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THE 3rd INTERNATIONAL CONFERENCE OF EUROPEAN ASIAN CIVIL ENGINEERING FORUM (EACEF) 2011, GERMAN ALUMNI NIGHT, and Half Day Seminar of German Professors

Theme: Designing and Constructing in Sustainability

Organized by:



Supported by:



**Deutscher Akademischer Austausch Dienst
German Academic Exchange Service**

Yogyakarta, 20 - 22 September 2011

Introduction:

This report is consisted of three activities, joint cooperation between Universitas Atma Jaya Yogyakarta (UAJY), Universitas Pelita Harapan (UPH), University of Stuttgart, University of Kassel, supported by DAAD through Grant for Alumni Events.

The committee has been also supported by The Ministry of Public Works of Republic of Indonesia and The Embassy of Federal Republic of Germany.

1. THE 3rd INTERNATIONAL CONFERENCE OF EACEF 2011

In September 2010, Prof. Dr.-Ing. Harianto Hardjasaputra set up the International Scientific committee, chaired by Prof. Dr.-Michael Schmidt (University of Kassel).

INTERNATIONAL SCIENTIFIC COMMITTEE

Chairman: Prof. Dr.-Ing. Michael Schmidt (University of Kassel, Germany)

Structural and Construction Engineering

Prof. Dr.-Ing. Dr.-Ing. E.H. Werner Sobek (University of Stuttgart, Germany)
 Prof. Dr.-Ing. Harianto Hardjasaputra (Universitas Pelita Harapan, Indonesia)
 Prof. Yoyong Arfiadi, Ph.D. (Universitas Atma Jaya Yogyakarta, Indonesia)
 Prof. Ir. Dr. Mahmood Md. Tahir, B.Sc. (Universiti Teknologi Malaysia, Malaysia)
 Prof. Dr.-Ing. Johannes Tarigan (Universitas Sumatera Utara, Indonesia)
 Prof. Dr.-Ing. Karl-Heinz Reineck (University of Stuttgart, Germany)
 Prof. Ir. Iswandi Imran, Ph.D (Institut Teknologi Bandung, Indonesia)
 Prof. Kuo-Chun Chang (National Taiwan University, Taiwan)
 Prof. Andy Chit Tan, Ph.D. (Queensland University of Technology, Australia)

Construction Management and Project Management

EACEF 2013• **Gallery**

Prof. Weng Tat Chan (National University of Singapore, Singapore)
 Prof. Dr.-Ing. Michael Korn (University of Karlsruhe, Germany)
 Prof. Khrisna Mochtar, Ph.D. (Institut Teknologi Indonesia, Indonesia)
 Prof. Dr.-Ing. Hans Wilhelm Alfen (Bauhaus-University of Weimar, Germany)
 Prof. I-Tung Yang Ph.D (National Taiwan University of Science and Technology)

EACEF 2011• **Gallery****Infrastructure (environmental, coastal, transportation, water) Engineering**

Prof. Nur Yuwono, Ph.D. (Universitas Gadjah Mada, Indonesia)
 Prof. Dr.-Ing. Jürgen Hothan (Leibniz-University of Hannover, Germany)
 Prof. Tawatchai Tingsanchali (Asian Institute of Technology, Thailand)
 Prof. Shunji Kusayanagi (Kochi University of Technology, Japan)

EACEF 2009• **Gallery****Geotechnical Engineering**

Prof. Ir. Masyhur Irsyam, PhD (Institut Teknologi Bandung, Indonesia)
 Prof. Chang-Yu Ou, Ph.D (National Taiwan University of Science and Technology, Taiwan)
 Prof. Jianye Ching, Ph.D (National Taiwan University, Taiwan)
 Prof. Horn-Da Lin, Ph.D (National Taiwan University of Science and Technology, Taiwan)

EACEF 2007• **Gallery****Building Materials Engineering and Nanotechnology**

Prof. Dr.-Ing. Michael Schmidt (University of Kassel, Germany)
 Prof. Yin-Wen Chan, Ph.D (National Taiwan University, Taiwan)
 Prof. Dr. Ir. Irwan Katili (Universitas Indonesia, Indonesia)
 Prof. Hilmi Bin Mahmud, Ph.D (Universiti Malaya, Malaysia)
 Prof. Dr.-Ing. Ludger Lohaus (Leibniz University of Hannover, Germany)

The member of ISC comes from the international universities in Europe, Asia, and Indonesia. They were assigned based on their expertise each to review the submitted abstracts & papers.

The civil engineering department of Universitas Atma Jaya Yogyakarta was the host of this conference. They set up the organizing committee, chaired by Ms. Ir. Anastasia Yunika M.Eng. The lecturers from both universities were involved in this committee.

Organizing Committee (OC):**STEERING COMMITTEE**

: Dean of Faculty of Engineering of UAJY
 Dean of Faculty of Design and Planning of UPH
 Director of Executive of EACEF
Prof. Dr.-Ing. Harianto Hardjasaputra (Alumni)

ORGANIZING COMMITTEE

Chairwoman : **Anastasia Yunika, S.T., M.Eng.** (anasyunika@yahoo.com)

Treasurer : Sumiyati Gunawan, S.T., M.T.

Vice Chairman 1 : Cilcia Kusumastuti, S.T., M.Eng.

Sponsorship & Promotion/ Exhibition : Ir. Hendra Suryadharma, M.T.

Ir. Y. Lulie, M.T.

Joey Tirtawijaya S.T., M.T.

Registration : Cilcia Kusumastuti, S.T., M.Eng.

Maya Nainggolan

Proceeding & Paper : Ferianto Raharjo, S.T., M.T.

Siswadi, S.T., M.T.

Dr. Ir. Wiryanto Dewobroto, M.T.

Merry Natalia, ST, M.Eng

Publication : Lukas Widya

Agung Pradjaka

Venue and equipment : Ir. Wiryawan Sarjono, M.T.

Januar Sudjati, S.T., M.T.

Vice Chairman 2 : Ir. Junaedi Utomo, M.Eng.

Plenary & Technical Session : Ir. Junaedi Utomo, M.Eng.

Dr.-Ing. Jack Widjakusuma

Program/ Master of Ceremony : Prof. Dr. Manlian Ronald A. Simanjuntak, S.T., M.T., D.Min.

