Table of contents

Preface xxxi
Conference organization xxiii
Non financial sponsors xxv

KEYNOTE LECTURES
A façade roadmap 3
U. Knaack

Pier Luigi Nervi: Architecture as challenge 7
M.A. Chiorino & C. Chiorino

The great counterintuitive: Re-evaluating historic and contemporary building construction for earthquake collapse prevention 11
R. Langenbach

Emilio Pérez Piñero: Inventor of deployability 17
F. Esrig

TECHNICAL CONTRIBUTIONS
Mini-symposia & special sessions

Modern renaissance timber construction
Merging seismic and fire design of timber buildings and potential and limitations on going high 23
B. Kasal, D. Kruse, N. Rüther & T. Polocoser

Status of Cross-laminated Timber construction in North-America 25
S. Gagnon & E. Karacabeyli

A review on seismic response of timber frames 27
H. Stamatopoulos & K.A. Malo

Investigation of seismic performance of multi-storey timber buildings within the framework of the SERIES project 29
M. Piazza & R. Tomasi

Seismic design of CLT buildings: Definition of the suitable q-factor by numerical and experimental procedures 31
L. Pozza, D. Trutalli, A. Polastri & A. Ceccotti

Seismic design of timber buildings with a direct displacement-based design method 33
C. Loss, M. Piazza & D. Zonta

Behaviour of moment connections in timber frameworks 35
A. Polastri, R. Tomasi, M. Piazza & I. Smith
From new tools and methods towards new tasks and ideals:
The impact of technology and science in the post-war era

The architecture of absence: Building, landscape and the changing character of technology in the post-war era
C.P.C. Cabral

New French architectural treatises for a new kind of public architecture
E. Monin

The development of architectural concrete in Belgium during the 1960s and 1970s
S. Van de Voorde

Working relationships between architects and structural engineers: World War II to the 1970s
D.T. Yeomans

Finnish architect-engineer cooperation on concrete and shell structures in the 1950s and 1960s
A. Niskanen

Innovation in reciprocal structures
Reciprocal systems based on planar elements
O. Baverel & A. Pugnale
Reciprocal-frame structures—a digital design instrument
U. Thonnissen
The proposal of an ancient technique for modern construction: A stone reciprocal structure
M. Brocato & L. Mondardini
Efficient design and fabrication of free-form reciprocal structures
D. Parigi & P.H. Kirkegaard
Static and kinematic formulation of planar reciprocal assemblies
D. Parigi & P.H. Kirkegaard

Innovation in timber
Wood structures—versatility and innovation
F. Jensen
Cross-laminated timber: A key material for the future of structural design
M. Nevada
Cross-laminated timber: Driving forces and innovation
A. Falk
The wooden cooling tower
E. Nozhova
MonaLisa Wood Pavilion: Poplar pl(a)ywood
G. Callegari, M. Sassone, A. Spinelli & R. Zanuttini
Robustness issues for design of innovative timber structures
F. Hald, P.H. Kirkegaard & J.D. Sorensen

Principles in practice for the analysis, conservation and structural restoration of architectural heritage
The ISCARSAH principles in practice
S.J. Kelley
The building and its structural history (or how the history is the source of endless technical knowledge)

M.M.S. Lagunes

167

Master Builders’ design skills in diagnosing the failures

G. Arun

169

Physical evaluation of the endless column

R.A. Sofronie

171

Structural evaluation of Kilitbahir castle in Canakkale, Turkey

A. Turer

175

Dismantling of foundation system for conservation of masonry structures in Angkor, Cambodia


177

General contributions

Building envelopes

Life cycle assessment of Irish residential buildings and typical building envelope analysis

A. Armstrong & J. Goggins

183

Proposals for intervention in obsolete building envelopes in Andalusia

M. Molina-Huelva, J.M. Rincón-Calderón & P. Fernández-Ans

185

Integrated design applied in thermal retrofitting solutions for residential buildings

A. Ciutina, V. Ungureanu, D. Dubina & D.M. Grecea

187

Modified plastic materials for a new generation of architecture

T. Ries

189

Isostatic lines’ study to optimize steel space grid envelope structures for tall buildings according to their solicitations

