PROCEEDINGS OF THE 10TH WORLD CONGRESS ON NEW TECHNOLOGIES (NEWTECH 2024)

AUGUST 25-27, 2024 | Barcelona, Spain

TABLE OF CONTENTS

WELCOME MESSAGE FROM THE CONFERENCE CHAIR

On behalf of the International Academy of Science, Engineering and Technology (International ASET Inc.), the organizing committee would like to welcome you to the 10th World Congress on New Technologies (NewTech 2024).

NewTech is aimed to become one of the leading international annual congresses in the fields of new technologies. This congress will provide excellent opportunities to the scientists, researchers, industrial engineers, and university students to present their research achievements and to develop new collaborations and partnerships with experts in the field.

While each conference consists of an individual and separate theme, the 4 conferences share considerable overlap, which prompted the organization of this congress. The goal of this undertaking is to bring together experts in each of the specialized fields, and at the same time allow for cross pollinations and sharing of ideas from the other closely related research areas.

In the tenth meeting of this conference, four Plenary Speakers and three keynote speakers will share their expertise with the aim of exposing participants to a wide spectrum of applications, and to foster crosspollination of ideas and develop new research interests. In addition, approximately 106 papers will be presented from professors, students, and researchers across the world.

We thank you for your participation and contribution to the 10th World Congress on New Technologies (NewTech 2024). We wish you a very successful and enjoyable experience.

Dr. Devika Chithrani
University of Victoria, Canada
Congress Chair and Proceedings Editor
NewTech 2024

Dr. Domenico Lombardo
CNR - (Consiglio Nazionale delle Ricerche), Italy
Local Chair and Proceedings Editor
NewTech 2024

ABOUT NEWTECH 2024

NewTech is aimed to become one of the leading international annual congresses in the fields of new technologies.

This congress will provide excellent opportunities to the scientists, researchers, industrial engineers, and university students to present their research achievements and to develop new collaborations and partnerships with experts in the field.

There are 5 conferences included in the NewTech Congress:

ICNFA 2024 - 15th International Conference on Nanotechnology: Fundamentals and Applications

ICEPR 2024 - 14th International Conference on Environmental Pollution and Remediation

ICBB 2024 - 10th International Conference on Bioengineering and Biotechnology

ICERT 2024 - 8th International Conference on Energy Research and Technology

ICCEIA 2024 - International Conference on Civil Engineering: Innovations & Advancements

While each conference consists of an individual and separate theme, the 5 conferences share considerable overlap, which prompted the organization of this congress. The goal of this undertaking is to bring together experts in each of the specialized fields, and at the same time allow for cross pollinations and sharing of ideas from the other closely related research areas.

- The proceedings is published in Ottawa, Canada.
- All papers were peer-reviewed
- The congress proceedings is published under an ISSN and ISBN number
- Each paper is assigned a unique DOI number by Crossref
- The conference proceedings is indexed by Scopus and Google Scholar
- The proceedings is permanently archived in Portico (one of the largest community-supported digital archives in the world)

Return to Top

SCIENTIFIC COMMITTEE

We would like to thank the following for accepting to act as a member of the Scientific Committee for the NewTech 2024 Congress:

Dr. Devika Chithrani
University of Victoria, Canada
Congress Co-Chair

Dr. Domenico Lombardo
CNR - (Consiglio Nazionale delle Ricerche), Italy
Technical Program Chair

Scientific Committee Members for ICNFA 2024

- **Dr. Bernadeta Dobosz**, Adam Mickiewicz University in Poznań, Poland
- **Dr. Redhouane Henda**, Laurentian University, Canada
- **Dr. Jeff Th. M. De Hosson**, University of Groningen, Netherlands
- **Dr. Rahul M. Mane**, Shivaji University, India
- **Dr. Daisuke Onoshima**, Nagoya University, Japan
- **Dr. Aimin Song**, Institute of Nanoscience and Applications Southern University of Science and Technology Shenzhen, China
- **Dr. Jules Thibault**, University of Ottawa, Canada
- **Dr. Ludwig Vinches**, École de Technologie Supérieure, Canada

Scientific Committee Members for ICEPR 2024

- **Dr. Zeki Ayag**, University Quality Commission-Advisor, Turkey
- **Dr. Priscilla Boccia**, INAIL/DIT, Italy
- **Dr. Monika Bojko**, Jagiellonian University, Poland
- **Dr. Elisabetta Franchi**, Eni S.p.A., Italy
- **Dr. Oliver Terna Iorhemen**, University of Northern British Columbia, Canada
- **Dr. Jianbing Li**, University of Northern British Columbia, Canada
- **Dr. Charles Lee**, The University of Newcastle, Singapore
- **Dr. Woo Hyoung Lee**, University of Central Florida, USA
- **Dr. Chih-Huang Weng**, I-Shou University, Taiwan

Return to Top

SCIENTIFIC COMMITTEE

We would like to thank the following for accepting to act as a member of the Scientific Committee for the NewTech 2024 Congress:

Scientific Committee Members for ICBB 2024

- **Dr. Wensheng Qin**, Lakehead University, Canada
- **Dr. Bindu S.**, Ramaiah Institute of Technology, India

Scientific Committee Members for ICERT 2024

- **Dr. Umberto Berardi**, Toronto Metropolitan University, Canada
- **Dr. Ming-Chang Lu**, National Taiwan University, Taiwan
- **Dr. Grzegorz Sierpiński,** Silesian University of Technology, Poland
- **Dr. Md Shafiullah**, King Fahd University of Petroleum & Minerals, Saudi Arabia

Scientific Committee Members for ICCEIA 2024

- **Dr. Iman Hajirasouliha**, University of Sheffield, UK
- **Dr. Firas AL Mahmoud**, University of Lorraine, France
- **Dr. Danuta Leszczynska**, Jackson State University, USA
- **Dr. Jiabin Li**, Katholieke Universiteit Leuven, Belgium
- **Dr. M. Shamim Miah**, Graz University of Technology (TU Graz), Austria
- **Dr. Vipulkumar Ishvarbhai Patel**, La Trobe University, Australia
- **Dr. Cao Hung Pham**, University of Sydney, Australia
- **Dr. Roger Tilley**, University of California Santa Cruz, United States, USA
- **Dr. Kamyab Zandi**, Director and CEO at Timezyx Inc., Canada

KEYNOTE SPEAKERS

THE PLENARY/KEYNOTE INFORMATION FOR THE 9TH WORLD CONGRESS ON NEW TECHNOLOGIES (NEWTECH 2024) IS AS FOLLOWS:

Plenary Speakers

Dr. Umberto Berardi
Toronto Metropolitan University, Canada
ICERT 2024 Plenary Speaker

Dr. Marte Gutierrez
Colorado School of Mines, USA
ICCEIA 2024 Plenary Speaker

Dr. Leon Shaw
Illinois Institute of Technology, USA
ICERT 2024 Plenary Speaker

Dr. Sharath Sriram
RMIT University, Australia
ICNFA 2024 Plenary Speaker

Keynote Speakers

Dr. Valérie Cappuyns
KU Leuven University, Belgium
ICEPR 2024 Keynote Speaker

Dr. Yunhong Jiang
University of Bristol, United Kingdom
ICBB 2024 Keynote Speaker

Dr. Konstantinos Lagoudakis
University of Strathclyde, UK
ICNFA 2024 Keynote Speaker

ICERT 2024 PLENARY SPEAKER

Dr. Umberto Berardi
Toronto Metropolitan University, Canada

N/A   **Return to Top**

Titles: Recent Advancements in Solid Electrolytes for Rechargeable Solid-State Batteries

Dr. Leon Shaw, Illinois Institute of Technology, USA

Abstract   **Return to Top**

Dr. Leon L. Shaw is Rowe Family Endowed Chair Professor in Sustainable Energy and Professor of Materials Science and Engineering at Illinois Institute of Technology, Chicago, Illinois, United States. He is the founding director of NSF Center of All-Solid-State Batteries. Dr. Shaw has extensive experience in nanomaterials synthesis and processing for applications in hydrogen storage, Li-ion batteries, Na-ion batteries, solid-state batteries, and structural materials. He has authored and co-authored more than 300 archival refereed publications in these areas. Among these 300+ publications 234 are journal articles and invited chapters for books and encyclopedias. His publications have been cited more than 14,200 times with h-index of 62 and i10-index of 204 (according to Google Scholar). His publications are ranked top 1.4% citations for career-long impact among all scientific fields and top 0.2% citations for career-long impact in the subfield of "materials" (based on the composite score c compiled by Elsevier). His accomplishments are recognized worldwide with many honors and awards, including "Energy Award" in 2018 and "Scientist Medal" in 2024 presented by International Association of Advanced Materials. Dr. Shaw is a Member of EU Academy of Sciences, a Fellow of International Association of Advanced Materials, a Fellow of ASM International, a Fellow of the World Academy of Materials and Manufacturing Engineering, and a Member of the Connecticut Academy of Science and Engineering.