Logistic/consumption/ banner/conference Kit	: Eva Lianasari, S.T., M.T. Etik Rukmini Supiyati
Transportation	: Ir. Arief Sudibyo Sribowo
Accommodation of speakers	: Anastasia Yunika, S.T., M.Eng. Vincent, ST
Documentation	: Wiko Retnanto
Technical visit & Farewell Dinner	: Ir. Harijanto Setiawan, M.Eng. Ir. Eko Setyanto, MCM
Website Administrator	: Hendy Wijaya, S.Kom

Program Schedule of Conference

Conference preparation

In December 2009 the OC announced the coming conference through flyer and website for **call for papers**.

We launch the conference website www.eacef.com, equipped with on line registration, to ease the authors in registration and submission their scientific paper.

The participants were welcomed to contribute the paper on the conference with following key dates:

1. Submission of a brief one-page abstract : 28 February 2011
2. Acceptance of the abstract : 31 January – 28 February 2011
3. Submission of the complete manuscripts : 1 July 2011
4. Review of the manuscripts : 15 June 2011 - 30 June 2011
5. Final submission of the Complete manuscripts : 1 July 2011

Conference date and venue:

Date : 20 – 22 September 2011

Venue :

September 20 ,2011

- Grand Quality Hotel, Yogyakarta

September 21 ,2011

- St. Thomas Aquinas Auditorium, Universitas Atma Jaya Yogyakarta

September 22 ,2011

- Technical Visit – Borobudur Temple & Prambanan Temple

The main theme of the conference is:

Designing and Constructing in Sustainability

The Scientific Committee has accepted 131 scientific papers from 20 countries. 91 papers were presented in 4 Plenary Sessions and 8 parallel technical sessions. They were divided into five groups, as such:

1. Structural and Construction Engineering
2. Construction Management and Project Management
3. Infrastructure (environmental, coastal, transportation, water) Engineering
4. Geotechnical Engineering
5. Building Materials Engineering (Nanotechnology)

Promotion

To promote the conference, the Organizing Committee has made one flyer and conference website: www.eacef.com

The Organizing Committee published the accepted scientific papers in the form of **Digital Proceeding** and **Printed Proceed** and also **Program Book/Abstract**.

Keynote Speakers

- Ir. Agus Widjanarko, MIP (German Alumni- University of Stuttgart), Secretary General of Public Works Ministry of Republic of Indonesia
- Dr. Norbert Baas, **His Excellency, the Ambassador of Republic Federal of Germany**

Invited Speakers

8 Invited Speakers from world class universities were invited to present their state of the art of research:

1. Dr.-Ing. Alexander Wetzel on behalf of Prof. Dr.-Ing. habil. Michael Schmidt (University of Kassel, GERMANY)
2. Dipl.-Ing. Linus Klein on behalf of Prof. Dr.-Ing. habil. Christian Moormann (University of Stuttgart, GERMANY)
3. Prof. Jong Sung Sim (University of Han Yang - KOREA)
4. Klaus Thorsten, M.Sc. on behalf of Prof. Dr.-Ing. habil. Werner Sobek (University of Stuttgart, GERMANY)
5. Dr. Keiji Ando (The Japan Iron and Steel Federation, JAPAN)
6. Prof. Shunji Kusayanagi (Kochi University of Technology, JAPAN)
7. Prof. Chan Weng Tat (National University of Singapore, SINGAPORE)

Conducting a two-day Conference

1stDay, September 20, 2011

Time: 8.00 – 17.00

Program: Plenary & Technical session

Welcoming and opening Speeches of the conference was delivered by:

1. Prof. Dr.-Ing. Harianto Hardjasaputra (UPH-Indonesia), Chairman of European Asian Civil Engineering Forum (EACEF)
2. Ms. Ir. Anastasia Yunika, M.Eng (UAJY-Indonesia), Chairwoman of Organizing Committee
3. Dr. Nils Wagenknecht, on behalf of Director of DAAD Jakarta Office
4. Dr. Rogatianus Maryatmo, Ph.D (Rector of UAJY-Indonesia)
5. Ir. Agus Widjanarko, MIP (German Alumni- University of Stuttgart), Secretary General of Public Works Ministry of Republic of Indonesia



Prof. Dr.-Ing. Harianto Hardjasaputra (Director of LPPM Universitas Pelita Harapan), Chairman of European Asian Civil Engineer Forum (EACEF)



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EACEF

The 3rd International Conference of European Asian Civil Engineering Forum
Yogyakarta, INDONESIA, 20 - 22 September 2011

Designing and Constructing in Sustainability



Keynote Speakers

- Ir. Agus Widjanarko, MIP (German Alumni- University of Stuttgart), Secretary General of Public Works Ministry, the Republic of Indonesia
- Dr. Norbert Baas, His Excellency, the Ambassador of Republic Federal of Germany

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Invited Speakers

The Development of Nanotechnology for Construction Materials

Prof. Dr.-Ing. habil. Michael Schmidt (University of Kassel)

Real-Time Rainfall and Flood Forecasting in Ta Tapao River Basin, Thailand

Prof. Tawatchai Tingsanchali, D.Eng. (Nakhon Pathom Rajabhat University)

Designing the Future

Klaus Thorsten, M.Sc. on behalf of Prof. Dr.-Ing. habil. Werner Sobek (University of Stuttgart, GERMANY)

New Structural Systems Employing Innovative Structural Materials

Keiji Ando (The Japan Iron and Steel Foundation, Japan)

Optimisation of Sustainable Geotechnical Structures in Urban Civil Engineering

EACEF 2013

Prof. Dr.-Ing. habil. Christian Moormann (University of Stuttgart)

The Development of Construction Safety Management Systems

Prof. Chan Weng Tat (National University of Singapore)

• **Gallery****Construction Management Research and Education Activities Moving Up Asian Universities Collaboration**

Prof. Shunji Kusayanagi (Kochi University of Technology, Thailand))

EACEF 2011• **Gallery****BM - Building Materials Engineering (Nanotechnology)****The Use of Local Materials in the Flexible Pavement Structure Towards the Sustainable Pavement Materials in Indonesia**

Bambang S. Subagio

EACEF 2009• **Gallery****Multiphases Hydration of the Activated Binary Blend Portland Cement – Trass**

Vera Indrawati Judarta

Utilisation of Soft Drink Can as Fibre Reinforcement in Concrete

A.S.M. Abdul Awal, Dianah Mazlan, and Md Latif Mansur

EACEF 2007• **Gallery****Another Looks: Application of Stick Scanner in RC Structures Assessment**

Achfas Zacoeb, Yukihiro Ito, and Koji Ishibashi

The Comparison of Microscopic and Macroscopic Characteristics between Low Calcium Fly Ash Geopolymer Binder and High Calcium Fly Ash Geopolymer Binder Using Indonesian Fly Ash

Simatupang, P.H., Pane, I., Sunendar, B., and Imran, I.