R. Señís

191

Balconies, analysis of constructive technology current state and foresight of new industrial development

L. Sierra & J.L. Zamora

193

Expanded cork as building envelope—architectonic and technological aspects

P. Sousa & P.J.S. Cruz

195

Computer and digital design tools

Modular construction systems for freeform architecture

S. Schafer, J. Reising, S. Abedini & A. Ljubas

199

Seismic rehabilitation of RC structures—case study: Educational building with GF + 4 storey height regime

M.C. Calin, D. Iordan & C.S. Dragomir

201

Thicker funicular: Particle-spring systems for variable-depth form-responding compression-only structures

B. Clifford

205

Architectural feedback in the structural optimization process

J. Fellner, E. Chatzi & T. Kotnik

207
Multimodal structural optimization for conceptual design
K. Martini

Investigating a new material practice
M. Tamke, P. Nicholas, P. Ayres & M. R. Thomsen

Study of the sensitivity of different building structures to tunneling induced settlements
C. Molins & C. Camós

Multi-objective optimization of concrete shells
T. Mendez Echenagucia, M. Sassone & A. Pagnale

Structures for quality and quantity of natural light in architecture
S. Bica, I. M. Cristiu & O. Miesa

Performance assessment of mixed CFRP retrofitting solution for RC slabs
S. C. Florău, V. Stoian, T. Nagy-György, D. Dan & D. Diaconu

The use of unconventional reinforcements in structures—design aspects
K. Jaafar

Comprehension and complex forms

The dynamic phraseology of structures: Enabling the design of complex systems
T.M. Boake

Railway stations between infrastructural complexity and architectural form
E. Conticelli & S. Tondelli

Structural analysis of the Curators’ Lab Arena—an impressive ephemeral timber structure
P.J.S. Cruz & A.O. Féio

Tessellation of Islamic star patterns on complex forms
M. C. Fernández-Cabo & A. Casas-Pérez

Parametric design and non-linear analysis of a large-scale deployable roof structure based on action origami
T.R. Gentry, D. Baerlecken, M. Swarts & N. Wonoto

Diagrids for design and construction of freeform tall buildings
K.S. Moon

Outrigger structures for twisted, tilted and tapered tall buildings
K.S. Moon

Discretization solutions for the construction of free form complex surface structures
H. Giles & A. Berk

Architectural topology parametrically defined by digital manufacturing
M.G. del Valle Lajas & J.A. Díaz

Virtual reality as a multidisciplinary communication tool
L. Houck, R. Hassan, T.K. Thüs & K. Solheim

Structural form as ornament
R.A. Oprita

Concrete and masonry structures

Reinforced concrete in the early 20th century: The search for a form language for the material
M.B. Dan
Technology of thin shells in the German baroque
V. Compán, M. Cámara & J. Sánchez

Control of conservation works for architectural heritage buildings by microseismic recordings and structural analysis
C.S. Dragomir, A. Duţu, C.S. Dragomir & E.S. Georgescu

“Reticolatus”: An innovative reinforcement for irregular masonry—a numeric model
M. Paradiso, S. Galassi, A. Borri & D. Sinicropi

Study to evaluate the characteristics of masonry for “Stirbey family chapel” to retrofit the structure
C.-L. Matei & R.-C. Matei

A critical assessment of concrete and masonry structures for reconstruction after seismic events in developing countries
H. McWilliams & C.T. Griffin

Funicular forms and earthquake performance of low-strength masonry buildings
S. Rthal & J. Edmisten

Load-bearing capacity of corroded reinforced concrete joists
J. Vercher, E. Gil & A. Mas

Determination of residual load-bearing capacity of existing masonry structures
J. Wittamy, T. Čejka & R. Zigler

Structural behaviour of masonry buildings subjected to landslide: Load path method approach
F. Palmisano & A. Elia

Fabric formed concrete structures and architectural elements
R.F. Pedreschi

Application of the operational modal analysis method for the control of the intervention in the Roman Theatre (Cádiz, Spain)
P. Pachon, E. Rodríguez-Mayorga, J.F. Jimenez, V. Compán, A. Saez & E. Yanes