ICCEIA 2024 PLENARY SPEAKER

Titles: Application of Machine Learning in Underground Construction and Tunneling

Dr. Marte Gutierrez, Colorado School of Mines, USA

View Abstract   **Return to Top**

Dr. Marte Gutierrez is the James R. Paden Distinguished Professor at the Department of Civil and Environmental Engineering and the Director of the Center for Underground Transportation Infrastructure (CUT-I) of Colorado School of Mines (CSM). Previously, he worked for 11 years at the Norwegian Geotechnical Institute and six years as an Associate Professor/Professor at Virginia Tech. He has published over 370 papers in book chapters, journals, and conference proceedings, given keynote and invited lectures at several conferences. He has been responsible for more than US$ 25 million in research funding. Dr. Gutierrez is an Associate Editor of three international journals and a member of the Editorial Board of four other international journals. He is the recipient of the 2011 Geotechnical Research Medal from the UK's Institute of Civil Engineers, the 2017 Applied Rock Mechanics Research Award and the 2020 Rock Mechanics Research Award both from the American Rock Mechanics Association, the 2016 Peter A. Cundall Honorable Mention Award, the Kwanghua Visiting Professorship from Tongji University, five Best Paper Awards and five Outstanding Reviewer and Editorial Board Member Awards. Dr. Gutierrez's main research interests are in Geomechanics for Energy, Environmental, and Transportation Sustainability.

ICNFA 2024 KEYNOTE SPEAKER

Titles: Creating Products and Impact through Nanoscale Materials and Technologies

Dr. Sharath Sriram, RMIT University, Australia

View Abstract	Return to Top

Professor Sharath Sriram jointly leads the Functional Materials and Microsystems Research Group at RMIT University, Melbourne, Australia. His research transforms discoveries in materials science and electronics into devices and products for high-speed electronics, sensors, and medical devices. He is Director of the Discovery to Devices Facility for scale-up manufacture of medical devices, and was Founding Deputy Director of the $60 million Micro Nano Research Facility. He has published close to 250 peer-reviewed articles. He is active in research policy and advocacy, and is current President of Science & Technology Australia.

Titles: Fundamentals and Applications of Unconventional Spin Control in Nanostructures

Dr. Konstantinos Lagoudakis, University of Strathclyde, US

N/A	Return to Top

Dr. Konstantinos G. Lagoudakis is currently a Reader (Associate Professor) at the department of Physics of the University of Strathclyde. He received his PhD at the Ecole Polytechnique Fédérale de Lausanne in 2010 and has worked as a postdoctoral scholar and a research associate at Stanford University until 2017. In 2018, he joined Strathclyde where he established the Experimental Quantum Nanoscience Lab. His areas of expertise span from polariton condensates in microcavities, to the development of scalable solid-state quantum hardware. Currently he is investigating fundamental physics and applications of hybrid quantum nanotechnologies.

ICEPR 2024 KEYNOTE SPEAKER

Titles: Sustainable Remediation: Challenges for an Interdisciplinary Approach to Contaminated Site Management

Dr. Valérie Cappuyns, KU Leuven University, Belgium

View Abstract   **Return to Top**

Valérie Cappuyns obtained a Master degree in Bio-science Engineering in 2000, and a PhD degree in Geology in 2004 at KU Leuven (Belgium). After her PhD she was a researcher at the Scientific Institute for Public Health. In 2007, she returned to KU Leuven, where she is currently a professor at the Faculty of Economics and Business. She teaches courses in the field of environmental sciences. Research interests include the sustainable management of contaminated sites (soils, sediments, and waste materials), environmental geochemistry and valorisation of secondary resources. She is (co)author of more than 90 publications in international peer-reviewed journals.

ICBB 2024 KEYNOTE SPEAKER

Titles: Biofabricated Advanced Materials for Diverse Applications

Dr. Yunhong Jiang, University of Bristol, United Kingdom

N/A   **Return to Top**

Dr Yunhong Jiang is an assistant professor at the Department of Applied Science, Northumbria University, Newcastle, United Kingdom. He obtained a PhD in Biochemical Engineering at the University of Leeds. His postdoctoral experience included positions at the University of Leeds, the University of Bath, and the University of Bristol. His research experience focused on Microbial Cell and Materials Interactions, Biological MOFs, and Functional and Sustainable Biopolymer Materials. Through groundbreaking research, Dr. Jiang explores novel techniques and methodologies to fabricate functional materials using biological systems as inspiration. His pioneering contributions have led to advancements in areas such as tissue engineering, drug delivery systems, biosensors, and more. His work spans across the realms of biotechnology, materials science, and engineering.

LIST OF PAPERS

The following papers were presented at the 9th World Congress on Mechanical, Chemical, and Material Engineering (NewTech 2023)

Bioengineering and Biotechnology

Utilizing Deep Eutectic Solvents for Hydroxide-Catalysed Synthesis of Ellagic Acid from Bio-Based Ethyl Gallate
Authors: Miša Mojca Cajnko, Anže Prašnikar, Blaž Likozar

Effect of Demographic Factors on Openness to Medical Technology
Authors: Ryan Oh, Sujata Bhatia

Reported Adverse Events for Hip Prostheses and Knee Prostheses Before, During, and After the COVID-19 Pandemic
Authors: Zehui Yi, Sujata K. Bhatia

Trends in Reported Adverse Events for Automated External Defibrillators (AEDs)
Authors: Joshua Kalarical

Investigation of Reported Adverse Events for Bioresorbable Coronary Artery Stents
Authors: Katherine Shen

Temperature Harmonic Analysis Of Austenitic Niti Under Dynamic Cyclic Loading
Authors: Valentina Pinto, Sofia Di Leonardo, Maria Galeazzo, Gaetano Burriesci, Giuseppe Pitarresi

Analysis of Imidacloprid on Tissue Section Using SALDI-MS Imaging
Authors: Yusuke Suzuki, Koichi Kitada, Shoko Matsushita, Aki Hayashi

Glycoproteins Isolated from Tongkat Ali Plants Capable to Elevate Testosterone in Both in vitro and in vivo Experiments
Authors: Jaya Vejayan, Fatinah Ahmad, Sharifah A.T. Said, Srikumar Chakravarthi, Barani Karikalan

Return to Top

LIST OF PAPERS

Bioengineering and Biotechnology

Repetitive Paired Pulse Magnetic Stimulation Over Spinal Cord Modulates Corticospinal Pathway And Supports Balance Performance: A Randomised Placebo-Controlled Trial
Authors: Veldema Jitka, Steingräber Teni, Klemm Michel, Straub Jan, Kurtzhals Saskia, Sasse Lea

The Spinal Cord Is A Promising Alternative To The Brain For The Application Of Direct Current Stimulation In Supporting Balance Abilities: A Randomised Placebo-Controlled Trial
Authors: Veldema Jitka, Steingräber Teni, von Grönheim Leon, Wienecke Jana, Regel Rieke, Schack Thomas, Schütz Christoph

High Definition Direct/Alternating Current Stimulation of Spinal Cord in Supporting Balance and Sensitivity: A Randomised Placebo-Controlled Trial
Authors: Veldema Jitka, Steingräber Teni, von Grönheim Leon, Klemm Michel, Straub Jan, Sasse Lea

Functionalisation of Polymeric Patches for Skin Tissue Engineering Applications with Plant Oil Additives
Authors: Didem Demir

Mitral Regurgitation And Atrial Fibrillation: An Explorative Fluid-Structure Interaction Study
Authors: Giulio Musotto, Alessandra Monteleone, Danila Vella, Leon Menezes, Andrew Cook, Giorgia Maria Bosi5 and Gaetano Burriesci

Investigating Sex-Dependent Differences in Tensional Homeostasis
Authors: Nourhan El Sherif, Diya Desai, Josephine Dunphy, Marin Perez, Sabrina Wilderotter, Michael Smith, Brianne Connizzo

Return to Top

LIST OF PAPERS

Bioengineering and Biotechnology

A Fully Automatic Multi-Vendor AI-System To Segment And Predict Resistance To Treatment Of Rectal Cancer On MRI
Authors: Jovana Panic, Arianna Defeudis, Lorenzo Vassallo, Stefano Cirillo, Marco Gatti, Antonio Esposito, Serena dell'Aversana, Salvatore Siena, Angelo Vanzulli, Daniele Regge, Samanta Rosati, Gabriella Balestra, Valentina Giannini

Solution to Global Warming By Increasing the Algae Based Products in Biotechnology
Authors: Meltem DALAY