Mechanical Properties of Concrete Using Rubber Tire Chips as Partial Coarse Aggregate Replacement

Ezahtul Shahreen A.W., Nor Ashikin M.K., and Roslina O.

Material Development of Nanosilica Based on Indonesia Silica Sand for Concrete Mix

Jonbi, Harianja, B., Imran, I., and Pane, I.

The Characteristic of Durability in High Performance Concrete

Chao-Lung Hwang, Chun-Tsun Chen, Fransiscus Mintar Ferry Sihotang, and Tuan Le Anh Bui

Self-Compacting Concrete in Its Durability Performance

Chao-Lung Hwang, Chun-Tsun Chen, Fransiscus Mintar Ferry Sihotang, and Tuan Le Anh Bui

The Utilization of Tailing Sand Ex Bangka Island for Rehabilitation Materials of Rigid Pavements

A. Setyawan, K.A. Sambowo, and Z. Senaring

Evaluation of Current Models for Estimating Long-Term Shrinkage of Lightweight Aggregate Concrete

S.A. Kristiawan

Multi Criteria Decision of Type and Building Material for Simple House Construction

Wahyu Wuryanti

Properties of Building Block Incorporating Waste Aggregates Bound With Alternative Binders

I Nyoman Arya Thanaya

Behavior of Baggase Ash – Cement Stabilized Soil with Fiber Inclusion

John T. Hatmoko and Yohanes Lulie

Analysis of the Use of Brackish Sand for Making Mortar in Mutun Beach, South Lampung Regency

Lilies Widodojoko

The Effect of Carbon Black and Natural Rubber Latex on Rheological Characteristics of Bitumen

Ismail bin Yusof, Madi Hermadi, Saad, and Abdulqader Ali Joda

Strength and Sulphate Attack Resistance of Roller Compacted Concrete with Circulating Fluidized Bed Combustion Ash

Mao Chieh Chi and Run Huang

Reaction between Alkaline Metal Ions and ASR Reactive Aggregate and Behavior of Na⁺ and K⁺ in Cement Paste Replaced by

Wei-Chien Wang, Chih-Chien Liu, and Chau Lee

Mechanical Properties of Concrete Containing Recycled Steel Fibres (RSF)

Noralwani Modtrifi and Izni Syahrizal Ibrahim

Enhancement on Strength Properties of Steel Fibre Reinforced Concrete

Noor Nabilah Sarbini and Izni Syahrizal Ibrahim

The Compressive Strength of Baggase Ash-Based Geopolymer Concrete

Ade Lisantono and John Tri Hatmoko

Comparison of Infrastructure Designs for Quay Wall and Small Bridges in Concrete, Steel, Wood and Composites with Regard to the CO₂-Emission and the Life Cycle Analysis

David Dudok van Heel, Trude MAAS, Jarit de Gijt, and Mozafar Said

Maturity Function to Predict Strength of Mortars Containing Ground Granulated Blast Furnace-Slag Cured at Different Curing Temperatures

Gidion Turuallo and M.N. Soutsos

Rutting and Fatigue Behavior of Nanoclay Modified Bitumen

Saeed Ghaffarpour Jahromi

The Effect of Cold Lava Aggregate as a Filler Material of Concrete

Ika Bali and Oskar Sitorus

Experimental Study to the Load-Displacement Response of The Interfacial Transition Zone in Concrete

Han Ay Lie and Parang Sabdono

The Influence of Compaction Methods on the Properties of Hollow Concrete Bricks Utilizing Fly Ash and Bottom Ash

Djwantoro Hardjito and Antoni

The Use of Spent Catalyst RCC-15 as Powder on Environmental-Friendly High-Performance Self-Compacting Concrete

Bernardinus Herbudiman and Ayu Setyaning Pijar Kemala

Influence of Curing Method on High Strength Self Compacting Concrete

Bernardinus Herbudiman and Ruli Adi Prasetya

Flexural Performance of High Strength Concrete Containing Steel Fibres

Sholihin As'ad and Andreas Saxer

Shear-Friction Strength of Recycled Aggregate Concrete

Khaldoun Rahal, Abdul Lateef Al-Khaleefi

A Fundamental Study on the Diagnosis Method of Existing RC Structures Using the Characteristics of Hammering Sound

Yuki Fukui and Yoshimi Sonoda

The Recent Development of Ultra High Performance Concrete (UHPC) in Indonesia

Hariato Hardjasaputra, Joey Tirtawijaya, and Giovano Tandaju

CM - Construction Management and Project Management

The Productivity Analyses of Bored Pile Foundation in the Main Bridge Area

Sentosa Limanto, Jonathan HK, Stephen H.S, and Hendri W

Best Practice for Safer Construction from Designers' Perspective

Abdul Rahim Abdul Hamid, Bachan Singh and Tan Kin Liang

Best Practice for Safer Construction from Contractors' Perspective

Abdul Rahim Bin Abdul Hamid, Bachan Singh and Mazni Binti Mat Zin

Optimal Bid Price in a Competitive Bidding under Risk Aversion

Andreas Wibowo

Project Financing and Risk Management in Transportation Projects: A Public Private Partnerships Framework

I Putu Mandiartha Colin F. Duffield, and Gigih U Atmo

Fault Tree Analysis of Work Accident Cause Factors in Mud Volcano Sidoarjo Disaster Management

Cahyono Bintang Nurcahyo Farida Rahmawati, and Diar Farobi

Productivity Problems Encounted by Indonesian Construction Foremen

Peter F. Kaming

Relationship Between Implementation of Safety Policy and Craftsmen's Productivity

Peter F. Kaming and Martino Ardianto

Risks Analysis in Public Private Partnership (Case Study: Traditional Market Development Projects in Surabaya)

Farida Rahmawati and Carla Widha Permatasari

The Implementation Effect of Aspects Relating to the Issues of Occupational Safety and Health Against Productivity in Constructi

Anton Soekiman and Syamsuduha

Cost of Quay Walls

J.G.de Gijt

Knowledge Management and Corporate Performance in Construction

Mochamad Agung Wibowo and Rudi Waluyo

Exploring Contractors' View on Green Construction

Jati Utomo Dwi Hatmoko, Ferry Hermawan, And Tia Putriani Styianingsih

Preliminary Study on Pre-Project Planning Activities of Public Infrastructure Projects

Febrina P.Y. Sumanti and M. Agung Wibowo

The Analysis of Building Reliability in Karawaci

Manlian Ronald A. Simanjuntak and Mukhodas Syuhada

GT - Geotechnical Engineering

Effective Reuse of Fly Ash as Fill Materials for Embankment Construction

Muhardi Aminaton Marto, Khairul Anuar Kassim, and Wan Suhairi Yaacob

Peak Base Acceleration of Semarang City with Three Dimensional Seismic Source Model