An approach to patents of prestressed concrete in 20th century architecture
M.P.L. Zurdo, J.A. Díaz & M. de Miguel Sánchez

Historical concrete structures in Romania and Italy: Exchange in building and conservation
M.B. Dan & C.O. Gociman

Emerging technologies
Monitoring the recovery of the architectural heritage
P.D. Simal, E.L. Rodríguez, E.L. Burlo & J.L. Díaz

The role of spontaneous construction for post-disaster housing
D. Félix, A.O. Feio, J.M. Branco & J.S. Machado

Comparing the embodied energy of structural systems in parking garages
C.T. Griffin, L. Bynum, A. Green, S. Marandyuk, J. Namgung, A. Burkhardt & M. Hoffman

Bridge design 2.0: Developments in the field of integrated, sustainable and durable bridge design
J. Smits

Earth architecture: Ancient and new methods for durability improvement
R. Eires, A. Cambões & S. Jalali

Daylight in interiors
L. Janečková & D. Bošová
Imagine architectural and structural design
Design of adaptive structures by kinematic synthesis of mechanisms
Y. Akgün, F. Maden & K. Korkmaz

Prestressing, technique and innovation in the 1950–1975 architecture
J.A. Diaz

Diagrid structures—innovation and detailing
T.M. Boake

Housing industrialization, success and failure, universal and local: Limits for housing globalization
A.L. Correia, V. Martinho & L.S. da Silva

Innovative architectural and structural design to preserve historical centers
D. Félix, A.O. Feio, J.M. Branco & J.S. Machado

Sustainable design of a multistory welded steel structure located in a seismic area
M. Georgescu, V. Ungureanu & M. Szitar

Concepts for a movable bridge
J. Holowaty

Partial dismantling of 1960s to 80s housing estates—a sustainable holistic solution
S. Huuhka

Design of reconfigurable doubly-curved canopy structure
F. Maden, K. Korkmaz & Y. Akgün

Natural structures and innovative design
N.O. Nawari & A.M. Gutierrez

A new building system: Structural aspects of COTaCERO system
J.P. Valcárcel, V. Hermo & J.B.R. Cheda

Hybrid structures: A case of a pedestrian bridge
T. Sophocleous, M.C. Phocas & A. Michael

Reciprocal structures in architectural shaping of floors and roofs
M. Piekarski

Origami based, deployable disaster relief shelter
S. Rihal

Three-hinged structures in a historical perspective
L. Slivnik

“Floating Roofs”: The Dorton Arena and the development of modern tension roofs
T.S. Sprague

Dynamic design of slender footbridges
E. Caetano & A. Cunha

Deployable stage: Proposal of an application with mobile structures
N. Torres

NaturWall®—timber multifunctional systems in refurbishment sustainable process
A. Spinelli & G. Callegari

Multi-objective search in the early phase of architectural design
T. Mendez Echenaguea, M. Sassone, P.A. Croset & A. Astolfi

Using the laser scanning technology in the rehabilitation of existing buildings
S. Pescari, D. Dan & V. Stoian
Computational morphogenesis in architecture: Structure and light
as a multi-objective design/optimization problem
A. Liuti, A. Pagnale & A. Erioli

Form structure inte(g)ration
E. Mele & M. Toreno

Mass-customized architectural design approach: Evaluation and a proposal
based on fractal geometry principles
M. Asefi & F. Fakourian

The legacy of the Modern Movement and its adversities in the face of the current
development of changeable housing construction solutions
H.J.V. Ferreira, L.S. da Silva & V. Murtinho

Nature-inspired structural optimization of freeform shells
F. Waimer, R. La Magna & J. Knippers

An innovative proposal for a deployable shading system
M. Asefi, E.E. Salari, Sh. Valadi & Gh. Kouchenani

Interdisciplinary work and educating architects and structural engineers

Hybrid architecture: Coupling structural understanding and architectural education
R. Balho, T. Kocaturk & A. Veliz

Cultivating the next generation of architects through pattern of structural systems
M.P. Callahan & I.K. Chang

