universiti Tun Hussein Onn Malaysia) Moderator: Dr. Eng. M. Zudhy Irawan
			QnA
10.55-11.35	15.55-16.35	11.55-12.35	Keynote Speech 4 (Dr. Tam Chat Tim – National University of Singapore) Moderator: Andy Prabowo, S.T., M.T.
			QnA
11.35-11.50	16.35-16.50	12.35-12.50	Interlude
11.50-12.00	16.50-17.00	12.50-13.00	Parallel Session Technical Briefing
12.00-13.00	17.00-18.00	13.00-14.00	Break
13.00-14.45	18.00-19.45	14.00-15.45	Parallel Session 1
14.45-15.15	19.45-20.15	15.45-16.15	Break
15.15-17.00	20.15-22.00	16.15-18.00	Parallel Session 2
17.05-17.30	22.05-22.30	18.05-18.30	Closing

Parallel Session Schedule: Geotechnical Engineering

Time : **13.00 - 14.15**

Room : **1.1**

Track : **Geotechnical Engineering**

No	Time (UTC +7)	Paper ID	Paper Title	Authors
1	13.00 - 13.15	6	Additional Horizontal Movement of The Single Pile Foundation with Combined Loads	Sumiyati Gunawan, Niken Silmi Surjandari, Bambang Setiawan, and Yusep Muslih Purwana
2	13.15 - 13.30	32	The Combined Effects of Terraces Slope Model and Geotextile Reinforcement Design in Sendangmulyo, Wonogiri.	Siti Nurlita Fitri and Niken Silmi Surjandari
3	13.30 - 13.45	59	REVIEW: Effects of Climate on the Geochemical Properties of Volcanic Rocks	Novi Asniar, Yusep Muslih Purwana, Niken Silmi Surjandari, and Bambang Setiawan
4	13.45 - 14.00	69	Analysis of Shift Pile Foundation on Mall and Hotel Projects in Bontang, East Kalimantan	Nicholas Joshua and Alfred Jonathan Susilo
5	14.00 - 14.15	70	Analysis of Diaphragm Wall Stability with Dewatering and Ground Freezing Treatment	Eduard Teja and Aniek Prihatiningsih

Parallel Session Schedule: Water Resources Engineering

Time : **15.15 - 16.45**

Room : **1.2**

Track : **Water Resources Engineering**

No	Time (UTC +7)	Paper ID	Paper Title	Authors
1	15.15 - 15.30	36	Erosion and Distribution of Total Suspended Sediment (TSS) Using Landsat-8 in Krueng Pase Watershed	I. Ramli, A. Achmad, H. Basri, and A. Izzaty
2	15.30 - 15.45	50	Nonlinear Effect of Fluid–Structure Interaction Modeling in the Rock-Fill Dam Jatiluhur	Albert Sulaiman, Wati A. Pranoto, Tati Zera, and Mouli D. Dewantoro
3	15.45 - 16.00	54	Assessment of Flooding Event in the Upper Sunter Watershed, Jakarta, Indonesia	A. A. Laksmi, A. H. S. Putro, W. S. Dharma, P. D. Saputra, N. Purwanti, and M. H. Fansuri
4	16.00 - 16.15	66	Analysis of the Utilization of the Embung Klampeyan, Tlogoadi Village, Mlati District, Sleman Regency, Indonesia	Edy Sriyono
5	16.15 - 16.30	38	Shoreline Change Cause of Abration in Bantan District Bengkalis Island as the Outstanding Beach Area	Hotmauli Tampubolon
6	16.30 - 16.45	58	Modeling of Flood Propagation in the Lower Citarum River Using a Coupled 1D-2D HEC-RAS Model	Angga H. Prawirakusuma, Sri Legowo Wignyo Darsono, and Arno Adi Kuntoro

Parallel Session Schedule: Structural Engineering & Construction Materials

Time : **13.00 - 14.45**

Room : **2.1**

Track : **Structural Engineering & Construction Materials**

No	Time (UTC +7)	Paper ID	Paper Title	Authors
1	13.00 - 13.15	13	Artificial Aggregate Made from Expanded Polystyrene Beads Coated with Cement Kiln Dust - An Experimental Trial	A. P. Wibowo, M. Saidani, and M. Khorami
2	13.15 - 13.30	11	The Use of Fly Ash in Pervious Concrete Containing Plastic Waste Aggregate for Sustainable Green Infrastructure	Steve W.M. Supit and Priyono
3	13.30 - 13.45	56	On-Field Testing of The Monolith Joint of The Full Slab on A Slab-On-Pile Bridge	A. Z. Risadi, J. I. Rastandi, B. O. B. Sentosa, and N. Handika
4	13.45 - 14.00	29	Structural Analysis Using Matched Acceleration Time Histories	Windu Partono
5	14.00 - 14.15	16	Load Transfer Shear Wall to Pile Cap Modelling Partially for Group Precast Pile	Daud Rahmat Wiyono, Roi Milyardi, Yosafat Aji Pranata, Asriwiyanti Desiani, Ginardi Husada, and Maria Christine Sutandi
6	14.15 - 14.30	41	Non-Linear Analysis of Steel Shear Key at Epoxy Joint	Khairunnisa Masturoh, Nuraziz Handika, and Heru Purnomo
7	14.30 - 14.45	8	Characterization of Heat Insulating Ceramic Fiber Raw Material for Green Environment	T. M. S. A. Hossain, Mst Alpona Akter, M.A Matin, M. A. Hakim, and M. F. Islam

Parallel Session Schedule: Structural Engineering & Construction Materials

Time : **15.15 - 16.45**

Room : **2.2**

Track : **Structural Engineering & Construction Materials**

No	Time (UTC +7)	Paper ID	Paper Title	Authors
1	15.15 - 15.30	5	Analysis of Hollow Concrete Column with CFRP Wrapping Using Finite Element Method	William Supardjo and Sunarjo Leman
2	15.30 - 15.45	57	Seismic Design Load Comparison of Reinforced Concrete Special Moment Frame and Dual Systems Based on SNI 1726:2019	Suradjin Sutjipto and Indrawati Sumeru
3	15.45 - 16.00	62	Analysis of The Sand Grains Influence on Damping Ratio Using Shear Test	Daniel Christianto, Vryscilia Marcella, Channy Saka, Alvira Nathania Tanika, and Yuskar Lase
4	16.00 - 16.15	24	Effect of Cement-Water Ratio on the Mechanical Properties of Reactive Powder Concrete with Marble Powder as Constituent Materials	Widodo Kushartomo, Henny Wiyanto, and Daniel Christianto
5	16.15 - 16.30	63	Parametric Study on Neutral Axis Growth of Concrete Beams Reinforced with Fiber-Reinforced Polymer and Steel Bars	Ahmad Zaki and Rendy Thamrin
6	16.30 - 16.45	61	Analysis of Asphalt Damping Ratio on Shear Test	Sunarjo Leman, Maria Kevinia Sutanto, Elizabeth Ivana Harsono, Vryscilia Marcella, Anugerah Tiffanyputri, and Yuskar Lase