Abdul Rochim

Dimension Effects of Upstream Filter of Rockfill Dam Against Hydraulic Fracturing

D. Djarwadi, K.B. Suryolelono, B. Suhendro, and H.C. Hardiyatmo

Improvement of the Load Carrying Capacity of UTHM Soft Clay Soil by Electro Osmotic Consolidation

Khairul Nizar Mohd Yusof and Abdul Kaharudin Arsyad

Analysis of Basal Heave Stability for Excavations in Soft Clay Using the Finite Element Method

Aswin Lim, And Chang- Yu Ou

Squeezing Potential Evaluation of Tunnel in Tropical Area

Vahed Ghiasi, Husaini Omar, Bujang Kim Huat, Zainuddin b. Md. Yusoff, Sina Kazemian, Mehrdad Safaei, Samad Ghiasi, Zainab Bakhshipour, and Ratnasamy Muniandy, Habibeh Valizadeh

Predicting Erosion Rate During the Hole Erosion Test as Affected by Clay Concentration and Wall Roughness

Kissi Benaissa, Khamlichi Abdellatif, Bezzazi Mohamed, and Miguel Angle Parron Vera, Rubio Cintas Maria Dolores

Validating the Juang Method in Order to Assess Liquefaction Potential of Soils in the Northern Moroccan Region of Tangier

Touil Noufal, Bezzazi Mohammed, Khamlichi Abdellatif, and Jabbouri Abdellah

Overview on Remotely Sensed Earthquake Precursors

Habibeh Valizadeh Alvan and Farid Haydari Azad

Influence of Construction Stages on Surface Settlement in NATM Tunnelling

H. Sohaei, M. Hajihassani, A. Marto, And M Karimi Shahrabaki

IS - Infrastructure (environmental, coastal, transportation, water) Engineering**Exploring the Passenger Loyalty: An Integrated Framework for Service Quality, Satisfaction and Loyalty for Informal Public Transportation**

Taslim Bahar, Ofyar Z Tamin, and Russ Bona Frazila

Financial Innovation for Toll Road Infrastructure Development

Lukas B. Sihombing, Ismeth S. Abidin, and Yusuf Latief

The Influence of Land Use in Transportation Planning

J. Dwijoko Anusanto Ahmad Munawar, Sigit Priyanto, and Bambang Hari Wibisono

Modeling Freight Transportation for Crude Palm Oil (CPO) in Central Kalimantan

Noor Mahmudah, Danang Parikesit, Siti Malkhamah, Sigit Priyanto, and Mark Zuidgeest

History, Conservation, and Development of Rail Transport in Indonesia

R. Didin Kusdian

Transportation Performance Indicator Survey on Transportation Agencies at Nanggroe Aceh Darussalam Province

Medis Sejahtera Surbakti, and Prof Yuwaidi Away

The Comparison of V/C and Travel Time Reliability Factor Affecting Daily Route Choice Behavior at Medan City

Medis Sejahtera Surbakti

Considerations of Composite Signalised Intersection Control System

Ben-Edigbe J. and Mashros N.

Travel Expenditure of Urban Transportation in Yogyakarta

Imam Basuki, Siti Malkhamah, Ahmad Munawar, and Danang Parikesit

Land Value and Transportation Provision Modeling (Case Study: Yogyakarta City)

Muiz Thohir and Ofyar Z. Tamin

Binder Type Selection for Foamed Cold Mix Asphalt

Sri Sunarjono

Trend of Rainfall Pattern and Extreme Rainfall in Jakarta

Cilcia Kusumastuti and Sutat Weesakul

Formulating Model to Separate Liquid Terminal Operation

Anwarudin and Ofyar Z. Tamin

Informal Settlement Mapping and Urban Riverside Poverty Analysis Case: Kahayan Urban Riverside Area

Noor Hamidah

Probabilistic Roughness Progression as a Measure of Road Network Pavement Maintenance Effectiveness

I Putu Mandiartha, Colin F. Duffield, Russell G. Thompson

Properties of Porous Asphalt Mixed Subjected to Laboratory Ageing

Che Norazman Che Wan, Meor Othman Hamzah, Ramadhansyah Putra Jaya, Mohdzuan Ahmad

Simulation of Shore Protection Structures Layout

Slamet Hargono

Using Geographic Information System for Flood Reduction in Bekasi City, Indonesia

Trihono Kadri

High Rate Water Treatment Plant System: Successful Implementation and Financial Prospect

Mohajit

Potential Application of Biomembrane System for Wastewater Reuse in Urban Housing Area

Elis Hastuti and Haryo Budi

Modeling Groundwater Flow and Salinity Intrusion by Advective Transport in the Regional Unconfined Aquifer of Southwest Bangladesh

Sajal Kumar Adhikary, Ashim Das Gupta, and Mukand S. Babel

Indonesian Water Capacity Building Programme

J.Q.J.C. Verberk, R. Garsadi, S. Notodarmojo, and A. Maenhout

Performance Analysis of Hydrology and Water Management for Flood Control System (A Case Study of Solo)

A. Padma Lakstaningty

SC - Structural and Construction Engineering

Partial Capacity Design, an Alternative to the Capacity Design Method

Benjamin Lumantarna and Ima Muljati

Finite Element Modeling for Reinforcing Steel Subjected to Reversed Cyclic Loading with Moderate Compressive Stress and Strain Demands

Data Iranata

The Effect of Structural Modelling on the Analysis of P-Delta Effect Case Study: Second-Order Analysis by a Commercial Computer Program, SAP2000

Wiryanto Dewobroto

Seismic Reinforcement Against Shear Failure by "Post-Installed Rebar" on Walls of Existing Underground Structures

Kensuke Yamamura and Osamu Kiyomiya

Lateral Torsional Buckling of Web Tapered I Beam

Paulus Karta Wijaya

Numerical Analysis of Circular Concrete Columns Confined with FRP Sheets Under Concentric Axial Load

Nico Nirwanto Laban and Andreas Triwiyono

Shear Strengthening Effect of RC Beams Retrofitted by Steel Reinforcement and PCM Shotcrete

A. Arwin Amiruddin

Analysis on the Contribution of Cross Beam to a Torsional Buckling of Thin, Rectangular Beam Section

Sri Tudjono, Windu Partono, and Joko Purnomo

Seismic Performance of Steel Special Moment Resisting Frame Using Reduced Beam Section

