



**ICM14**  
SANTIAGO • CHILE

International  
Conference on  
the Mechanical  
Behaviour  
of Materials

# Conference Program

**Santiago, Chile**  
**12th-14th**  
**July 2023**



[contact@icm-14.com](mailto:contact@icm-14.com)



<http://icm-14.com>



DEPARTAMENTO DE  
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## LOCAL ORGANISING COMMITTEE



**Professor Erick I. Saavedra Flores**  
ICM-14 Chair  
Director in the Civil Engineering Department,  
University of Santiago, Chile

- **Leonardo Brescia Norambuena**
- **Carlos Felipe Guzmán**
- **Juan Carlos Pina**
- **Cristian Vargas Riquelme**
- **Sergio J. Yanez**

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- **Belfor Galaz, University of Santiago**
- **Carlos Felipe Guzmán, University of Santiago**
- **Claudio García-Herrera, University of Santiago**
- **Cristian Canales, University of Concepción**
- **Cristian Vargas Riquelme, University of Santiago**
- **Diego Celentano, Pontifical Catholic University of Chile**
- **Diego Vasco, University of Santiago**
- **Erick I. Saavedra Flores, University of Santiago**
- **Felipe Vicencio, Universidad San Sebastián**
- **Gerardo Araya-Letelier, Pontifical Catholic University of Chile**
- **Jaime Campbell, University of La Serena**
- **Jorge Hinojosa, Talca University**
- **Jose Norambuena-Contreras, University of Bio-Bio**
- **Juan Carlos Pina, University of Santiago**
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- **Leonardo Brescia Norambuena, University of Santiago**
- **Manuel Chávez, University Andres Bello**
- **Marcela Cruchaga, University of Santiago**
- **Patricio Cendoya, University of Concepción**
- **Roberto Ortega Aguilera, University of Santiago**
- **Rodrigo Astroza, University of the Andes**
- **Sergio J. Yanez, University of Santiago**
- **Siva Avudaiappan, University of Santiago**
- **Viviana Letelier, Universidad de la Frontera**
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- Anthony Waas, University of Michigan, USA
- Ashok Saxsena, University of Arkansas, USA
- Beatriz Gonzalez-Rodrigo, Universidad Politécnica de Madrid, Spain
- Bhushan Karihaloo, Cardiff University, United Kingdom
- Charles Clifton, The University of Auckland, New Zealand
- Daya Reddy, University of Cape Town, South Africa
- Debes Bhattacharyya, The University of Auckland, New Zealand
- Emilio Calius, Callaghan Innovation, New Zealand
- Erick I. Saavedra Flores, University of Santiago, Chile
- Francesco Noto, CERN, Switzerland
- Gerhard A. Holzapfel, Graz University of Technology, Austria
- George Papanicolaou, University of Patras, Greece
- Ghatu Subhash, University of Florida, USA
- Gopalkrishnan Srinivasan, Indian Institute of Science, India
- Gulshan Kumar, Guru Gobind Singh Indraprastha University, India
- Horacio Espinosa, Northwestern University, USA
- J.N. Reddy, Texas A&M University, USA
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- Jihua Gou, University of Central Florida, USA
- Johann Sienz, Swansea University, UK
- Jung Kwan Seo, Pusan National University, Korea
- Justin Fernandez, University of Auckland, New Zealand
- Leonardo Godetroid, Universidade Federal de Ouro Preto, Brazil
- Markus J. Buehler, Massachusetts Institute of Technology, USA
- Milan Brandt, RMIT, Australia
- Mike Xie, RMIT, Australia
- Majid Ayatollahi, Iran University of Science and Technology, Iran
- Milos Djukic, University of Belgrade, Serbia
- Nasr Ghoniem, University of California Los Angeles, USA
- Norman A. Fleck, University of Cambridge, UK
- Pier Marzocca, RMIT, Australia
- Paulo Pimenta, University of Sao Paulo, Brazil
- Peng Cao, The University of Auckland, New Zealand
- Raj Das, RMIT, Australia
- Ramesh Rayudu, Victoria University, New Zealand
- Reza Vaziri, The University of British Columbia, Canada
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- Sabrina Vantadori, University of Parma, Italy
- Satya Atluri, University of California Irvine, USA
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- Shaker Meguid, University of Toronto, Canada
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- Tomasz Wierzbicki, Massachusetts Institute of Technology, USA
- Tomas Martin, University of Bristol, UK
- Vadim Silberschmidt, Loughborough University, United Kingdom
- Wesley Cantwell, University of Liverpool, United Kingdom
- Yuris Dzenis, University of Nebraska-Lincoln, USA
- Zbigniew Kowalewski, Institute of Fundamental Technological Research, Poland