Teaching seismic and wind subjects to architecture students
I.K. Chang, M.P. Callahan, P. Lu, H.Y. Chan & S. Luong

Embracing the past: Using historical structures to teach engineering fundamentals
R.J. Dermody

Design engineer construct: Building large scale structures
K. Dong & J. Feldman

The interdisciplinary design studio—identifying collaboration
K. Dong, J. Doerfler & T. Fowler

Constructing by creative re-use of unexpected materials
P.L. Carvalho & P.J.S. Cruz

Understanding the interplay between structure and architecture using
Building Information Modeling (BIM)
N.O. Nawari

Force material form—transferring historical construction concepts into contemporary
architectural design
M. Rinke & J. Schwartz

Numerical models of a beam belonging to a tall building: Errors and approximations
within ordinary design
L. Sgambi, N. Basso, R. Pavani, E. Civelli, C.D. Meroni & M. Pagin

Conceptual structural design: An important topic in architectural education
L. Sgambi, N. Basso & M.E. Codazzi

The advantage of full-size construction as an educational tool
in architecture education
J. Siem, B.O. Braaten, B. Manum, P. Aalto & A. Gilberg
Found in translation: Physical models as a structural design tool for architects
Th. Vilquin

Reframing structures: Frame experimentation in artistic studies
I. Vrouwe & B. Pak

Aesthetics in the education of civil and structural engineers
J.M. Songel

Lightweight and membrane structures

Fold here: Optimizing a disaster relief shelter with prototypes
R.M. Arens & E.P. Saliklis

Deployable membrane structures: Design proposal for the scissors-type system
O.F. Avellaneda & R. Sastre

Innovative solutions for ultra-lightweight textile shelters covering archaeological sites
A. Zanelli, E. Rosina, R. Maffei, G. Carra & P. Beccarelli

Tree like structures and fractals
J.S. Sánchez, F. Escrig & T.R. León

Lightweight architecture: Characteristics for an effective application in case of emergency
R. Maffei, A. Zanelli & P. Beccarelli

Minimal-surface-T-connections in architecture
G.H. Filz

Spaceplates Building System
A. Romme, I. Sorvin & A. Bagger

Qualitative investigation: Efficiency of a membrane roof project
E.F. Nunes, J.B.M. de Sousa Jr., A.M.S. de Freitas & B. Bater

“Corogami Hut” case study
C. Wiebe

Surface- and mesh-based approaches towards a materialization of architectural catenoids
G.H. Filz, S. Schiefer & Th. Stecher

Temporary reticulated membrane at PSI
P.D. Endres

Special structures

Shapes and behavior of triangular grid structures: Current trends in architecture of the 21st century
E.G. Meza & J.A. Díaz

Elevated pedestrian ways in Japan: A historical view
H. Isohata

Building on planet Mars student project
A. Nussbaumer, P. Zurbruegg, S. Erkman & T. Besson

Adaptable hybrid steel structures: Kinetic modeling and simulation study
M. Matheou, M.C. Phocas & E.G. Christoforou

Analysis of Portadas de Feria subjected to wind loads incorporating nonlinearity of the guys
M.T. Rodriguez-León, J.S. Sánchez & F. Escrig

xiv
Foundation Louis Vuitton: Exploring new structural typologies
A.M.B. Geli & M.P. Sendra

Steel and composite structures
Specificity of shaping light gauge steel shells
J. Abramczyk

Numerical analysis of sliding rigid beam-column joints made from encased tubes for high-rise structures
A.A. Valls, A.A. Puigcerver & J.M. Carreras

Experimental and theoretical analysis of bridges with encased filler beams
V. Kwočík, R. Vargová & P. Beke

Shear connection of composite steel and concrete bridge trusses
M. Charvát & J. Macháček

Experimental study on steel-concrete shear walls with steel encased profiles retrofitted with FRP composites
D. Dan, A. Fabian, V. Stoian & T. Nagy-György

The re-use of disassembled steel structures between architectural design and environmental sustainability
M. Pongiglione, C. Calderini & A. Giachetta

