

# FINAL PROGRAM

## 13<sup>th</sup> International Conference on Superplasticizers and Other Chemical Admixtures in Concrete

## 15<sup>th</sup> International Conference on Recent Advances in Concrete Technology and Sustainability Issues

Milan (Italy), July 10 – 15, 2022

Organized by:

American Concrete Institute – Italy Chapter

University of Bergamo

Department of Engineering and Applied Sciences



UNIVERSITÀ  
DEGLI STUDI  
DI BERGAMO

Department  
of Engineering  
and Applied Sciences

# 13<sup>th</sup> International Conference on Superplasticizers and Other Chemical Admixtures in Concrete (SOCAC)

Milan (Italy), July 10 – 13, 2022

## **Sponsored by:**

ACI International – USA  
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## **Main topics**

Chemistry of superplasticizers  
Development and applications of superplasticizers compatibility with cements, blended cements, aggregates, etc.  
Compatibility issues involving superplasticizers and other chemical admixtures  
Development and applications of other chemical admixtures  
Development and applications of superplasticizers and other chemical admixtures for new binders  
Viscosity modifying admixtures  
Corrosion inhibitors  
Shrinkage reducing admixtures  
Expansive admixtures  
Polymers in concretes  
Chemical admixtures for ready-mixed mortars and precast concretes  
Admixtures and binders for digital fabrication  
Testing methods and standard advancement  
Chemical admixtures and sustainable development  
Case history

## **Conference Honorary Chairpersons**

Mario Collepardi – Enco Srl – ITALY  
V. Mohan Malhotra – Ottawa, ON – CANADA

## **Conference Chairperson**

Luigi Coppola – University of Bergamo – ITALY

## **Organizing Committee**

Pietro Gambarova – Polytechnic of Milan – ITALY  
Massimiliano Pescosolido – ATECAP, Federbeton – ITALY

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Ara Jeknavorian – Jeknavorian Consulting Services - USA  
Harald Justnes – SINTEF – NORWAY  
Kamal Khayat – Missouri Univ. of Science and Technology - USA  
Lei Lei – TUM – GERMANY  
Roberta Magarotto – Master Builders Solutions Spa – ITALY  
Surendra Manjrekar – Special Coatings Mumbai – INDIA  
Pierre-Claver Nkinamubanzi – NRC – CANADA  
Marta Palacios – E. Torroja Inst. For Construction Science – SPAIN  
Ioanna Papayianni – Aristotle University of Thessaloniki – GREECE  
Francisca Puertas – E. Torroja Inst. For Construction Science – SPAIN  
Etsuo Sakai – Tokyo Institute of Technology – JAPAN  
Wolfram Schmidt – BAM – GERMANY  
Tongbo Sui – Sinoma International Engineering – CHINA  
Arezki Tagnit-Hamou – University of Sherbrooke – CANADA  
Francesca Tittarelli – Polytechnic University of Marche – ITALY  
Roberto Troli – Betonrossi Spa - ITALY  
Ziming Wang – Beijing University of Technology – CHINA

# 15<sup>th</sup> International Conference on Recent Advances in Concrete Technology and Sustainability Issues (RACTSI)

Milan (Italy), July 13 – 15, 2022

## **Sponsored by:**

ACI International – USA  
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## **Main topics**

Sustainable issues and CO<sub>2</sub> emissions  
CO<sub>2</sub> emissions reduction in the  
manufacturing of portland cement  
Durability and corrosion, service life  
prediction and life-cycles analyses  
Recycled and artificial aggregates  
Porous and no fines concretes  
Polymer concretes and polymer  
modified concretes  
Innovative and alternative test  
methods for concrete  
Alternative binders to portland cement  
Alkali-activated materials and  
geopolymers  
New concrete coating materials  
Use of industrial/agriculture by-  
products for building materials  
Shrinkage compensating concretes  
Shotcretes and execution  
New reinforcements for concrete  
High performance concretes  
High density concretes  
Under-water concreting  
Concretes in marine environments  
Repairing works of damaged concretes  
Self-curing concretes  
Digital fabrication with concrete

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## **Conference Chairperson**

Luigi Coppola – University of Bergamo – ITALY

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Davide Gabrielli – Draco Italiana Spa - ITALY  
Walter Nussbaumer – Mapei Spa – ITALY

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Raffaele Cioffi – Parthenope University of Naples – ITALY (Chair)  
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Claude Bédard – Euclid Canada – CANADA  
Vlastimil Bilek Sr. – VSB Tech. Univ. Ostrava – CZECH REPUBLIC  
Ezio Cadoni – SUPSI Lugano – SWITZERLAND  
Didar Cheema – Curtin University – AUSTRALIA  
Denny Coffetti – University of Bergamo – ITALY  
Silvia Collepardi – Enco Srl - ITALY  
Valeria Corinaldesi – Polytechnic University of Marche – ITALY  
Martin Cyr – University of Toulouse – FRANCE  
Deborah Floris – Italcementi Spa – ITALY  
Ravindra Gettu – Indian Institute of Technology Madras – INDIA  
Harald Justnes – SINTEF – NORWAY  
Kamal Khayat – Missouri Univ. of Science and Technology - USA  
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# 13<sup>th</sup> International Conference on Superplasticizers and Other Chemical Admixtures in Concrete (SOCAC)