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- **Dr. Arunachalam Rajendran (USA)**
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## KEYNOTES SPEAKERS



**Professor Markus J. Buehler**  
Professor of Civil and Environmental  
Engineering  
Massachusetts Institute of Technology, USA



**Professor Norman A. Fleck,**  
**FREng, FRS**  
Professor of Mechanics and Materials  
Engineering Department  
University of Cambridge, UK



**Professor Gerhard A.**  
**Holzapfel, Ph.D.**  
Professor of Biomechanics  
Graz University of Technology Institute of  
Biomechanics, Austria



**Professor Stelios Kyriakides**  
Professor of Aerospace Engineering and  
Engineering Mechanics  
University of Texas, USA

**DON'T  
MISS  
OUT!**

16:00

17:30

**HALL LOS VOLCANES**

**PM  
JULY 11TH**

**OPENING COCKTAIL**



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AM

JULY 12TH

Santiago, Chile  
12th-14th  
July 2023

START END

7:30 9:00		REGISTRATION ON SITE			
ROOM		PARINACOTA/TUPUNGATO	LLAIMA	PUYEHUE	CALBUCO
9:00 9:30		OPENNING SESSION			
9:30 10:30		Multi-phase lattices: the role of an infilled phase Prof. Professor Norman A. Fleck University of Cambridge, UK			
10:30 11:00		COFFEE BREAK			
11:00 12:50		Timber structures	Materials mathematics modelling	Composites and polymers	Computational mechanics
11:00 11:30		From Microstructure to Macroscopic Response in Timber: A Methodology Bridging Cell Wall Rheology and Quasi-Brittle Behavior (Carlos Felipe Guzmán)	Numerical investigation on the thermo-mechanical response of Steel-Timber Composite structures exposed to fire (J.C. Pina, M. Godoy, and G. Roa)	Highlights on ANSYS engineering simulation for the study of the mechanical behavior of materials (Léa Décultot and Carlos Olivares Garrido)	Design and evaluation of personalised peripheral artery stent (Liguo Zhao and Ran He)
11:30 11:50		Correlation between microstructural changes and evolution of the modulus of elasticity in radiata pine wood exposed to temperatures below the carbonization level (Lenko Alvarez Briones, Marcelo Henríquez Suarez, Sebastián Painamil Parra, Christian Seal Mery, Cristina Villamar Ayala, Juan Carlos Pina and Eduardo Pérez Pulgar)	Numerical analysis of the integration scheme of an extended Gurson-Tvergaard-Needleman damage model (Carlos Ulloa, Anselmo Rodríguez and Carlos Felipe Guzmán)	Characterization of Mechanical and Fracture Properties of Thermoplastic Binders for Solid Propellants (Kyungha Kim, Kyungha Kim, Byoung-Ho Choi, Ilyhun Kim, Sunyoung Lee, Hyunseob Lee and Seongho Yoon)	Biomechanical Analysis of an Alligator Mandible Structure (Joshua Rodriguez, Simon Barter and Raj Das)
11:50 12:10		Investigating Structure-Soil-Structure Interaction in Cross-Laminated Timber Buildings Subjected to Seismic Loads (Sebastián Torres-Olivares, Erick I. Saavedra Flores, Carlos Felipe Guzmán, Juan Carlos Pina and Sergio J. Yanez)	Parametric analysis of the mechanical behavior of Cu-Al-Be shape memory alloy strands for applications in self-centering systems (Christian Medina, Ricardo Antonio Herrera and Juan Felipe Beltran)	Improvement of the thermal durability of polymer-based composite using functionally graded filler (Kamil Krzywinski, Santiago El Awad, Konrad Jozef Krakowiak and Lukasz Sadowski)	A hygro-viscoelastic model for the wood cell wall (Raul Lazo-Molina and Carlos Felipe Guzmán)
12:10 12:30		Nonlinear Finite Element Model for Cyclically Loaded Cross-Laminated Timber Building Connectors (Rodrigo Tapia and Erick I. Saavedra Flores)	Elastoplastic characterization of rolled C11000 copper sheets via strain dependent yield surface parameters: Experiments, modeling, and simulation (Alvaro Navarrete Rosales, Matias Pacheco, Claudio Garcia-Herrera, Diego Celentano and Javier Signorelli)	Structural resistance and loading case analysis for buckling collapse prevention in thermoplastic liners for oil applications (Federico Rueda, Camila Quintana, Patricia Frontini and Fabricio Pietrani)	Revaluation of industrial cellulose waste through the manufacture of materials based on mycelium (Hugo Muñoz and Mamié Sancy)
12:30 12:50			Mixed continuous/discrete representation of plastic flow inhomogeneities during high-strain-rate and severe plastic deformation of aluminium alloys (Elijah Borodin, Elijah Borodin, Afonso Barroso, Vladimir Bratov, Alexander Mayer, Andrey Jivkov and Oleg Bushuev)	Influence of drilling parameters on the appearance of delamination and quality of holes in machining thermoplastic polymer composites reinforced with carbon fibers (Marcel Yuzo Kondo, Emanuele Schneider Callisaya, Edson Cocchieri Botelho, Michelle Leali Costa, Manoel C S Alves and Marcos Valério Ribeiro)	A Measurement of Thin Film Properties with Covered Elastic Cuboids and RUSpec Method (Ji Wang, Jinghui Wu, Fengling Hanga and Baocheng Meng)