Development And Validation Of An AI-Based Pathomics Biomarker To Predict Response To First-Line Treatment In Metastatic Colorectal Cancers
Authors: Giulia Nicoletti, Debora Cafaro, Valentina Giannini, Gianluca Mauri, Caterina Marchiò, Luca Lazzari, Andrea Sartore-Bianchi, Federica Marmorino, Maria Nieva Munoz, Nadia Saoudi González1, Alberto Puccini, Martina Di Como, Maria Costanza Aquilano, Emanuela Bonoldi1, Salvatore Siena, Silvia Marsoni, Daniele Regge

Linear and nonlinear approaches in processing of neurophysiological data: biomedical and mathematical principles
Authors: Juliana Alexandra Knocikova

An Investigation into EGFR Tyrosine Kinase Inhibitors: Adverse Events, Cost and Prescribing Trends
Authors: Shravani Gote

Comparison of Reported Adverse Events for Two Plant-Derived AntiCancer Therapeutics: Paclitaxel and Docetaxe
Authors: Kaitlyn Abraham

Adverse Effects of Selective Serotonin Reuptake Inhibitors (SSRIs)
Authors: Ria Mani

LIST OF PAPERS

Environmental and Remediation

Smartphone-enabled chemical analysis for environmental monitoring in resource-poor and remote areas
Authors: Izabela Rzeznicka, Phoomwish Promthong, Harison Rozak

Photoelectro- and Photothermal-catalytic Removal of Environmental Pollutants by using 2D and 3D Graphene Oxide Materials
Authors: Jing Shang, Yuhan Liu, Kuang Yu, Mei Yu

Structure-Related Health Effects Of Atmospheric Soot Particles
Authors: Rui Tang, Jing Shang

Construction of a Novel Metal-free Heterostructure Photocatalyst for Enhanced Photocatalytic CO_2 Reduction
Authors: Yuhan Liu, Jing Shang, Yue Wang, Jing Peng

Post-Consumer Textile Recycling: Challenges and Opportunities, Northern Periphery and Arctic Communities' Perspective
Authors: Charmaine Medina, Tatiana Samarina, Anna Tervonen, Outi Laatikainen

Exploring Plasmonic Nanoparticles Inside Cells: A Comprehensive Methodology Integrating Spontaneous and Stimulated SERS, FACS, SEM and ICP-AES
Authors: Aleksei Smirnov, Tamasri Senapati, Ahmed Hasan, Carola Kapfer, Dominik Wigger, Burkhard Kleuser, Eckart Ruehl, Elena Solovyeva, Vladimir Sharoyko

LIST OF PAPERS

Energy Research and Technology

The Application of Visibility Graph and Graph Attention Network for Urban Smart Grid Short-Term Load Forecasting
Authors: Bo Peng

A Peak-Shaving-Oriented Incentive Mechanism for Smart Grids
Authors: Fabio Lilliu, Diego Reforgiato Recupero

Predictive Modelling of PEMFC Degradation Against Hydrogen Crossover Using Machine Learning Models in Matlab
Authors: Ricky Jay Gomez, Dahlia Apodaca, Michelle Almendrala

New Technology in Civil Engineering

Corrosion Assessment of Reinforced Concrete Structures using Ground-Penetrating Radar
Authors: Mercedes Solla, Vega Pérez-Gracia, Simona Fontul

Crack Density and Length Detection using Machine Learning
Authors: Malvika Koushik, Poorna Hegde, Bhawana Rudra

A Framework for an Optimization Process to Locate Electric Vehicle Charging Stations
Authors: Abdullah Al-Juboori, Akmal Abdelfatah, Tarig Ali

Revolutionizing Building Construction with Drone Technology – An Application Review in UAE
Authors: Yousef Alqaryouti, Mariam Al Suwaidi, Raed Mohmood AlKhuwaildi, Hind Kolthoum, Issa Youssef, Mohammed Al Imam

Return to Top

LIST OF PAPERS

Road, Bridge and Railway Engineering

New Insights Into Road Cavity Detection From GPR Data
Authors: Ahmed Elseicy, Mercedes Solla, Pedro Arias

Quantifying Seismic Resilience of Highway Bridges: A Case Study using Bayesian Neural Network
Authors: Jacob Atkins, Farahnaz Soleimani, Donya Hajializadeh

Kernel-based Column Drift Ratios Prediction in Highway Bridges
Authors: Sonia Zehsaz, Sabarethinam Kameshwar, Farahnaz Soleimani

Use of LandInfra Standard for GPR Data Digitization: Towards Sustainable Road Transport Infrastructure
Authors: Gemma Guillamón-Andreu, Mercedes Solla

Searching for Precision in Pavement Evaluation: A Comparative Analysis of Smartphones for Measuring the International Roughness Index (IRI)
Authors: Javier Vasquez-Monteros, Juan Palacios-Ortega, Paulo Samaniego-Rojas, Carola María Gordillo Vera

Return to Top

LIST OF PAPERS

Miscellaneous Topics in Civil Engineering

Effect of Distance on Hydraulic Efficiencies of Successively Located Grate Inlets
Authors: Cumhur Ozbey

Development of RISHA Precast Concrete System for School Buildings Function in Indonesia's Severe Earthquake Regions
Authors: Angga Arief Gumilang Sabaruliman, Yoga Megantara, Yosafat Aji Pranata

Hydraulic design of irrigation networks with optimization methods
Authors: Mireya Lapo-Pauta, Javier Martinez-Solano, Holger Benavides-Muñoz, José Fuerte Díaz

Impact of Horizontal Curves and Gradient on the Speed of Heavy Vehicles on Two-Lane Rural Mountain Roads: Case of the Loja-Catamayo Road
Authors: Maria Soledad Segarra-Morales, Diego Fernando Ortega Lapo, Javier Vasquez-Monteros

Dynamic Analysis of a Slender Building Using Two Parallel Spectral Analysis Methods
Authors: Natalia Ibarra, Alicia Arévalos, Raúl Silva, Iván Quintana, Belén Martínez-Pavetti

Comparing Aerial Photogrammetry with UAV-LIDAR in High Vegetation Rural Areas
Authors: Freskida Abazaj, Arli Llabani, Genti Qirjazi

Analyzing the Impact of Basalt Fiber Concrete on Continuous Beams Reinforced with BFRP Bars Through Numerical Simulation
Authors: Samar Alsaleh, Osama Mohamed

Return to Top

LIST OF PAPERS

Building Materials

Effect of Specimen Size and Shape on the Mechanical Properties of Recycled Aggregate Concrete
Authors: Yahya Salah, Karol Sikora, Kamal Jaafar, Sana Amir

An Investigation on OGFC Mix Made with VG-40 and CRMB-55 Binders
Authors: Pavan Kumar Sharma, Shivani Shukla, Mahabir Panda

Alkali-Activated Mine Tailings and Solid Wastes as Precursors for Geopolymers
Authors: Tatiana Samarina, Arturo Reyes, María Victoria Letelier, Daniza Castillo Godoy, Yimmy Silva Urrego, Jacqueline Cuevas, Esther Takaluoma

Study Of Ceramic Masses Obtained Using Raw Materials Of Technogenic Origin
Authors: Storchai Nadiya, Nazarenko Oleksiy, Berezovska Alona, Storchai Katerina, Zalievskyi Volodymyr

Mask Residues In Asphalt Mixtures For Roads
Authors: Ana Ortiz, Juan García, Juan Guanín

Posters Session

Nanotechnology Approaches for the Development of Next-Generation Dental and Personal Care Products
Authors: Radu Claudiu Fierascu, Irina Fierascu, Anda Maria Baroi, Roxana Ioana Matei (Brazdis), Toma Fistos, Irina Elena Chican, Ioana Silvia Hosu, Lia Mara Ditu

Development of New Nanomaterials and Nanocomposites for Environmental Protection
Authors: Irina Fierascu, Radu Claudiu Fierascu, Anda Maria Baroi, Roxana Ioana Matei (Brazdis), Toma Fistos, Irina Elena Chican, Ioana Silvia Hosu

Development Of Glaucoma Fibrous Implant Made From PVDF And PEO
Authors: Radek Jirkovec, Anna Tauchmanova, Andrea Klapstova, Jiri Chvojka

LIST OF PAPERS

Posters Session

Sn(IV) porphyrin-Incorporated Metal Oxide Nanomaterials for Visible Light-Active Photocatalytic Water Remediation
Authors: Nirmal Kumar Shee, Hee-Joon Kim

Promotional Effects And Risks Of Multi-Walled Carbon Nanotubes On Phytoremediation Of Plastic Films
Authors: Haoran Liu, Lena Ciric, Manni Bhatti

Automated Weighing of PM Filters: Impact of Equilibration Duration
Authors: Kamila Widziewicz-Rzońca; Patrycja Rogula-Kopiec; Sławomir Janas; Piotr Oskar Czechowski;