Ima Muljati and Hasan Santoso

Bonding Capacity of Self Compacting Concrete Containing Fly Ash and MIRHA

Agus Kurniawan, Nasir Shafiq,

Steel Fiber Concrete Slab Application as Replacement of Ordinary Roof Tiles

Agus Kurniawan

Analysis of Structural Healthiness Using Hilbert Transform

Jack Widjajakusuma

Seismic Performance of Structure with Vertical Set-Back Designed Using Partial Capacity Design

Pamuda Pudjisuryadi Benjamin Lumantarna, S. Teddy, and H. Wijoyo

Analysis of Factors Influencing Elevation of Balanced Cantilever Structure for Precast Segmental Box Girder Bridge Construction

Gambiro and Heru Purnomo

The Analysis of Slab Beam in Tall Buildings with Earthquake Load

Ernie Shinta Yosephine Sitanggang and Johannes Tarigan

A Proposal of Tensile Test of Pultruded GFRP Plate

Jongsung Sim, Hyunjoong Kim, and Kihong Lee

Performance Based Design Review of 16-Story Twin Tower with Connecting Bridge-Way

Amelia Kusuma and Naveed Anwar

Lesson and Learning from 5 Big Earthquakes in Sumatra 2004 - 2010

Johannes Tarigan

The Flexural Strength And Rigidity Of Composite Plywood-Meranti Stress Skin Panel

Johannes Adhijoso Tjondro, Dina Rubiana Widarda, Leonardus Eka Dharma

Parametric Study of Modified Continuous Bang-Bang Controller

Yoyong Arfiadi

Reconstruction of Distributed Force Characteristics in Case of Non Punctual Objects Impacting Elastic Beams

- A. Elbakari, F. El Khannoussi, A. Khamlichi, R. Dkiouak, A. Hajraoui, M. Bezzazi, A. Limam, E. Jacquelin
Bolts Connections in Steel Bridge Structure Theory and Facts
Lanny Hidayat and Demson Sihaloho
- Composite Columns in Low-to-Medium-Rise SCBFS with Braces in the Two-Story X-Configuration**
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B.M. Nguyen, J. A. Roelvink, and P. H. A. J. M. van Gelder
- A Fundamental Consideration of Defect Evaluation of Concrete Structures Using Infrared Thermography**
Tatsuro Watanabe and Yoshimi Sonoda
- Dynamic Behaviour of Footbridges Subjected to Human-Induced Dynamic Loads; A Case Study of Footbridges in Surabaya**
Endah Wahyuni, asdamnu, Ananta S.Sidharta and Dicky Ardhian Prasetya
- Mechanical Behavior of GFRP Rock Bolt for Permanent Support of Tunnel**
Jongsung Sim and Hyunjoong Kim
- The Development of Green Structural Concrete In Indonesia**
Hadi Rusjanto Tanuwidjaja
- A Discussion on Durability of High Strength Concrete (HSC) in View Point of Micro Pore Structure**
Rita Irmawaty, Hidenori Hamada, Yasutaka Sagawa and Sho Yamatoki
- The Aerodynamic Derivatives of Suramadu Cable Stayed Bridge**
Sukamta
- Shear Capacity of the Composite Styrofoam Filled Reinforced Concrete Beams**
Rudy Djamaluddin
- The Flexural Strength of African Wood Flange–Plywood Web I-Joist**
Johannes Adhijoso Tjondro and Michael Pio
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A. Yusof

Composite Columns in Low-to-Medium-Rise SCBFs with the Two-Story X-Configuration Braces

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Abstract

Column demands of special concentrically braced frames (SCBFs) were investigated by Richards (2009). In low-rise SCBFs with braces in the two-story X-configuration, column demands were up to 100% greater than those commonly used in the design because of force redistribution that occurs after brace buckling. The 2005 AISC Seismic Provisions do not require columns to be designed for the maximum force that can be delivered to them if $\frac{kl}{r} \leq 4\sqrt{\frac{E}{F_y}}$. If $\frac{kl}{r} \leq 4\sqrt{\frac{E}{F_y}}$ columns are designed for loads corresponding to twice the axial loads caused by the design base shear ($P_u = \Omega_o \times P_{base_shear}$, where $\Omega_o = 2$). This approach is based on engineering judgement that is need to be questioned for the SCBFs with braces in the two-story X-configuration. The design of the columns should be done based on the maximum load that can be delivered by the braces. Composite columns, either encased or filled, can be an economical solution for the very high column demands. The concrete in the composite column can be added to carry additional loads without requiring an increase in the size of the steel section. The 2005 AISC Specification for Structural Steel Buildings provides the simple and practical methods to determine the capacity of composite columns. This specification allows composite columns to be designed with a minimum of 1% steel ratio, down from the 4% required in previous LRFD specifications. Very heavy columns would be the results of the design if bare steel columns instead of composite columns are employed. The design of composite columns using the 2005 AISC Specification will be discussed.

Key Words: 2005 AISC Specification, column demand, composite column, special concentrically braced frame, two-story X-configuration braces

Introduction

Special concentrically braced frames (SCBF) have been known as a very efficient and economical system for resisting lateral forces and minimizing building drifts. SCBFs are efficient because framing members resist primarily axial loads with little or no bending in the members until the compression braces in the system buckle. Brace buckling is allowed because special gusset plate detailing is required for both in-plane and out-of-plane brace buckling design, depending on brace buckling mode selected.

When the compression brace buckles in a V or inverted V configuration, the beam at the mid-span connection must deflect downward because of the unbalanced forces on the beam. This deflection can result in significant damage to the slab system attached to the beam. It can be implied from the AISC Seismic Design Manual (...) that the two-story X-braced frame is a better alternative to the V or inverted V braced frame because the two-story X configuration braces prevents the development of unbalanced forces on the beam, and distributes this unbalanced vertical load to other levels that are not experiencing high seismic demands providing for better overall frame performance.

A research done by Richards(...) showed that in low-rise SCBFs with braces in the two-story X-configuration column axial demands were up to 100% greater than those commonly used in the design because of force redistribution that occurs after brace buckling. The results of this research showed that the two-story X-braced configuration is not necessarily a better or safer alternative to the V or inverted V configuration because of the additional axial load capacity. Very heavy columns would be the results of the design if bare steel columns are employed. Therefore composite columns, either encased or filled, can be an economical solution to deal with the additional axial load capacity over that available with steel columns alone. The columns in special two-story X-braced frames should be designed based on the capacity of the braces.