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START END

12:50 14:00

LUNCH

14:00 15:00

**Compressive Behavior of Foams: Experiments and Modeling**

Prof. Stelios Kyriakides  
University of Texas, USA

ROOM

PARINACOTA/TUPUNGATO

LLAIMA

PUYEHUE

CALBUCO

15:10 16:10

**Alloys  
and fatigue**

**Seismic and dynamic analysis**

**Timber structures**

**Cement based materials**

15:10 15:30

Cr/CrN coating effect on the fatigue crack nucleation period of Ti-6Al-4V alloy  
**(Martin Ferreira)**

Structural Integrity Assessment of a Generation-IV Reactor under Blast Waves  
**(Tae-Yong Kim and Yoon-Suk Chang)**

Thermomechanical analysis in CLT compartments exposed to fire  
**(Guillermo Alonso Roa Muñoz, Matías Godoy, Sergio J. Yanez, Carlos Felipe Guzmán, Erick I. Saavedra Flores and Juan Carlos Pina)**

Exploring the Potential of Pumice Stone as Coarse Aggregate: An Experimental Approach to Reduce Concrete Self-Weight  
**(Cristian Canales, Krishna Prakash Arunachalam, Siva Avudaiappan, Maria Vanessa, Gutierrez Senepa, Cristian Alexis Canales, Cardenas Pablo Ignacio, Cuello Moreno Teresita Marzioletti and Saddam M. Ahmed)**

15:30 15:50

Quantitative evaluation of fatigue crack initiation on Ti-6Al-4V alloy by using Schmid factor  
**(Jinta Arakawa, Hiroyuki Akebono and Atsushi Sugeta)**

Seismic rehabilitation of a soft story structure with hysteretic dampers  
**(Paul Edmundo Guerrero Dumancela, David Escolano and Santiago Mota)**

Seismic Structure-Soil-Structure Interaction between a pair of cross-laminated timber buildings  
**(Felipe Vicencio and Erick I. Saavedra Flores)**

Experimental analysis of Helix Aspers shell use as cementitious material  
**(María José Campos-Cortés, Leonardo Brescia-Norambuena, Claudia Retamoso and Nestor Escalona)**

15:50 16:10

Increasing crack resistance of NiTi particle reinforced aluminum alloys with tunable initial stress fields  
**(Mohammed Ali Lakhdari, Rafael Estevez, Muriel Veron, Aude Simar, Laurent Delannay and Nelson Gomes)**

Improving the Fatigue Design of Mechanical Systems such as Refrigerator  
**(Seongwoo Woo)**

Study of the structural mechanical behavior of cross-laminated timber buildings subjected to seismic loads  
**(Yasmín Delgado and Erick I. Saavedra Flores)**

Influence of granulometry and aggregates' proportion on mechanical properties of Lightweight concrete produced using Brazilian expanded clay  
**(Lays Costa, Hidelbrando Diogenes and Maria Isabel Valente)**