Theoretical and experimental studies on composite steel-concrete structural shear walls with steel encased profiles
A. Fabian, V. Stoian & D. Dan

Analysis of composite section columns under axial compression and biaxial bending moments
E. Fenollosa & I. Cabrera

Great steel structures: The Italian post-war trial
M. Zordan & F. Fragnoli

Required performance level of an existing building for over roofing
Zs. Nagy & M. Cristuțiu

Innovative conception and design of structural systems for flexible floor spaces
C. Odenbreit, O. Hechler & M. Braun

Double curved aluminum façade
K. Najjar

Comparing the seismic performance of concentrically braced frames with and without self-centering behaviour
G.J. O'Reilly & J. Goggins

Efficient solution for large motorways composite bridges
E. Petzek, L. Toma & E. Meteş

Technical solutions for rehabilitation of old arch bridges
E. Petzek, L. Toma & R. Băncilă

Reconversion process of an old building into a modern commercial center
Zs. Nagy & M. Cristuțiu

Adapting a historic truss viaduct to modern requirements
J. Holowaty

xv
Structural solutions for emergency architecture
T. Otilia-Alexandra & G.D. Mihal 471

The borderline between architecture and structural engineering
The challenges of structure in today's architectural, economic and social context
A.B. Larena & J.B. Larena 475

Conceptual planning by the structural engineer
A. Gianoli 477

Alpexpo building by Jean Prouvé in Grenoble: The specific issue of the suspended facade
A. Coste & C. Blachot 479

Great light spans: Geometry and simple structural behaviour—2nd half of the 20th century
V.A. García & J.A. Díaz 481

Structure and architecture: The illogical results of considering them two separated entities, after the 2009 earthquake in L'Aquila
C. Bartolomucci 483

A concrete prefabricated attic
C. Bocan 485

The importance of engineers in the development of modern Spanish architecture: Alejandro de la Sota's industrial architecture
M.C. González & A.S. Estrela 487

Architecture and engineering in the new leaning towers
M. Câmara, V. Compán & J. Sánchez 489

Structure as architectural system
B. Corotis & A. Daringa 491

Closing the gap while celebrating the divide: Tools for A/E collaborative learning
M.K. Donofrio 493

A multi-performance comparison of long-span structural systems
C.T. Griffin, E. Douville, B. Thompson & M. Hoffman 495

Timber framed masonry buildings, an earthquake resistance influenced architecture
A. Dutu, J.G. Ferreira & C.S. Dragomir 497

Homeostatic patterns
A. Erioli, C. Giacobazzi & G. Castellazzi 499

J.M. Rovira & C.B. García 501

The role of architectural theory in exploiting the potential of iron load-bearing structures
M.V. Hårja 503

The interaction of architects and structural engineers for the Hellenic World Complex in Athens
E.S. Kyriazis 505

A structural language for a conceptual design collaboration
L. Luyten 507

Engineers and the role of structures in architecture
B. Manum & D. Nilsen 509
On the extension of graphical statics into the 3rd dimension
M. Schrems & T. Kotnik

Configuration design for collective housing building structure—IFD systems configuration
J. Nikolic

Architectural taming of infrastructure: Interaction architect—structural engineers
R. Tarczewski & P. Ogieski

Infrastructures and environmental impact: The synergy of architectural and structural design
M. Pasca

New species of structures
J. Pérez-Herreras

The disappearance of the structural analysis barrier: The Sydney Opera House from a contemporary perspective
J.R. Rey

The role of structures in daylighting retrofits for existing buildings
M. Sedor, C.T. Griffin & K. Kontis

Built environment sustainability—breaking the borderlines between architects and civil engineers
M.A. Scitar, T.O. Gheorghiu & D.M. Grecea

Examining the architectural engineer
M.S. Uhlein

Traditional and scientific knowledge for a sustainable vulnerability reduction of rural housing in Haiti
A. Caimi, H. Guillaud, O. Moles, F. Vieux-Champagne, P. Garnier, S. Grange, Y. Steffert & L. Daudeville

Experimental tests on steel members with variable I welded section
I.M. Cristianu & D.L. Nunes