Strength and Ductility of Concrete Encased Composite Columns

Composite columns can take one of two forms: a pipe or HSS filled with plain concrete or a rolled steel shape encased in concrete with both vertical and transverse reinforcement. Although the behaviors of encased and filled composite columns are based on the same general principles, there are enough differences, especially with regard to details, that the AISC Specification treats them separately. This paper discusses the application of concrete encased composite columns to special two-story X-braced frames.

Strength of Encased Composite Columns

If buckling were not an issue, the column strength could be taken as the summation of the axial compressive strengths of the component materials:

$$P_o = A_s F_y + A_{sr} F_{yr} + 0.85 A_c f'_c \quad (\text{AISC Equation I2-4})$$

Because of slenderness effects, the strength predicted by AISC Equation I2-4 cannot be achieved. To account for slenderness, the relationship between P_o and P_e is used, where P_e is the Euler buckling load and is defined as

$$P_e = \frac{\pi^2 (EI)_{eff}}{(KL)^2} \quad (\text{AISC Equation I2-5})$$

Where $(EI)_{eff}$ is the effective flexural rigidity of the composite section and is given by

$$(EI)_{eff} = E_s I_s + 0.5 E_s I_{sr} + C_1 E_c I_c \quad (\text{AISC Equation I2-6})$$

$$C_1 = 0.1 + 2 \left(\frac{A_s}{A_c + A_s} \right) \leq 0.3 \quad (\text{AISC Equation I2-7})$$

The nominal strength is calculated as follows:

When $P_e \geq 0.44 P_o$

$$P_n = P_o \left[0.658 \left(\frac{P_o}{P_e} \right) \right] \quad (\text{AISC Equation I2-2})$$

When $P_e < 0.44 P_o$

$$P_n = 0.877 P_e \quad (\text{AISC Equation I2-3})$$

For LRFD, the design strength is $\phi_c P_n$ where $\phi_c = 0.75$

Curvature Ductility of Encased Composite Columns

EI-Tawil and Deierlein(...) studied the strength, stiffness and ductility of concrete encased composite columns using fiber section analysis (Fig. 1). Three sections shown on Fig. 2 was used as prototypical design examples to investigate the strength and stiffness of encased composite columns cross sections. Reinforcing bars and structural steel sections have yield strength of $F_{yr} = 414 \text{ Mpa}$ and $F_{ys} = 345 \text{ MPa}$ respectively. Three concrete strength are used - $f'_c = 28, 69, \text{ and } 110 \text{ Mpa}$ representing low-, medium-, and high-strength concrete. Different encased shapes with structural steel ratio of $\frac{A_s}{A_g} = 0.04, 0.08, \text{ and } 0.16$ were studied. . The naming convention reflects the steel ratio and concrete strength (e.g., S-08-M refers to a section with a steel ratio of $\frac{A_s}{A_g} = 0.08$ and medium-strength concrete). The transverse reinforcement in Fig. 2, consisting of 16-mm diameter ties spaced at 320 mm, meets the standard (nonseismic) ACI 318 requirements.

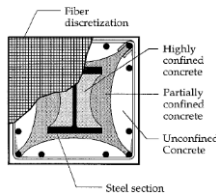


Fig.1. Fiber Idealization of Concrete Encased Composite Column

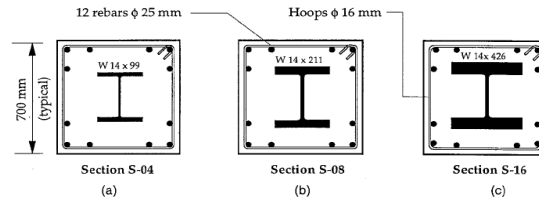


Fig.2. Prototype Composite Column: (a) S-04; (b) S-08; (c) S-16

For high seismic regions where large member ductility is required, the AISC/LRFD Seismic Provisions (...) for encased composite columns require transverse hoop reinforcement with a minimum area A_{sh} equal to

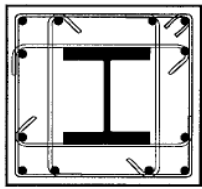
$$A_{sh} = 0.09h_c s \left(1 - \frac{F_{ys} A_s}{P_n}\right) \left(\frac{f'_c}{F_{yh}}\right)$$

where h_c = cross-sectional dimension of the confined core region measured center-to-center of the tie reinforcement; s = vertical spacing of the hoop reinforcement; F_{ys} = specified yield strength of the structural steel; A_s = cross-sectional area of the structural steel core; P_n = nominal compressive axial strength of the composite column; f'_c = specified concrete compressive strength; and F_{yh} = specified yield strength of the ties. In subsequent analyses, the seismic hoop reinforcement shown in Fig. 3, is investigated to evaluate confinement effects on the strength and ductility of composite columns. This reinforcement consists of 16-mm diameter hoops with four branches, spaced along the column at 100 mm on center for concrete with $f'_c = 28$ and 69 MPa and at 75 mm on center for $f'_c = 110$ MPa concrete.

Defining the yield ϕ_y , and ultimate ϕ_u curvatures as shown in Fig. 4, the curvature ductility of the cross section is defined as

$$\mu_\phi = \frac{\phi_u}{\phi_y}$$

Members of frames designed for inelastic action in regions of high seismicity should have curvature ductilities of approximately $\mu_\phi > 12$. The inelastic behaviour of the S-08 composite cross sections with three concrete strength were evaluated based on the moment versus curvature behaviour and shown in Fig. 5 - 9.



4-Legged Hoops
 ϕ 16 mm @ 100 mm

Fig. 3. Fiber Idealization of Encased Concrete Columns

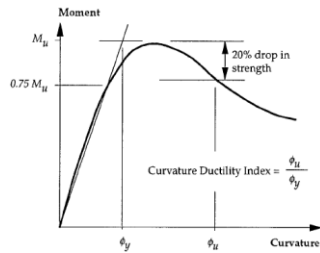


Fig. 4. Definition of Curvature Ductility Ratio

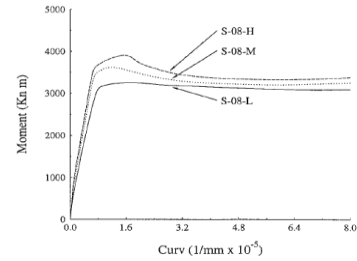


Fig. 5. Moment versus Curvature Response for Section S-08 as Function of Concrete Strength