Mechanochemistry Applications in the Remediation of Potentially Toxic Elements
Authors: Chenhao Wu, Caroline Kirk

Evaluating The Efficiency Of Various Reactive Media Removing Uranium From Groundwater
Authors: Beatriz Carbonell, Elena Torres, Antonio Garralón, Belén Buil, María Jesús Turrero

Evaluating Microplastic Pollution in the St. John's River: A Multi-County Analysis and Exploring Novel Ferrofluid Remediation Approaches
Authors: Rhea Bagchee

Return to Top

LIST OF PAPERS

Poster Session

Conceptual Cloud-Based Sliding Mode Speed Control for Synchronous Motors
Authors: David Marcos-Andrade, Francisco Beltran-Carbajal, Ivan Rivas-Cambero, José Humberto Arroyo-Núñez, Gilberto Alvarez-Miranda, Jose Luis Hernandez-Avila

Effects Of Feeding Cycles On The Microbial Community In The Biofilter Of A Recirculating Aquaculture System
Authors: Martyna Godzieba, Piotr Hliwa, Slawomir Ciesielski

Decisions Supporting System for Safety Management of Agricultural Dam in Korea Peninsula
Authors: Byoung-Han Choi, Baeg Lee, Seok-Man Kang

Experimental Modelling of Washboard Phenomenon in Unpaved Roads
Authors: María José Torres, Bernardo Caicedo, Pablo Alvarado, Laura Ibagon Fabricio Yépez

Enhancing Nonlinear Solitary Wave Propagation Device using PLA Plate
Authors: Pablo Alvarado, Bernardo Caicedo, María José Torres, Juan P. Villacreses, Fabricio Yepez

Plasma Treatment for Mould Inactivation on Building Materials: Surface Coverage Evaluation with Automated Image Analysis
Authors: Mária Domonkos, Petra Tichá, Jana Jirešová, Eliška Lokajová, Kamila Zdeňková, Vladimír Scholtz, Pavel Demo

LIST OF PAPERS

Poster Session

Model-Based Analysis of Effective Inactivation of Aspergillus Brasiliensis by Non-thermal Atmospheric Plasma
Authors: Petra Tichá, Mária Domonkos, Filip Přeučil, Eliška Lokajová, Jana Jirešová, Kamila Zdeňková, Vladimír Scholtz, Pavel Demo

Integrating Sea Level Considerations into Civil Engineering Practice
Authors: Bledar Sina, Eduart Blloshmi, Arli Llabani

A Comparison of Photogrammetric Methods for the 3D Surveying of Civil Buildings
Authors: Arli Llabani, Eduart Blloshmi, Bledar Sina

GNSS "Global Navigation Satellite Systems" Applications in Modern Civil Engineering Projects
Authors: Eduart Blloshmi, Bledar Sina, Arli Llabani

LIST OF PAPERS

Innovations and Advancements

Digital Twin Applications In Construction: Creation And Interaction Of Virtual And Data LayersDigital Twin Applications In Construction: Creation And Interaction Of Virtual And Data Layers
Authors: Yingpei Sun, Qing Wang, David Toll, Stefan Szyniszewski1

High-Static-Low-Dynamic Vibration Isolator Component Designed By Topology Optimization with Hyperplastic Material
Authors: Yu-Hsin Kuo, Wen-Nan Cheng, Chih-Chun Cheng, Chung-Yu Tsai, Tzu-Fan Chiang, Cheng-Kuo Sung, Chien-Sheng Liu

Enhancing Construction Efficiency through Last Planner System: A Study of Cultural Integration and Team Feedback Dynamics
Authors: Rozi Karimi, Milad Baghalzadeh Shishehgarkhaneh, Robert C. Moehler, Yihai Fang

Calculating Rainfall Flow in a Substation Hydraulic System
Authors: Varvara Roubtsova, Mathieu Emond-Castonguay, Nathalie Thibeault

Bond Performance of GFRP Bars Embedded into Low Carbon Concrete and Portland Cement Blocks
Authors: Manjola Caro, Victor Wiles, Matthias Nahum

Development of a New Laboratory Earthquake Setup Featuring a Paraffin oil-based Gel as Analogue Material
Authors: Abdallah Aoude, Ioannis Stefanou, Jean-François Semblat, and Vito Rubino

Integration of Finite Element Simulations and Experimental Validation in the Analysis of Demountable Clamp Joints for Steel Structures
Authors: Fernando Nunes Cavalheiro, Manuel Cabaleiro, Borje Conde1 Brais Barro

Agile Frameworks in Construction Project Management: A Systematic Review
Authors: Yvan Huaricallo Vilca, Jeremy Becerra León

LIST OF PAPERS

Innovations and Advancements

Assessing the Impacts of Autonomous Vehicles for Freeway Safety
Authors: Hisham Y. Makahleh, Haitham A. Badrawi, Akmal Abdelfatah

Assessment and Retrofitting Of a Multi-Storey Reinforced Concrete Building
Authors: Ilias Kouremenos, Salomi Papamichael, Anthos Ioannou, John Bellos

Life Cycle Assessment of Conventional and Sustainable Villas in the United Arab
Emirates: A Comparative Case Study
Authors: Maryam Elgzeary, Bushra Tatan, Omar Ibrahim, Hazem Gouda

Expansion of flood control capacity in design standard of agricultural dam
Authors: Baeg Lee, Byoung-Han Choi

Earthquake Vulnerability Evaluation of Istanbul's Districts Using DEA-Based Models
Authors: Mehmet GÜDELEK, E.Ertugrul KARSAK

Nanotechnology: Fundamentals and Applications

Neutron Scattering Strategies for Investigating Internal Architecture of mRNA Lipid
Nanoparticle
Authors: Haikun Liu, Mark Louis P. Vidallon, Sylvain Trepout, Mitchell J. Moon, Marina Cagnes,
Nageshwar Rao Yepuri, Rico Tabor, Karlheinz Peter, Liliana de Campo, Xiaowei Wang

Multi-channel Microfluidic Particle Counter via Optical Absorption Sensing
Authors: Qingyue Xian, Xiao Luo, Jie Zhang

Revealing the Structural Intricacies of Biointerfaced Emulsions with Neutron Scattering
Authors: Mark Louis P. Vidallon, Ashley P. Williams, Mitchell J. Moon, Haikun Liu, Sylvain Trépout,
Alexis I. Bishop, Boon Mian Teo3, Rico F. Tabor, Karlheinz Peter, Liliana de Campo, Xiaowei Wang

Return to Top

LIST OF PAPERS

Air Pollution and Treatment

Tire Particles Of Different Sizes Induce A Proinflammatory Response Of Varying Intensity In Lung Cells
Authors: Abderrahmane Bouredji, Jérémie Pourchez, Valérie Forest

IoT and Machine Learning Enhanced Techniques for Early Ocean Pollutant Detection and Tracking Systems
Authors: Miquel Massot-Campos, Ayodeji O. Abioye, Loitongbam Gyanendro Singh, Arturo Vazquez-Galvez, Yan Wu and Henrik T. Sykora

Assessment of Air Quality Using Personal Exposure Sensors during the 2023 Dhofar Monsoons Period
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Comparative Analysis of VOC Emissions between New and Old Plants of a Light Oil Cracking Company
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ENVIRONMENTAL POLLUTION OF THE CASPIAN REGION OF AZERBAIJAN
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Authors: Ziqi Jiang, Yinchuang Yang, Huihe Qiu

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Authors: Lamya Al Qahtani, Munirah Aldossary, Fadia El Hamami, Ala A. Hussein

Real-Time Algebraic Estimation of Variable Torque and Parameters in Controlled Synchronous Motors
Authors: Alexis Castelan-Perez, Francisco Beltran-Carbajal, Ivan Rivas-Cambero, David Marcos-Andrade, Jesús C. Hernandez, Romy Perez-Moreno

Return to Top

LIST OF PAPERS

Wastewater Management and Treatment

Removal Of Ibuprofen From Wastewaters By Aluminum Modified Hybrid Porous Activated Carbon Derived From Coconut Shells
Authors: Athanasia K. Tolkou, Natalia Malouchi, Ramonna I. Kosheleva, Pavlos Efthymiopoulos, Kalliopi Ladomenou1, Michail Chalaris, Athanasios C. Mitropooulos, Ioannis A. Katsoyiannis, George Z. Kyzas

Advancing Produced Water Treatment: Hollow-Fiber Membrane Efficiency in Oil-Water Separation
Authors: Abdalrahman Alsulaili, Sarah Alshawish, Carolyn M. Cooper, Lynn E. Katz, and Frank Seibert

Remediation Activities in Italian Superfund Sites: the case study of Naples - Bagnoli
Authors: S. Bellagamba, F. Paglietti1, S. Malinconico, G. Bonifazi, S. Serranti, A. Aurigemma