# 15<sup>th</sup> International Conference on Recent Advances in Concrete Technology and Sustainability Issues (RACTSI)

## Secretariat

Denny Coffetti

University of Bergamo

**denny.coffetti@unibg.it**

Valentina Trinchese

American Concrete Institute – Italy Chapter

**aciitalychapter@gmail.com**

## Website

SOCAC Conference

<http://www.aciitaly.com/events/socac2021>

RACSTI Conference

<http://www.aciitaly.com/events/ractsi2021>

## Conference Venue and Date

Hotel Sheraton Milan San Siro

Via Caldera, 3 – 20153 Milan (Italy)

+39 02 915221 – [www.sheratonmilansansiro.com](http://www.sheratonmilansansiro.com)

Here you can find the e-brochure.

<https://www.zebrasd.com/e-brochure/SheratonMilanSanSiro/>

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## PROGRAM 13^ SOCAC

July 10, 2022		
18:30	<div>Registration SOCAC</div> <div>Welcoming cocktail (sponsored by ACI Italy Chapter)</div> <div></div>	
July 11, 2022 - Sala Magnolia		
08:00	Registration SOCAC	
09:00	Opening ceremony SOCAC chaired by Luigi Coppola, conference chairperson, Charles Nmai, ACI Int. President, Sergio Cavalieri, Rector of the University of Bergamo and Giovanna Barigozzi, Head of Department of Engineering And Applied Sciences, University of Bergamo	
09:40	Session S1 Chair: R.J.Flatt	KEYNOTE: "40 Years of PCE Superplasticizers - History, Current State-of-the-Art and an Outlook" - Johann Plank and Lei Lei, TU Munich, Germany
10:20		"Effect of Acid-ether Ratios on The Properties of PCE and Their Effects in Dispersing CSH Crystals" – Serina Ng, Chang An YuCai, China
10:40		"Thermal Stability of HPEG-type Polycarboxylate Superplasticizers" – Ivan Bondarenko, Russian Engineering Academy, Russia
11:00	Coffee break (sponsored by ACI Italy Chapter)	
11:30	Session S2 Chair: W.Nussbaumer	KEYNOTE: "Experimental method and thermodynamic model for competitive adsorption between polycarboxylate comb-copolymers" - Robert J. Flatt, ETHZ, Switzerland
12:10		"PCEs containing C5 and C6 based PEO side chains: A comparison on the synthesized polymers and the resulting dispersing effectiveness" – Mirko Gruber, Chang An YuCai, China
12:30		"Ecologic and Economic Cement Production and Performance Tests on Concrete" – Ozlem Akalin, Plustechno, Turkey
12:50		"Thixotropic and chemical structural build-up of cement pastes with superplasticizer under different storage conditions" – Alexander Mezhev, BAM, Germany
13:10	<div>Lunch (sponsored by Federbeton)</div> <div></div>	
14:30	Session S3 Chair: R. Magarotto	KEYNOTE: "Molecular modeling of chemical admixtures; opportunities and challenges" - Aslam Kunhi Mohamed, ETHZ, Switzerland
15:10		"Meta-Analysis of PCE Structures as Dispersants in Cementitious Materials" -Torben Gadt, TU Munich, Germany
15:30		"Side chains and the competitive adsorption between polycarboxylate ethers" – Stefanie Anne Weckwerth, ETHZ, Switzerland
15:50		"Effect of the PCE side chain length and grafting density on the plastic viscosity of cement paste" – David Nicia, TU Braunschweig, Germany
16:10		"The effect of the charge density of a comb polyphosphate superplasticizer on the structural build-up of cement paste" – Alexander Mezhev, BAM, Germany
16:30	Coffee break (sponsored by ACI Italy Chapter)	
17:00	Session S4 Chair: L.Lei	KEYNOTE: "Air entraining admixtures: mechanisms, evaluations, and interactions" - Lori E. Tunstall, Colorado School of Mines, USA
17:40		"Mixing procedure parameters affecting air entrainment in concrete" – Ida Ros, Master Builders Solutions, Italy
18:00		"Methylsiliconate as Set-Retarding Admixture" – Kalina Materak, Lodz University of Technology, Poland
18:20		"Experimental and Theoretical Investigations on the Adsorbed Layer Thickness of PCE Comb Polymers" – Christopher Schiefer, TU Munich, Germany
18:40		"Concrete mix design made easy with chemical admixtures- A case study of a Ghanaian project" – Mark Bediako, CSIR, Ghana
20:00	<div>Italian Aperitivo (sponsored by Master Builders Solutions)</div> <div></div>	