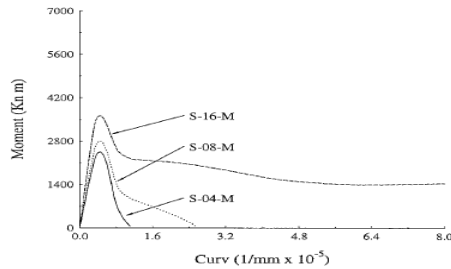
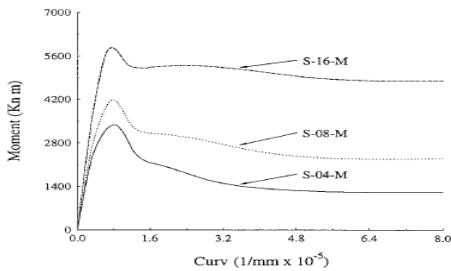


Fig. 6. Response of Sections with Medium-Strength Concrete: (a) $P = 0.3P_o$; (b) $P = 0.6P_o$

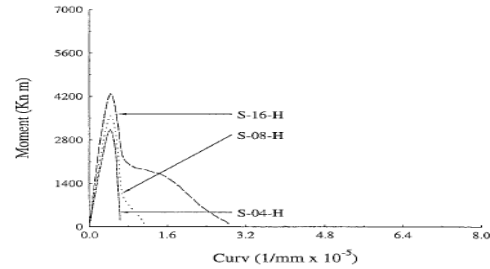
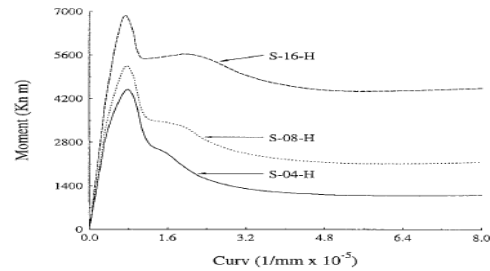


Fig. 7. Response of Sections with High-Strength Concrete: (a) $P = 0.3P_o$; (b) $P = 0.6P_o$

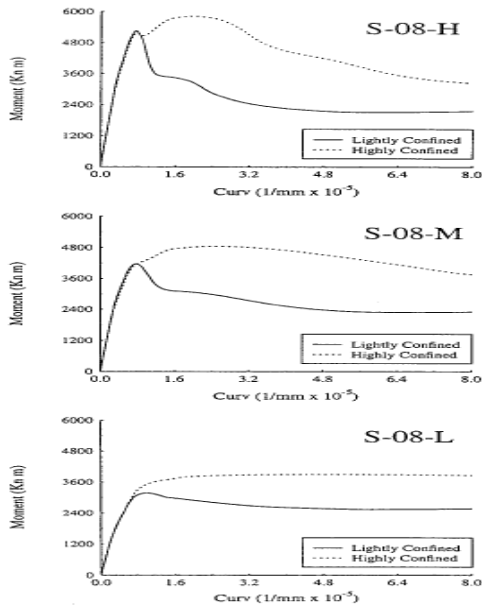


Fig. 8. Comparison of Responses of Section S-08 with Standard Ties and Seismic Hoop Reinforcement and $P = 0.3P_o$: (a) High-Strength Concrete; (b) Medium-Strength Concrete; (c) Low-Strength Concrete

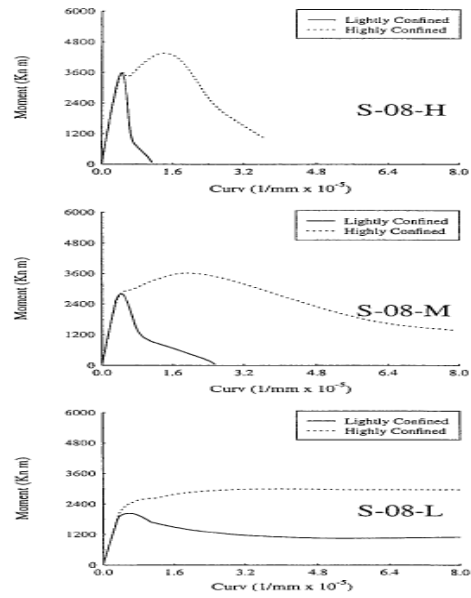


Fig. 9. Comparison for Responses of Section S-08 with Standard Ties and Seismic Hoop Reinforcement and $P = 0.6P_o$: (a) High-Strength Concrete; (b) Medium-Strength Concrete; (c) Low-Strength Concrete

The results of the evaluation of the encased composite columns (...) were as follows:

1. Composite columns with normal strength concrete ($f'_c = 28$ MPa) had curvature ductilities on the order of $\mu_\theta = 4 - 12$ when subjected to intermediate to high axial load levels ($P = 0.3 - 0.6P_o$).
2. Ductility improved significantly when confinement steel was provided by the transverse hoop reinforcement specified in the AISC/LRFD Seismic Provisions for composite columns.
3. The compression load $P = 0.6P_o$ is about the maximum that should ever occur in a design.
4. The presense of a large steel core provides a beneficial residual strength following concrete crushing and leads to improve ductility. Columns with encased shapes benefit from the confinement of the concrete between the column flange (Fig. 1)

Column Demands of Special Two-Story X-Braced Frames

Two-story X-braced frames was considered as a better configuration of Chevron frames(Hewit, AISC Seismic..) because the brace on the upper story brace in tension will resist the unbalance force on the beam (Fig. 10), allowing a smaller beam section to be used. The investigation done by Richards() shows that the

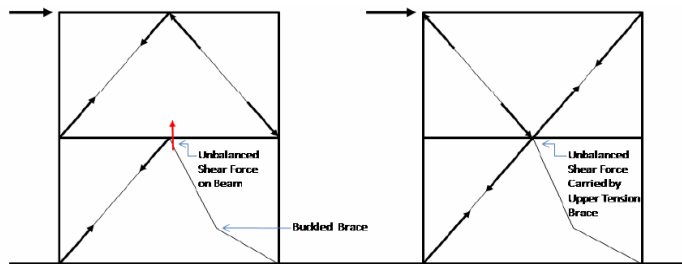


Fig. 10. Unbalanced VS Balanced Chevron Connections

column demands in two-story X-Braced frames were unrealistically high. The axial forces in the columns are sensitive to buckling of the braces as shown in Fig. 11. When brace is removed, analogous to buckling, column demands double even with the same floor forces. The 2005 AISC Seismic Provisions do not require columns to be designed for the maximum force that can be delivered to them if $\frac{kl}{r} \leq 4\sqrt{\frac{E}{F_y}}$. If $\frac{kl}{r} \leq 4\sqrt{\frac{E}{F_y}}$ columns are designed for loads corresponding to twice the axial loads caused by the design base shear ($P_u = \Omega_o \times P_{base_shear}$, where $\Omega_o = 2$). This approach is based on engineering judgement that is need to be questioned for the SCBFs with braces in the two-story X-configuration. The design of the columns should be done based on the maximum load that can be delivered by the braces ().