Sustainable Energy

Combining Electricity and Ecological Resilience - Towards a New Holistic Framework
Authors: Maria Andersson, Louise Ödlund, Patrik Thollander

Challenges in the Future Swedish Energy System
Authors: Louise Ödlund, Maria Andersson

Experimental Research On Effect Of Activating Temperature On Combustion And Nox Emission Characteristics Of Pulverized Coal In A Novel Purification-Combustion Reaction System
Authors: Kun Su, Ziqu Ouyang, Hongliang Ding

Energy and Economic Comparison Between Traditional APV and Concentrating APV-CPV Agrivoltaic Systems
Authors: Olga Di Marino, Carlo Renno

Investigation On Wide-Load Regulation With Fuel Fluidized Modified Combustion System Coupling With A Thermal Combustible Particle Storage Unit
Authors: Hongliang Ding, Ziqu Ouyang, Kun Su

Return to Top

LIST OF PAPERS

Environmental Protection

Sustainable Practices and Environmental Impact Assessment in a Lifelong Learning Center
Authors: Jarotwan Koiwanit, Yonrapach Areerob, Sakkarin Saepoo, Viachaslau Filimonau

Comparing Perennial Grasses in a Phytoremediation Field Trial for Soil Hydrocarbon Removal – Fuel Depot, north-west Victoria, Australia
Authors: Robert McKenzie, Jai Sudholz

Critical Metals Removal Via Sustainable Solvent Extraction Technique From Metal Scrap Recycling Waste
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Features Of Compost Made From Eggshells And Coffee Beans For Green Cos Lettuce Cultivation
Authors: Thipsuree Kornboonraksa, Mookanda Thanomdee, Suriyada Nathai and Jaruwan Songsanthia

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Return to Top

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Return to Top

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Return to Top

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Return to Top

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Return to Top

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Return to Top

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Return to Top

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Return to Top

Development of RISHA Precast Concrete System for School Buildings Function in Indonesia's Severe Earthquake Regions

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Abstract - This paper aims to convey the results of the development of dry joint modular precast concrete system for school buildings function in the severe earthquake areas of Indonesia with values of $Ss \geq 0.911$ and $S1 \geq 0.391$. The numerical model of the structure was developed by utilizing the partial experimental test results from various type of structural member joints of the system. From the results of these tests, the nonlinear behavior of each type of structural joints in the form of a moment vs rotation curve is obtained to be implemented in the structural model using nonlinear link elements in order to represent the nonlinear behavior of the structure. The contribution of strength and stiffness of the infilled masonry walls using lightweight Autoclaved Aerated Concrete (AAC) brick is modelled through nonlinear strut elements whose behavior has been calibrated with experimental test results. A pushover analysis in the numerical model was carried out to obtain the system capacity curve of the proposed building structure with the typology of the school building. The results of performance point evaluation of the structural capacity curve using methods of ATC-40 and FEMA 440 in various loactions of severe earthquake areas in Indonesia show that the performance of Damage Control (DC) was achieved by providing a horizontal steel frame at the topmost elevation of the building structure in order to obtain the diaphragm behavior in each structural module.

Keywords: dry joint, modular, precast concrete, RISHA, school building, pushover analysis

1. Introduction

RISHA (abbreviation for *Rumah Instan Sederhana Sehat* / Instant home, simple, 'healthy') is a precast concrete system with bolted connection that was developed by Research Institute of Human Settlements, Department of Public Works of Republic Indonesia in 2004. The precast concrete structure comes with three reinforced concrete structural components namely P1, P2, and P3. The beam components in RISHA structure are assembled by the P1 components while the column components are assembled by the combination of P1 and P2 that can be formed to the L, T, and Plus column section shape [1]. Initially, the precast concrete system was designed as modular volumetric structure with the standard modular dimension of 3x3x3 m³ for residential function. The standard modular structures then are replicated in order to achieve the targeted dimension of the overall structure.

One of the advantages of a precast system like RISHA is the good economic value obtained when it is mass-produced [2]. A study prove that houses with RISHA technology have advantages in terms of cost and duration of construction [3]. In addition, the application of this precast system also has advantages in terms of environmental friendliness which is achieved through the efficient use of concrete volume compared to conventional buildings [4].

Currently, there are some needs of the RISHA precast concrete system to be implemented for school buildings that obviously need larger structure. This lead to the extension in the dimension of the precast concrete system standard volumetric modular structure up to 9x9x4.5m³ from the initial design of 3x3x3 m³ as illustrated in Figure 1 to meet the minimum size requirement of a classroom in Indonesia.

In year 2021, Directorate of Housing and Settlement Engineering Development, Directorate General of Human Settlements, Ministry of Public Works and Housing, conducted a research about development of the precast concrete system in order to be implemented for school building. The research involved the combination of several experimental

laboratory tests and analytical works. As the result, this paper proposes the configuration and design for the modular precast concrete structure for school building applications in the severe earthquake areas in Indonesia with values of Ss ≥ 0.911 and S1 ≥ 0.391.

(a) Standard volumetric module   (b) Extended volumetric module
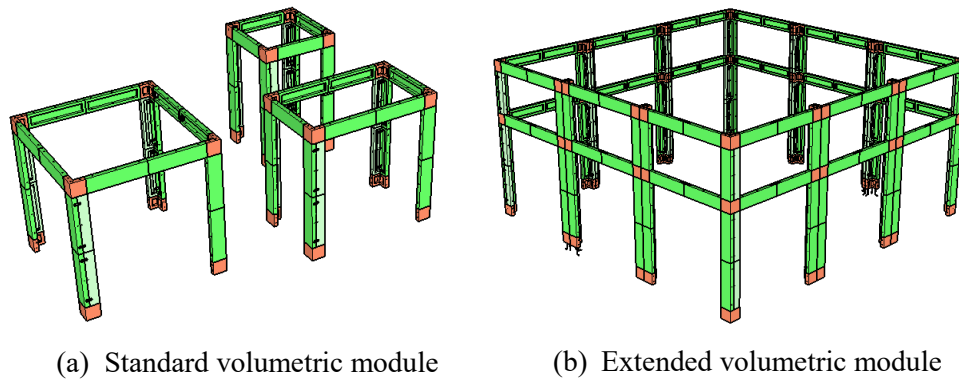
Fig. 1: Standard and extended volumetric module of the proposed precast concrete structure.

2. Literature Review
2.1. Precast Structure Modelling Strategy Literature Review

Modeling the joint behavior of precast reinforced concrete elements is a complex mathematical problem. When calculating conventional reinforced concrete structures, the structural elements are assumed to be an integral monolith system. Meanwhile, this assumption does not apply to precast concrete systems where the connection behavior model can only be known through experimental studies. Each type of precast joint system has a different behavior from one another. The actual computational model for the analysis of precast joints has resulted in the introduction of semi-rigid joint systems.

One method that can be applied to model semi-rigid connections in structural models is to use nonlinear link elements at the connection points. With these link elements, the stiffness matrix and the equivalent load matrix can be modified so that the effect of the connections on the behavior of the structure can be modeled [5]. Various studies [6-11] show that the dry bolted precast concrete connection has the benefits of better ductility and energy dissipation ability, and more convenience in assembling. Equivalent stiffness formulation methods to simplify the analysis of precast concrete frame structures with semi-rigid joints can also be used [12].

2.2. Experimental Study

The experimental laboratory tests are mainly purposed to understand the nonlinear behavior of joint connections that exist in the proposed system. A number of cyclic loading tests were performed partially to obtain the nonlinear behavior of each joint type such as column to foundation joint and beam to column joint [18]. Further the results of those partial joint tests have been processed and analyzed to develop a well calibrated numerical model of the proposed system.

3. Materials and Methods
3.1. Specimen Description

The experimental tests were conducted using the precast concrete components that were produced without a mix design process in order to get the minimum strength data that represents the poor material condition which is frequently found in the fields. Here the concrete for the specimens were produced using 2 cements : 3 sands : 4 screen agregate composition that have the average compressive strength of 17 MPa. This specimen is used in order to get the minimum strength for research use only, while the actual authorized guideline still specifies fc' of 25 MPa for new construction.

The mechanical connection components such as bolt and strip plate were using the standard connection dimension where the diameter of bolts are 12 mm (M12 bolt) while the strip plates for bolted connection pad were 2 mm thicks and

30 mm wide. The material of M12 bolts are ASTM A307 while the strip plates are using galvanized steel materials with yield stress (fy) of 250 MPa. The examples of some structural components photopgraphs is presented in Figure 2.

Fig. 2: Examples of some structural components photographs.