**July 12, 2022 - Sala Magnolia**

09:00	Session S5 Chair: M. Palacios	<b>KEYNOTE: "Recent advances in the use of inhibitors to prevent chloride-induced corrosion in reinforced concrete" - Marco Ormellese, Milan Polytechnic, Italy</b>
09:40		"Novel Hybrid Additive for Low-Carbon Concrete" – Giorgio Ferrari, Mapei, Italy
10:00		"Effect of different retarders and their combination with superplasticizer on the properties of CSA" – Alexander Govin, Lyon University, France
10:20		"Phosphated Superplasticizers as Effective Water Reducing Agent for $\alpha$ -Calcium Sulfate Hemihydrate Systems" – Na Miao, TU Munich, Germany
10:40		"Investigation on mechanical properties of mortars produced with potassium humate and vinyl acrylate monomer based chemical admixtures and statistical analysis data by SPSS Programme" – Kadir Kilnic, Kırklareli University, Turkey
11:00	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
11:30	Session S6 Chair: G. Ferrari	<b>KEYNOTE: "Viscosity modifying agents: key components of advanced cement-based materials with adapted rheology" - Marta Palacios, E. Torroja Inst. For Construction Science, Spain and Wolfram Schmidt, BAM, Germany</b>
12:10		"Novel perspective to explain the retarding effect of organic admixtures in silicate-activated slag" – Vlastimil Bilek jr, Brno University, Czech Republic
12:30		"Effect of solution chemistry on superplasticizers in alkali-activated slag" – Clara Paillard, Chryso, France
12:50		"Influence of HPEG-based polycarboxylate on the flow properties of alkali-activated slag: sodium hydroxide and sodium carbonate activated systems" – Lei Lei, TU Munich, Germany
13:10	<b>Lunch (sponsored by Chryso)</b> 	
14:30	Session S7 Chair: L.E. Tunstall	<b>KEYNOTE: "Nanoclays as a rheology modifying admixture" - Jae Hong Kim, Korea Advanced Institute of Science and Technology, Republic of Korea</b>
15:10		"Influence of the hydroxypropylation of starch on its performance as viscosity modifying agent" – Alexander Mezhev, BAM, Germany
15:30		"Synthesis and Analysis of an Anti-segregation Admixture based on Acrylamide Copolymer" – Serina Ng, Chang An YuCai, China
15:50		"Effect of calcium ions on bio-based polymers for rheology control" – Wolfram Schmidt, BAM, Germany
16:10		"Long term performance of corrosion inhibitors in concrete" – Fabio Bolzoni, Milan Polytechnic, Italy
16:30	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
17:00	Session S8 Chair: W. Schmidt	<b>KEYNOTE: "Recent progress in superabsorbent polymers for concrete" - Christof Schroefl, TU Dresden, Germany</b>
17:40		"Impact of a novel slow absorption superabsorbent polymer on compressive strength and autogenous shrinkage of concrete" – Yuya Akao, Nippon Shokubai, Japan
18:00		"CO2-efficient mix design with an innovative strength- enhancing concrete admixture" – Alberto Olivo, Master Builders Solutions, Italy
18:20		"Seeding Accelerator based on Nano Calcium Hydroxide" – Patrick Juilland, Sika Technology, Switzerland
18:40		"Research and analysis of a novel water proofing agent with strength enhancing ability" – Mirko Gruber, Chang An YuCai, China
20:00	<b>Italian Aperitivo (sponsored by Draco Italiana)</b> 	

**July 13, 2022 - Sala Magnolia**



09:00	Session S9 Chair: C.Nmai	<b>KEYNOTE: "Interaction Between Polycarboxylate Superplasticizers and Non-calcined Clays and Calcined Clays" - Lei Lei, TU Munich, Germany</b>
09:40		"The effect of alkanolamine admixtures in the hydration of limestone calcined clay cements (LC3)" – Franco Zunino, EPFL, Switzerland
10:00		"The Influence of the Molecular Structure of PCEs on the Interaction with Expandable Clays" – Fabio Castiglioni, Mapei, Italy
10:20		"Impact of comb-type superplasticizers on the rheological properties of limestone-calcined clay cements" – Marta Palacios, Eduardo Torroja Institute for Construction Science, Spain
10:40		"Molecular Design of an Allylether PCE with Enhanced Clay Tolerance" – Yue Zhang, TU Munich, Germany
11:00	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
11:30	Session S10 Chair: J.Plank	<b>KEYNOTE: "Where are admixtures going?" - Giorgio Ferrari, Mapei Spa, Italy</b>
12:10		"Use of Innovative Admixtures in Precast/Prestressed Concrete" – Charles Nmai, Master Builders Solutions, US
12:30	<b>Closing remarks SOCAC – Luigi Coppola</b>	
12:50	<b>Lunch (sponsored by Colabeton)</b> 	