16:10 17:00

COFFEE BREAK + POSTER PRESENTATIONS (REVIEW THE NEXT PAGE)

17:00

SOCIAL ACTIVITY - PIANO AFTERNOON



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16:10 17:00

**POSTER PRESENTATIONS**

16:10 16:35

Fatigue Life Prediction Analysis of  
Automobile Suspension System  
Bracket Considering Residual Stress  
Due to Thermal Stress

**Kee Joo Kim**

Mechanical behaviour of metal-epoxy  
hybrid microlattice  
structures

**Joey Tallon**

A Study of the Ductile Fracture of  
High-Density Polyethylene Pipe  
Using Pipe Coupon Creep Tests with  
Various Process Conditions

**JunKeun Chae**

16:35 17:00

A novel mathematical approach for  
gravity-driven granular flows  
in block caving

**Francisco Vivanco**

Experimental assessment of shear  
wave velocity and relative  
density as predictors for liquefaction  
potential by means of laminar soil  
shear box tests

**Pablo Medina**



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9:00	9:30	 ICM - OUTLOOK AND FUTURE PERSPECTIVES				
9:30	10:30	<b>Attention-based molecular modeling of hierarchical bio-inspired nanocomposites and protein materials</b> Professor Markus J. Buehler Massachusetts Institute of Technology, USA				
10:30	12:00		<b>Structures optimization</b>	<b>Experimental analysis</b>	<b>Alloys modelling</b>	<b>Multi-scale analysis</b>
10:30	11:00		Microstructurally Induced Fracture Modes in Crystalline Materials <b>(Mohammad Zikry and M-J. Chen)</b>	Mechanical activation assisted of biobased encapsulated rejuvenators to promote asphalt self-healing <b>(Jose Concha, Miguel Saez-Gutierrez and Jose Norambuena)</b>	Challenges, possibilities and limitations in modeling bone-orthopedic device interaction from an engineering standpoint <b>(Gastón Alonso)</b>	Chemical Reaction and Strength of Tricalcium Phosphate Nano-Coating Application on Dental Implants by Atomistic Calculations <b>(Alla Balueva, Iliia Dashevskiy, Dmitry Lisovenko and Wynn Kwiatkowski)</b>
11:00	11:20		Seismic rehabilitation of a soft story structure with hysteretic dampers <b>(Paul Edmundo Guerrero Dumancela, David Escolano and Santiago Mota)</b>	The stress field of the Flattened Brazilian Disc <b>(Yingtao Zhao, Zhetong Wang, Wenshuo Bai, Dingxin Sun and Qinwei Ma)</b>	Artificial neural networks for enhancing prediction capability of strain-rate sensitive mechanical modeling <b>(Víctor Tuninetti)</b>	Phonon Dispersion Relation as a Predictor of Plastic Flow Cascades <b>(Mark Wootton and Beñat Gurrutxaga-Lerma)</b>
11:20	11:40		Methodology proposal for the design of flexible steel tanks <b>(Nicolas Fuente and Marcela Cruchaga)</b>	Influence of deficient surface treatment on the adhesion capacity of cementitious adhesives <b>(Benjamín Navarrete, Juan Pablo Varas and Gerardo Araya-Letelier)</b>	Comparative analysis of the results of research on the properties of a composite material elements of bridge structures with initial characteristics and regulatory requirements after 17 years of operation <b>(Andrey Ushakov and Yuri Klenin)</b>	Systematic analysis of strain effect on interfacial thermal resistance between graphene and silicon <b>(Chao Li, Yunhe Sheng and Yu Su)</b>
11:40	12:00		Study of the steel-concrete composite shear wall under axial and lateral loads by finite elements <b>(Masoud Javadi and Erick I. Saavedra Flores)</b>	Analysis of power consumption during the machining of epoxy-based CFRP <b>(Emanuele Schneider Callisaya, Manoel Cleber de Sampaio Alves, Marcel Yuzo Kondo, Marcos Valerio Ribeiro, Michelle Leali Costa and Edson Cocchieri Botelho)</b>	Calibration factors for mass loss of longitudinal and transverse reinforcement in accelerated corrosion process in the RC sections <b>(Gheyasuddin Ahmad, P Kamatchi, J Prakashvel and Erick I. Saavedra Flores)</b>	Impact of adhesive connections on the mechanical performance of steel-framed gypsum-board panels <b>(Camilo Guzman, Gerardo Araya-Letelier, Rodrigo Astroza and Eduardo Miranda)</b>
12:00	13:00	POSTER PRESENTATIONS (REVIEW THE NEXT PAGE)				
13:00		SOCIAL ACTIVITY: SANTA RITA VINEYARD AND WINE TESTING				