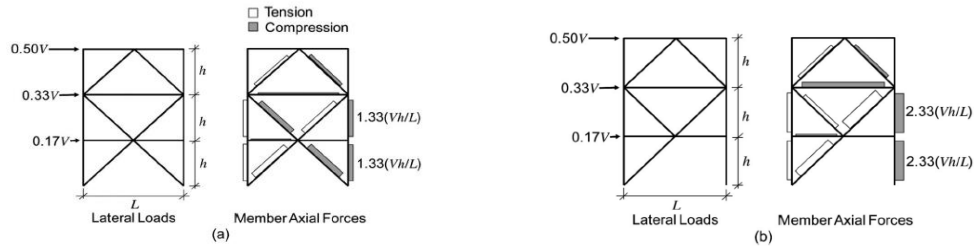


Fig. 11. Forces in SCBF with two-story X bracing: (a) before brace removal; (b) after brace removal

Composite Special Concentrically Two-Story X-Braced Frames

Encased composite columns can be an ideal solution for use in seismic regions. It is anticipated that the overall behaviour of the composite systems will be similar to SCBF counterpart and that inelastic deformations will occur through axial yielding and/or buckling of braces. There are two options for the design of the columns in SCBFs based on the slenderness of the braces (Aisc 341):

1. § 4.1 - AISC Seismic Provisions: for $\frac{K.L}{r} \leq 4\sqrt{\frac{E}{F_y}}$, then $P_u = \Omega_o \times P_{base\ shear}$, where $\Omega_o = 2$. This approach is based on engineering judgement that is need to be questioned for the SCBFs with braces in the two-story X-configuration.
2. §13.2a - AISC Seismic Provisions: for $4\sqrt{\frac{E}{F_y}} < \frac{K.L}{r} < 200$, then P_u equal to the bracing capacity. This is a more rational approach for the SCBFs with braces in the two-story X-configuration.

Fig. 12 shows the elevation view of the lateral resisting system of a five-story office building constructed at a hard soil in zone 6 region of Indonesia. All braced bays have the two-story-X configuration. W shapes ($F_y = 350$ MPa) are used for all beams and columns. Square HSS ($F_y = 46$ Ksi) are used as braces based on $\frac{K.L}{r} \leq 4\sqrt{\frac{E}{F_y}}$ and $b/t < 6.4\sqrt{\frac{E}{F_y}}$. The compressive and tensile capacities of the braces are shown in Table 1.

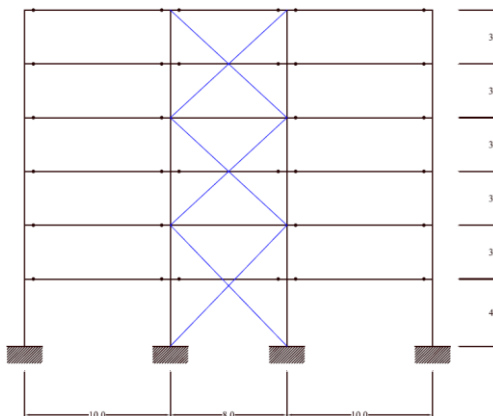


Fig. 12. Elevation View

Table 1. Bracing Capacities (kN)

HS178x178x10	+2744.41	-1983.19
HS178x178x11	+3152.97	-2296.33
HS203x203x13	+4112.18	-3264.75
HS203x203x13	+4112.18	-3264.75
HS203x203x13	+4112.18	-3264.75
HS203x203x13	4112.18	-2879.12

The column demands based on the bracing capacity are shown in Table 2. It can be seen the the column demands are unrealistically high and very heavy columns would be the results of the design if bare steel columns are employed.

Table 2. Maximum Possible Columns Demands (kN)

	Strength Design		Ductility Design	
	1.2xD + 0.5xL± 1.0xE _h		1.2xD + 0.5xL± (bracing capacities)	
6	230.71	W200x46	2094.98	W200x100
5	493.45	W200x46	2492.58	W200x100
4	1092.82	W250x58	7138.92	W310x226
3	1356.95	W250x58	7537.74	W310x226
2	2195.66	W310x97	12897.25	W360x382
1	2465.26	W310x97	13301.85	W360x382

The composite special two-story X braced frames is an economical solution to the high additional axial load capacity over that available with steel columns alone. Under severe seismic conditions the appropriate collapse-avoidance strategy could employ:

1. Composite columns with normal strength concrete ($f'_c = 28$ MPa)
2. Confinement steels in the form of transverse hoop reinforcement
3. Compression load $P \leq 0.6P_o$
4. Large steel cores, where the steel sections alone can resist the $1.2xD + 0.5xL \pm 1.0xE_h$.

Design of composite columns are quite straightforward. Examples of the design can be seen in the AISC design examples CD.

Conclusions

Care should be taken when computing maximum possible columns demands in special frames with two-story X-braced configuration. In high seismic regions, concrete encased composite columns can be an ideal solution to deal with the additional axial load capacity over that available with steel columns alone. The composite system can be expected to have the overall behaviour similar to SCBFs counterpart.

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Fig. 12 shows the elevation view of the lateral resisting system of a five-story office building constructed at a hard soil in zone 6 region of Indonesia. All braced bays have the two-story-X configuration. The maximum column loads are calculated using the following load combinations:

1. $1.2 \times D + 1.6 \times L$
2. $1.2 \times D + 0.5 \times L \pm 1.0 \times E_h$

W shapes ($F_y = 350$ MPa) are used for all beams and columns. Square HSS ($F_y = 46$ Ksi) are used as braces based on $\frac{KL}{r} \leq 4\sqrt{\frac{E}{F_y}}$ and $b/t < 6.4\sqrt{\frac{E}{F_y}}$. The compressive and tensile capacities of the braces are shown in Table 1. The column demands based on the bracing capacity are shown in Table 2. It can be seen the the column demands are unrealistically high and very heavy columns would be the results of the design if bare steel columns are employed.

The composite special two-story X braced frames is an economical solution to the high additional axial load capacity over that available with steel columns alone. Under severe seismic conditions the appropriate collapse-avoidance strategy could employ:

5. Composite columns with normal strength concrete ($f'_c = 28$ MPa)
6. Confinement steels in the form of transverse hoop reinforcement
7. Compression load $P \leq 0.6P_o$
8. Large steel cores, where the steel sections alone can resist the $1.2 \times D + 0.5 \times L \pm 1.0 \times E_h$. The concrete in the composite column can carry the additional loads without requiring an increase in the size of the steel section