3.2. Precast Structure Joint Connection Nonlinear Behavior

As mentioned above, the precast joint connections nonlinear behaviors in this research were obtained by a number of partial joint connections cyclic loading tests. In this research, partial joint connections tests were performed for an exterior beam-column joint connection and several column joint connections. The results of each capacity curves then are converted into momen-rotation curves that represent the semirigid behavior of each connections.

The typical setup of the column joint connections for all column section types is illustrated in Figure 3. The rotation of the column joints are calculated by processing the the displacement datas that are recorded by some transducers located around the lower part of the column as depicted in Figure 3. The momen-rotation curves of several column types of the proposed system such as column L, T, and Plus' in both orthogonal directions of the column sections are presented in Figure 4, while the momen-rotation curve of the exterior beam-column joint connection followed by it's cyclic loading test configuration is presented in Figure 5. It is necessary to note that all of the column joint tests are conducted in form on fully anchored condition as specified in the official RISHA guideline (no bolt holes in the column-to-foundation connection are left empty).
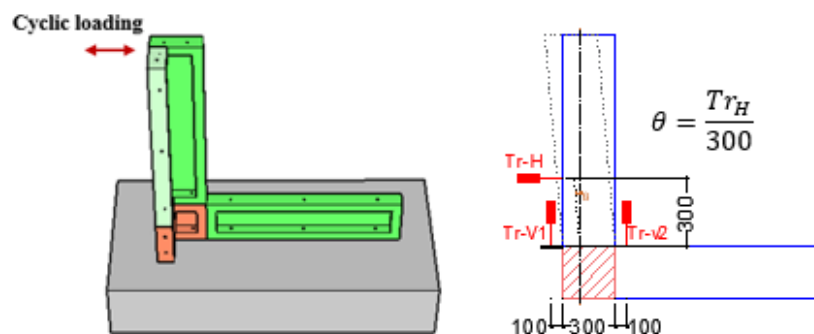
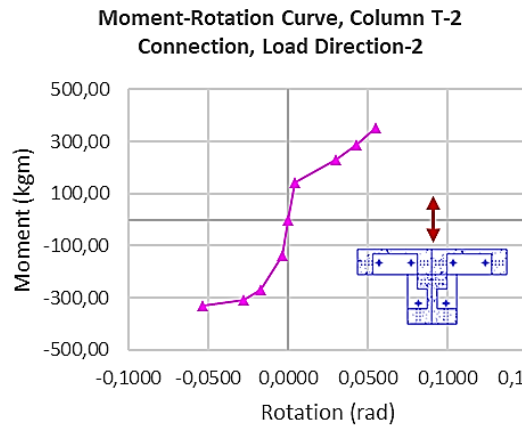Fig. 3: Typical setup of the column joint connections.
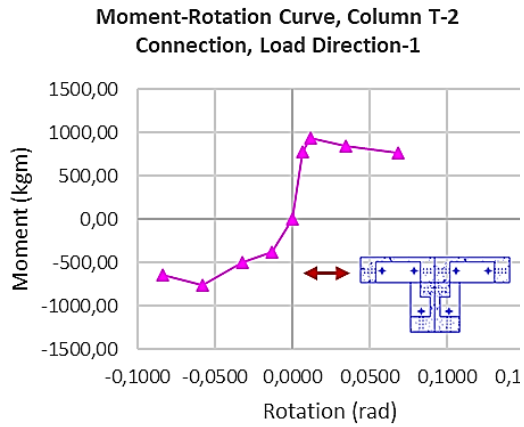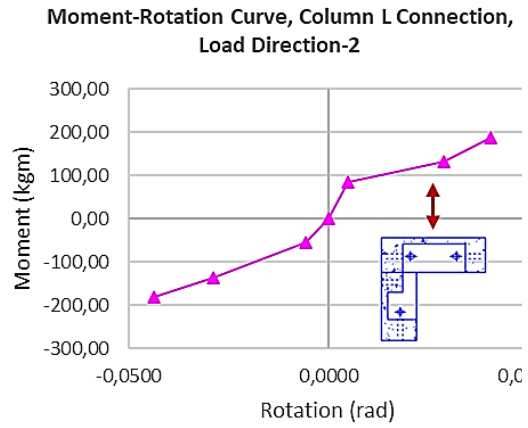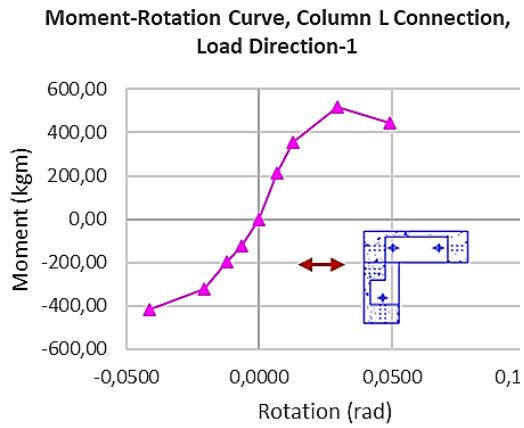
$$\theta = \frac{Tr_H}{300}$$
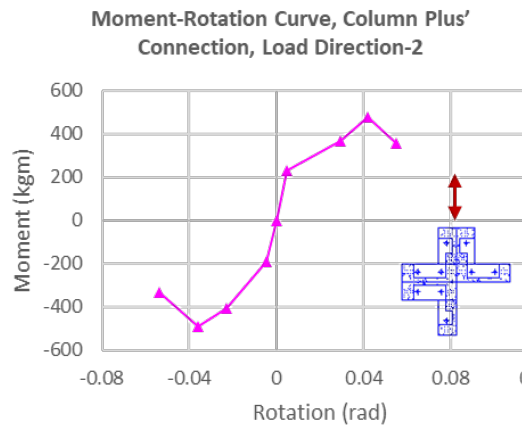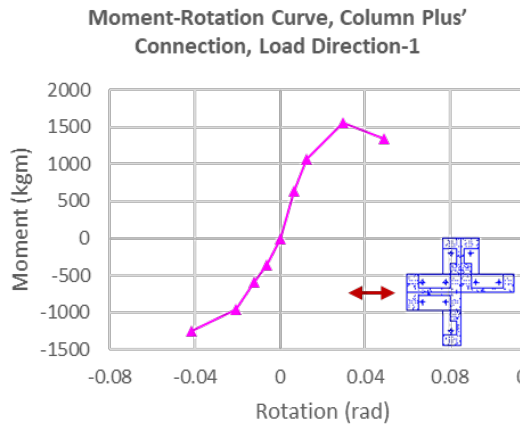
Fig. 4: The momen-rotation curves of several column types of the proposed system.
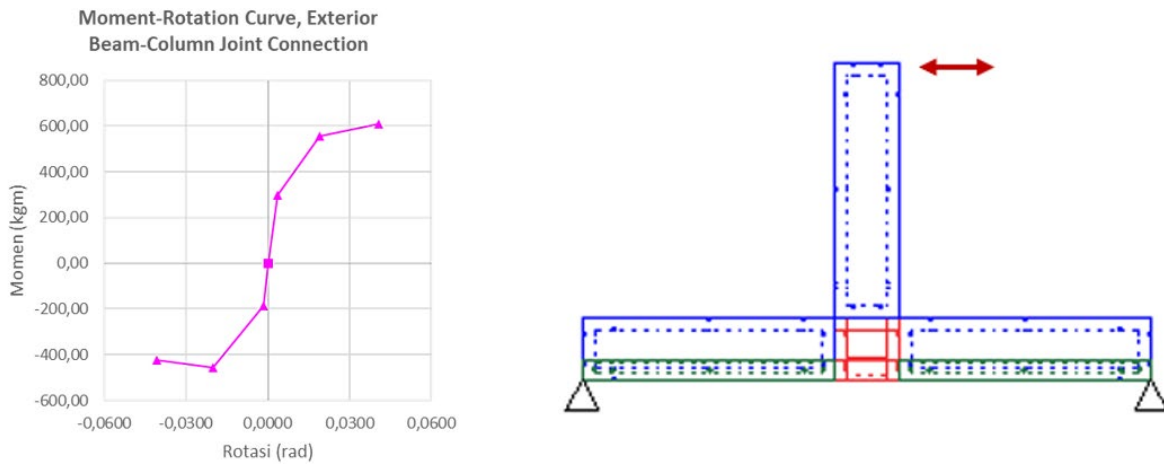
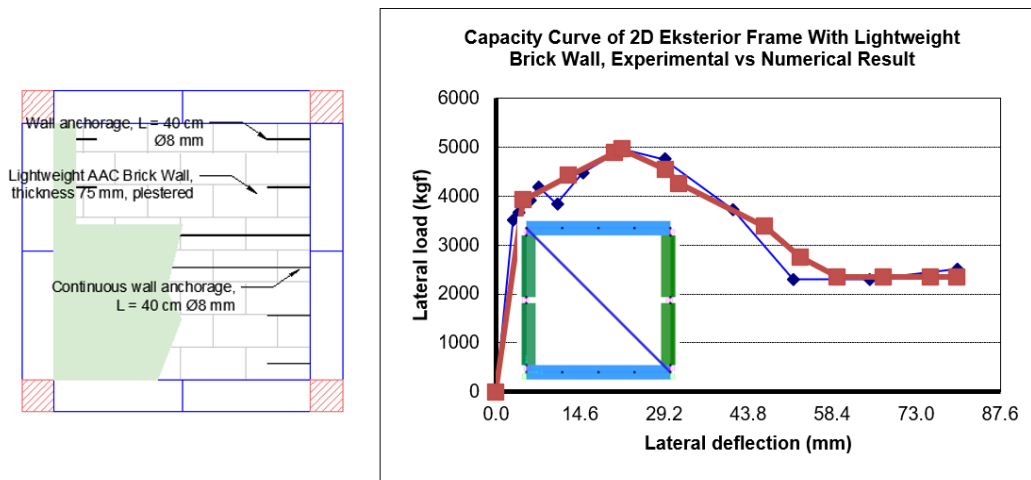Fig. 5: The momen-rotation curves of exterior beam-column joint of the proposed system.