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12:00 13:00

**POSTER PRESENTATIONS**

12:00 12:20

Mechanical Behavior of Bulldog-Toothed Connectors in Radiata Pine Wood Connections Using Finite Elements

**Moises Bautista Gresve Galleguillos**

Study of mechanical performance of pinus radiata wood under torsional loading by computational homogenisation

**José Barrientos**

Quasi-fragile fracture modeling of timber using a stabilized mixed finite element formulation

**Willy Morocho Luna**

12:20 12:40

Transient streaming potential considering changes in the surface potential in the bone matrix

**Junghwa Hong**

Design of a rotational bistable mechanism : a parametric and ergonomic study

**Kéliane Megret**

Development of predictive models for fatigue life of additively manufactured Ti-6Al-4V hip replacements

**Fernando Roberto Gómez**

12:40 13:00

Implementation of a uniaxial MEMS accelerometer for dynamic measurements in earthquake shaking table test

**Pablo Tobar**

Numerical modeling of anchoring headed connectors considering the influence of edge and group effects on reinforced concrete elements under tension

**Joao Paulo de Barros Santos**

Numerical model of a steel end-plate moment connection using a novel cyclic loading protocol

**Jorge Pi**



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ROOM		PARINACOTA/TUPUNGATO	LLAIMA	PUYEHUE	CALBUCO
8:00	9:00	REGISTRATION ON SITE			
9:00	10:00	<b>Mechanical Behavior of Human Aortic Walls and Ultrastructural Changes under Loading</b> Professor Gerhard A. Holzapfel, Ph.D. Graz University of Technology, Austria			
10:30	11:00	COFFEE BREAK			
11:00	13:00	<b>Materials mathematics modelling</b>	<b>Construction materials</b>	<b>Multi-scale modelling</b>	<b>Materials fatigue</b>
11:00	11:20	Exploiting p4gm plane group for design of phononic crystals <b>(Pavel Galich and Ilai Nadejde)</b>	Towards sustainable shotcrete in mining: A literature review on the utilization of tailings as a partial replacement for fine aggregate <b>(Adolfo Alcayaga, Adolfo Alcayaga, Siva Avudaiappan, René Gomez and Fernando Betancourt)</b>	Mechanical properties of glassy polymer nanocomposites via atomistic and continuum <b>(Hilal Reda)</b>	Fatigue life assessment of structures under realistic loading conditions <b>(Andrei Kotousov, Christopher Wallbrink, James Hughes and Aditya Khanna)</b>
11:20	11:40	Predicting bifurcation patterns in architected materials - A group theoretic approach <b>(Rachel Azulay, Christelle Combescure and Justin Dirrenberger)</b>	The effect of copper tailings addition on the mechanical and electrochemical properties of mortars <b>(Carlos Sepulveda, Lisa Munoz, Carolina Guerra, Nicolas Carrasco and Mamie Sancy)</b>	Modeling and analysis of directional energy absorption capacity of resin-filled auxetic polylactic acid <b>(Ignacio Ríos, Victor Tuninetti, Gonzalo Fincheira, Cesar Garrido and Rodrigo Valle)</b>	Determination of near-threshold fatigue crack propagation in an aisi 316l stainless steel using different precracking techniques <b>(Luís Henrique Camargo Bonazzi, Javier Plata and Claudio Ruggieri)</b>
11:40	12:00	Heterogeneous mechanical metamaterials with extreme bulk-to-shear modulus ratio: an evolutionary design approach <b>(Sara E Rodriguez, Raj Das and Emilio Calius)</b>	Experimental study of nanosilica based concrete with nano silica gel <b>(Cristian Canales, B. Samatha, Saddam M. Ahmed, Siva Avudaiappan, Lucas Pedro Daza Badilla, Teresita Marzioletti and Krishna Prakash Arunachalam)</b>	Multi-Scale analysis of fiber-reinforced-concrete structures <b>(Pouriya Pirmoradi, Payam Poorsolhjoui and Akke Suiker)</b>	Applications of Infrared Thermography to the Fatigue Characterization of Functional and Structural Materials <b>(Raúl Ignacio Bustos and Alejandro Yawny)</b>
12:00	12:20	Non-periodic mechanical metamaterials for robotics <b>(Weihao Luo, Weihao Luo, Emilio Calius, Raj Das and David Howard)</b>	Design and development of recycled concrete from construction and demolition mixed recycled aggregates in a circular economy <b>(Marcos Diaz)</b>	A numerical study on the time-dependent degradation of paper artifacts <b>(Amir Parsa Sadr, Emanuela Bosco and Akke Suiker)</b>	Thermal fracture of functionally graded coatings with multiple cracks <b>(Vera Petrova and Siegfried Schmauder)</b>
12:20	12:40	The fracture toughness of demi-regular lattices <b>(Milad Omid and Luc St-Pierre)</b>	Compressed earth blocks: effect of constituent weight fraction and process parameters on the resistance to mechanical loads <b>(Marian Valenzuela, Gustavo Ciudad, Jorge Leiva, Renato Hunter, Juan Pablo Cárdenas, Shady Attia and Víctor Tuninetti)</b>	Application of Maxwell's far-field homogenization methodology to evaluation of third-order elastic constants of particulate composites <b>(Andrei Kotousov, James Vidler and Ching-Tai Ng)</b>	Monitoring of fatigue damage development in as-received and exploited 10CrMo9-10 power engineering steel supported by Digital Image Correlation <b>(Zbigniew Kowalewski, Mateusz Kopec and Adam Brodecki )</b>
12:40	13:00	Influence of heat treatment on deformation and mechanical properties of maraging steel C300 obtained by Selective Laser Melting (SLM) <b>(Hilal Reda)</b>	Preliminary insights on the use of copper slag as supplementary cementitious material <b>(Claudia Burbano-Garcia, Yimmy F. Silva, Gerardo Araya-Letelier and Marcelo Gonzalez)</b>	Application of the Edinburgh bonded particle model through computer simulation of concrete <b>(Angela Arriagada, Patricio Cendoya, Siva Avudaiappan and Pablo Parra)</b>	Modelling cyclic deformation and fatigue crack growth through coupling of phase field and viscoplasticity <b>(Liguo Zhao and Jianan Song)</b>