The evolutionary process of built heritage influenced by the architecture/engineering borderline decisions
A. Tavares, A. Costa & H. Varum

Confrontation between building and ground: Notions of force and gravity in the work of João Vilanova Artigas
L. Borgonovi e Silva & T. Kotnik

Structuring geometry and abstraction of structures in architectural synthesis
Dž. Bijedić, R. Cahtarević & S. Halilović

Design of the Brasilia TV Tower
E.B.C. Azambuja & J.M.M. Sánchez

Energy efficiency upgrading, architectural restyling and structural retrofit of modern buildings by means of “engineered” double skin façade
F. Feroldi, A. Marini, B. Badiani, G.A. Plizzari, E. Giuriani, A. Belleri & P. Riva

Structural assessment of heritage architecture
M. Holicky & M. Sykora

Structure and architecture in the design studio
P.D. Endres & C. Wetzel

Can collaboration within multidisciplinary teamwork be explained using Belbins theory?—a case study
A.S. Dederichs & J. Karlshoj
The tectonic of architectural solutions

AgwA architecture office: Study cases on structure and architecture
H. Fallon & B. Vandenbulcke

Viljo Revell: Tectonic structures
J.J.F. Forés

The Tectonic meaning in Le Corbusier's architecture the case of Le Cabanon
F. Hakonsen

Mies' early American work and the Tectonic bond between architecture and structure
R.S. Avilés

Alternative affordable housing through simulated 3D architectural tectonic: V3 Residence, Putrajaya
R. Ab. Rahman & A.A. Dzaharudin

Tectonics or reinforced concrete and timber and earthquake vulnerability
M. B. Dan

Combining shape grammars and BIM in the rehabilitation design process of the bourgeois house of Oporto: The research progress
E. Coimbra & V. Riso

AgwA architecture office: Addressing structure in architecture competitions
H. Fallon & B. Vandenbulcke

Towards an improved architectural quality in contemporary architecture
C. Kristensen & P.H. Kirkegaard

The use of new materials

Agricultural residues applications in contemporary building industry
H. Dahy & J. Knippers

The finishing touch for better energy efficiency of episodically used masonry wall single family houses
S. T. Djambova & O. Simov

Light, colour, form and surface
C. Eckhardt

How to build the future with limited and finite resources?
Y. Sieffert, D. Daudon & J.-M. Huygen

Thermal and energy refurbishment of university buildings using phase change materials
L.N. Gomes, M.S. Rodrigues, R.S. Vicente & T.R. Silva

Cement-bonded particleboards of modified composition with alternative raw sources utilization
T. Melichar & J. Bydžovský

Timber structures

Connections loaded perpendicular to grain—analysis of the failure behavior and design approach
B. Franke & P. Quenneville

Contribution to the fire resistance of timber construction using boards
M. Dufková & P. Kuklík
Low cost construction: State of the art and prospects for using structure wood apartment buildings in Portugal
M. Oliveira, J.P. Couto, P. Mendonça, J.M. Branco, M. Silva & A.P. Reis

Embodied information in structural timber
E. Jannasch

Convertible city: Light wood prefab systems in the extension of built environment
A. Spinelli

Analysis of the elasto-plastic failure behavior of wood under compression
S. Franke

Fire-resistance analysis of a novel wood-concrete composite deck
R. Meena, M. Schollmayer & S. Hehl

Optimized generation of non-standard wood structures based on native irregular components
V. Monier, G. Duchanois & J-C. Bignon

Development of prefabricated timber-concrete composite floors
P. Nechanicky & P. Kuklik

Barriers to the design and use of cross-laminated timber structures in high-rise multi-family housing in the United States
J. Schmidt & C.T. Griffin

A modular timber construction system made with ribbed-box or rather hollow-box elements
S. Franke & R. Hausammann

The Roman timber framework, a neglected construction method
X. Laumain

The behavior of toothed-plate connectors under reversed cyclic loading
E. Tuukkanen & K. Öiger

On seismic response of retrofitted wooden house by collapsing process analysis
T. Takatani & H. Nishikawa

Author index