Fig. 6: Compression strut element calibration for lightweight brick wall modeling.

3.3. Lightweight Brick Wall Strength Contribution

The strength and stiffness of the infilled wall contribution on the overall building structure is considered by modelling a diagonal compression strut element inside a frame structure. The strut element behavior is calibrated by a cyclic loading test of 2D frame specimen with 75mm thick plastered lightweight AAC brick wall. The lightweight bricks wall are anchored to the frame structure as illustrated in Figure 6 (left). Figure 6 (right) shows the calibration result of the strut element where the numerical model capacity curve meet the experimental result. The opening of the wall is considered by applying a reduction factor of the strut element strength of 0.5 considering the ratio of opening in each structural frame in the school prototype to be proposed.

3.4. The Proposed Structural Configuration

Some structural configuration adjustments are proposed for the prototype of the school building. The strip plate dimension of the mechanical connection is recommended to be increased using a thickness of a minimum of 2.5 mm and approximately 40 mm wide. The minimum compressive strength of the concrete materials should be 25 MPa as

stated in the official RISHA componet fabrication guideline. All of the techncial rules of RISHA connection system including column anchorage to foundation and wall anchorages should be followed.

In order to get better dynamic behavior for the overall building structure, the steel stiffener frames that are located on the building top elevation at the extended volumetric module of the structure are introduced. The stiffener frames consist of UNP 100x50x5x7.5 beams that are supported by longitudinal UNP 150x75x6.5x10 girders. The diagonal members using Pipe 3.5 inch on each corner of the modules are also installed. Figure 7 illustrates the configuration of the steel brace frames on the proposed school building with four class rooms. Additionally, some 5 mm thick steel plates installation at the joints of the perimeter interior columns at an elevation of +3.00 meters of the structure is also proposed. This led to the improvement of the joint rigidity of the column-to-column connections. The location and 3D visualization of the steel plate placements are presented in Figure 8.
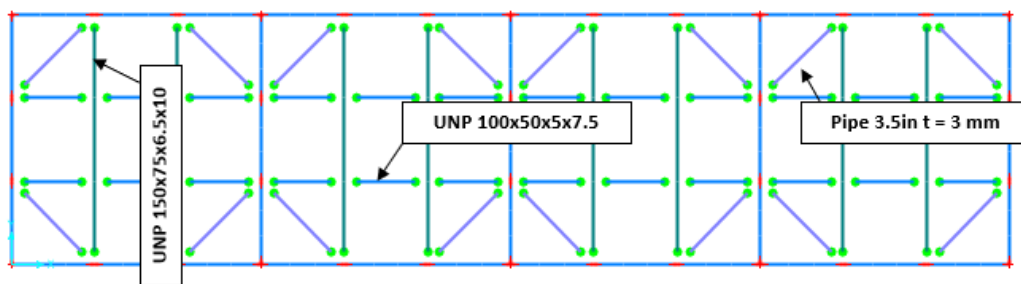

Fig. 7: Steel brace frames on the building top elevation for extended module of the proposed structure.
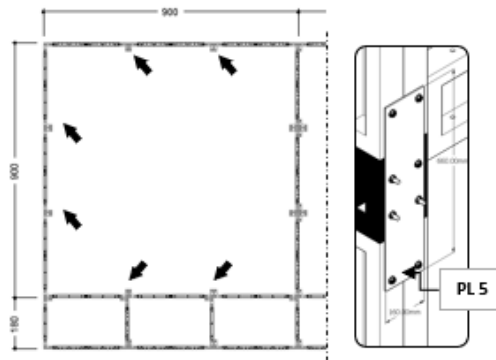

Fig. 8: Steel plates at the joints of the perimeter column at an elevation of 3 meters of the structure.

4. Results and Discussions
4.1. Structure Numerical Modelling

The structural performance of the proposed system is evaluated using the developed numerical modeling methodology for this precast structural system where the semirigid nonlinear behavior of each structural joint connections are modeled using nonlinear link elements that consists of the momen-rotation definitions related to each joint types as given in Figure 4 and Figure 5. The idealization method for the numerical model and the calibration result of the numerical model according to the capacity curve from the 2D frame cyclic test is depicted in Figure 9a.

In this research, the structural performance evaluation of protoypte building is conducted on the school building with four classrooms of 9x9x4.5 m³ size with a corridor in front of the building as shown in Figure 9b. For a conservative reason, this prototype model is taken because it is expected to be the largest extended volumetric model for each classroom. The numerical modeling of the structure is conducted using SAP2000.

4.2. Pushover Analysis and Performance Evaluation

The result of pushover analysis of the prototype structure in both X and Y directions are presented in Figure 10. There is a difference in the stiffness between Push-X and Push-Y due to the asymmetric orientation of the structural columns and the difference in the masonry-infilled walls density in each direction. The structural performance evaluation will be conducted using ATC-40 and FEMA 440 Equivalent Linearization methods. The monitored joint displacement in each loading direction is selected to the joint with the largest deformation of the top elevation for conservative reason. However, the installed steel brace frame induce a diaphragm behaviour at the top elevation of the structure so the deformation of any joint nodes in the highest elevation of the structure are approximately the same.

There are six locations that are selected for structural performance evaluations. All of them are locations with severe earthquake hazard in Indonesia with values of $Ss \geq 0.911$ and $S1 \geq 0.391$ except Manokwari city. The interstory drift limit of 0.015 is taken for the Damage Control performance according to ATC-40 as shown in Table 1. The result of structural performance evaluation according to ATC 40 and FEMA 440 Equivalent Linearization methods are presented in Table 2 and Table 3 respectively, while the sample of performance point results calculated from the computer program are depicted in Figure 11 to Figure 14. It is seen that the prototype structure reaches the Damage Control performance (DC) which means that the structural components are expected not to experience damages after the design earthquake and only some minor repairs for nonstructural elements are necessary.
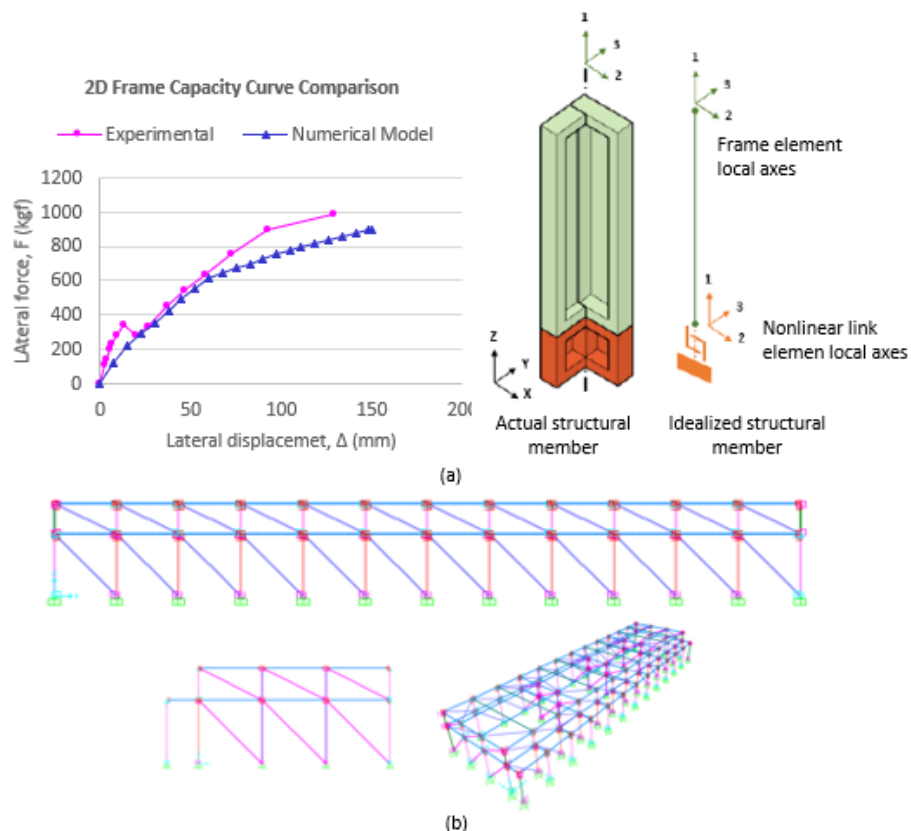