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**12th-14th**  
**July 2023**

START	END	LUNCH			
ROOM		PARINACOTA/TUPUNGATO	LLAIMA	PUYEHUE	CALBUCO
13:00	14:00				
15:30	17:50	<b>Materials mathematics modelling</b>	<b>General materials behaviour</b>		<b>Experimental analysis</b>
14:00	14:20		Computing strain rate effects on concrete compressive strength by Smooth Particle Hydrodynamics <b>(Christian Droguett, Erick I. Saavedra Flores and Sergio J. Yanez)</b>		Applying Chaospy And The Monte Carlo Method In The Analysis Of The Influence Of Statistical Parameters Of Superficial Texture On Human Dental Contact <b>(Flavia Bastos, Leonardo Goliatt Fonseca and Evelyn Oliveira)</b>
14:20	14:40	A Measurement of Thin Film Properties with Covered Elastic Cuboids and RUSpec Method <b>(Ji Wang, Jinghui Wu, Fengling Hang, Baocheng Meng, Ji Wang)</b>	Influence of deficient Surface conditions on the adhesion capacity of cementitious adhesives <b>(Juan Pablo Varas-Aros, Benjamín Navarrete and Gerardo Araya-Letelier)</b>		Determination of the minimum inhibitory concentration to combat E. Coli, of an amorphous borosilicate compound, as an alternative antibacterial substance <b>(Bertha Silvana Vera Barrios, Josue Amilcar Aguilar Martinez and Elisban Juani Sacari Sacari)</b>
17:00		<b>SOCIAL ACTIVITY: Night trekking in Mahuida Park</b>			



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## **SHORT COURSE**

# **Advanced Design and Manufacturing of Composite Materials and Structures**



**Wednesday, July 12,**  
**from 12:30 to 14:00**

### **Course Content:**

- Module 1: Application and Manufacturing of Composite Materials**
- Module 2: Mechanics of Composite Lamina/Laminate**
- Module 3: Failure Analysis of Composite Laminates and Structures**
- Module 4: Analysis and Design of Composite Laminates and Structures**
- Module 5: Advanced Manufacturing of Composite Materials, including Additive Manufacturing**



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