Fig. 9: (a) Nonlinear behaviour modelling and calibration for the numerical model using nonlinear link element for each joint; (b) Numerical model of the school building prototype with four 9x9x4.5 m^3 size for each classrooms.
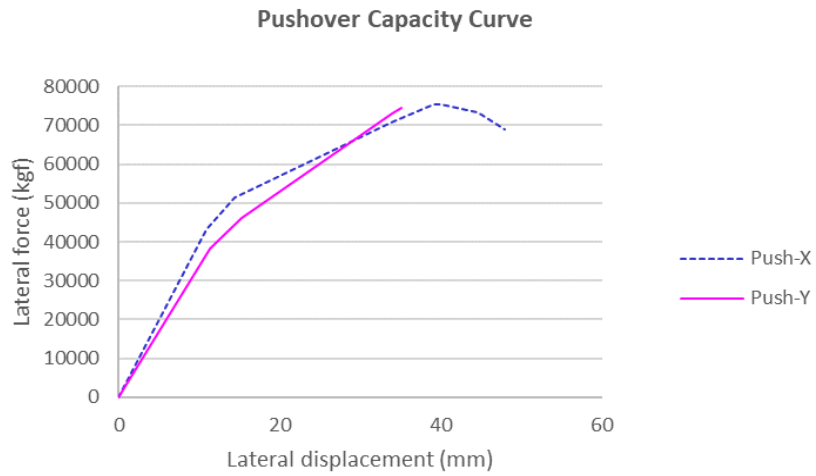
Pushover Capacity Curve

Fig. 10: Pushover capacity curve of the prototype model.

Table 1: Performance level limit according to ATC-40.

Interstory drift limit	Performance level			
	Immediate Occupancy	Damage Control	Life Safety	Structural Stability
Maximum total drift	0.01	0.01 - 0.02	0.02	0.33 Vi/Pi
Maximum inelastic drift	0.005	0.005 - 0.015	No limit	No limit

Table 2: ATC 40 performance evaluations.

No.	Lokasi	Coeff. ATC-40		Performance Point		d/h	Performance
		Ca	Cv	V (kgf)	d (m)		
1	Banda Aceh SD	0.570	0.998	72645.84	0.0340	0.0113	DC
	Banda Aceh SE	0.474	1.170	64516.04	0.0280	0.0093	DC
2	Bengkulu SD	0.600	1.020	74341.02	0.0350	0.0117	DC
	Bengkulu SE	0.480	1.200	65005.66	0.0280	0.0093	DC
3	Gorontalo SD	0.600	1.020	74341.02	0.0350	0.0117	DC
	Gorontalo SE	0.480	1.200	65005.66	0.0280	0.0093	DC
4	Jayapura SD	0.600	1.050	74341.02	0.0350	0.0117	DC
	Jayapura SE	0.540	0.495	70035.78	0.0320	0.0107	DC
5	Palu SD	0.600	1.020	74341.02	0.035	0.0117	DC
	Palu SE	0.480	1.200	65005.66	0.028	0.0093	DC
6	Mamuju SD	0.642	1.080	71949.43	0.034	0.0113	DC
	Mamuju SE	0.510	1.275	67489.83	0.03	0.0100	DC

Table 3: FEMA 440 equivalent linearization performance evaluations.

| No.	Lokasi	Coeff. ATC-40		Performance Point		d/h	Performance
		Ca	Cv	V (kgf)	d (m)		
1	Banda Aceh SD	0.570	0.998	70425.59	0.0340	0.0113	DC
	Banda Aceh SE	0.474	1.170	74410.63	0.0350	0.0117	DC
2	Bengkulu SD	0.600	1.020	69094.13	0.0340	0.0113	DC
	Bengkulu SE	0.480	1.200	74227.86	0.0350	0.0117	DC
3	Gorontalo SD	0.600	1.020	69094.13	0.0340	0.0113	DC
	Gorontalo SE	0.480	1.200	74227.86	0.0350	0.0117	DC
4	Jayapura SD	0.600	1.050	69094.13	0.0340	0.0113	DC
	Jayapura SE	0.540	0.495	72099.53	0.0340	0.0113	DC
5	Palu SD	0.600	1.020	69094.13	0.034	0.0113	DC
	Palu SE	0.480	1.200	74227.86	0.035	0.0117	DC
6	Mamuju SD	0.642	1.080	67172.58	0.033	0.0110	DC
	Mamuju SE	0.510	1.275	72991.28	0.035	0.0117	DC
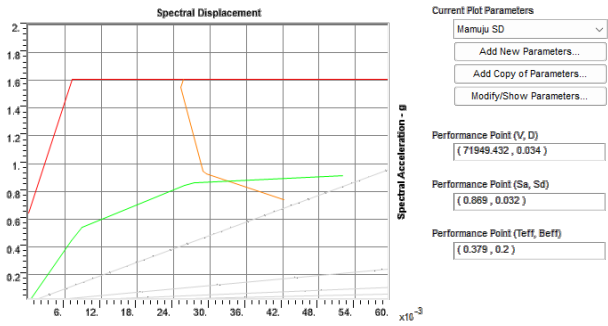
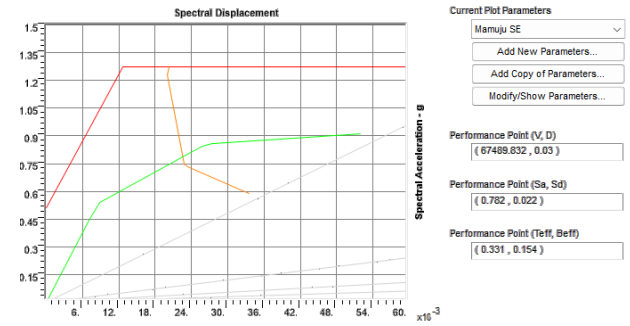Fig. 11: ATC 40 performance point sample on Mamuju SD.

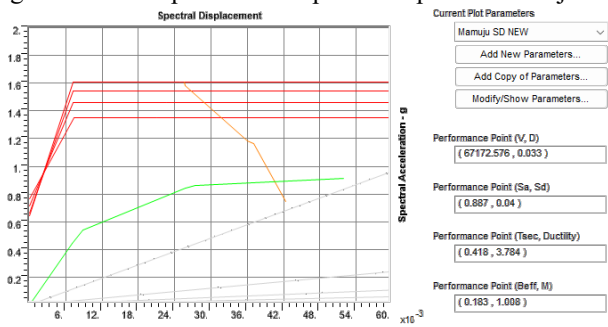Fig. 12: ATC 40 performance point sample on Mamuju SE.

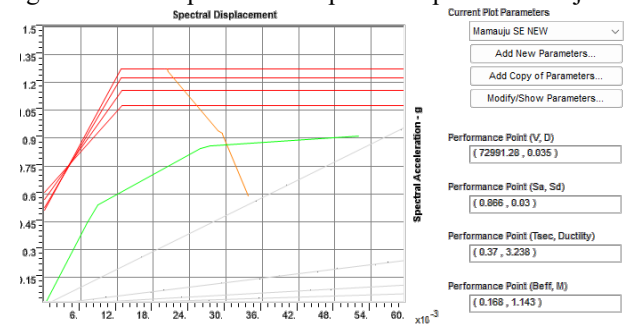Fig. 13: FEMA 440 equivalent linearization performance point sample on Mamuju SD.

Fig. 14: FEMA 440 equivalent linearization performance point sample on Mamuju SE.

5. Conclusion

The performance point evaluations of the proposed precast concrete school building prototype using ATC-40 and FEMA 440 Equivalent Linearization methods in some Severe Earthquake hazard areas in Indonesia show that the performance of Damage Control (DC) was achieved. It means that the structural components are expected not to experience damages after the design earthquake and only some minor repairs for nonstructural elements are necessary.

However, the capacity curve of the numerical model that is obtained in this research is still considering the poor quality of concrete materials. By updating the moment-rotation and other material properties definitions such as the concrete compressive strength of a minimum 25 MPa as specified in the proposed technical guideline, would lead to higher structural capacity curve.

Acknowledgements

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