## PROGRAM 15^ RACTSI

13:00	<b>Registration RACTSI</b>	
14:00	<b>Opening ceremony RACTSI chaired by Luigi Coppola, conference chairperson, Charles Nmai, ACI Int. President and Fabio Previdi, Head of Engineering Faculty, University of Bergamo</b>	
14:20	Session R1 Chair: P.C.Nkima-mubanzi	<b>KEYNOTE: "Limestone calcined clay cement and concrete: A state-of-the-art review" - Shashank Bishnoi, IIT Delhi, India</b>
14:50	<b>Award Session SOCAC &amp; RACTSI</b> Chair: L.Coppola	<b>AWARD 1: "Reuse of waste materials in concrete: challenges and opportunities in a circular economy" – Valeria Corinaldesi, Marche Polytechnic University, Italy</b>
15:20		<b>AWARD 2: "Pumice lightweight sand and lechuguilla natural fibers as internal curing agents in UHPC" – Alejandro Duran Herrera, Universidad Autónoma de Nuevo León, Mexico</b>
15:50		<b>AWARD 3: "Cement-Based Composites in Structural Health Monitoring" - Francesca Tittarelli, Marche Polytechnic University, Italy</b>
16:30	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
17:00	<b>Luca Bertolini Memorial Award, 2nd edition</b>	

20:30	<b>Banquet Award (sponsored by Mapei)</b> 
22:30	<b>"The Uppertones" Live Music Concert (sponsored by ACI Italy Chapter)</b> 



July 14, 2022 - Sala Magnolia		
09:00	Session R2a Chair: S. Bishnoi	<b>KEYNOTE: "Recent advances in digital fabrication with concrete" - Rob Wolfs, TU Eindhoven, Netherlands</b>
09:40		"Characterization of Quarry Waste Powder for Calcined Clay Production" – Yury Villagran Zaccardi, Gent University, Belgium
10:00		"Lowering the clinker factor of limestone calcined clay cements (LC3) below 50%: a comparison with natural pozzolans" – Franco Zunino, EPFL, Switzerland
10:20		"Study of the effect of different type of clays on the initial flowability of mortars in the presence of polycarboxylate superplasticizers" – Giorgio Ferrari, Mapei, Italy
10:40		"Multi-objective design of LC3: Sustainability and Strength" – Renee Rios, Georgia Institute of Technology, US
11:00	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
11:30	Session R3a Chair: P.C.Nkinamubanzi	<b>KEYNOTE: "A review of recent advances in the science and technology of seawater-mixed concrete" – Federica Lollini, Milan Polytechnic, Italy</b>
12:10		"Low-Carbon Durable Concrete for the New Genoa's San Giorgio Bridge" – Francesco Surico, Mapei, Italy
12:30		"Assessment of the Reinforced Concrete Piles of a Highway Bridge after 35 Years after their Repairs" – Silvia Collepari, ENCO, Italy
12:50		"The conservation state of highway foundation bridge piles" – Christian Paglia, SUPSI University, Switzerland
13:10	<b>Lunch (sponsored by Calcestruzzi)</b>  <b>Calcestruzzi</b> <small>HEIDELBERGCEMENT Group</small> <small>Calcestruzzi, bringing Italcement's innovations to market</small>	
14:30	Session R4a Chair: R. Wolfs	<b>KEYNOTE: "Pathways towards sustainable concrete" – Denny Coffetti, University of Bergamo, Italy</b>
15:10		"Influence of carbonated RCA on the hardened properties of concrete" – Nicoletta Russo, Milan Polytechnic, Italy
15:30		"Recycled Concrete Aggregate from Construction and Demolition Waste: characterization and use in sustainable concretes" – Beatrice Malchiodi, University of Modena and Reggio Emilia, Italy
15:50		"Characterization of Recycled Asphalt Pavement as aggregate for concrete" – Andrea Filippi, Milan Polytechnic, Italy
16:10		"Preliminary characterization of concrete made with RAP aggregate" – Elena Redaelli, Milan Polytechnic, Italy
16:30	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
17:00	Session R5a Chair: V. Bilek Sr	<b>KEYNOTE: "Investigations on the mechanical behavior of UHPC materials under dynamic loading" – Ezio Cadoni, SUPSI University, Switzerland</b>
17:40		"Influence of steel fibers on durability properties of UHPFRC" – Bianca Paola Maffezzoli, Milan Polytechnic, Italy
18:00		"Very High-Performance Fiber Reinforced Concrete (VHPFRC) Testing and Finite Element Analysis" – Vincenzo Romanazzi, University of Salento, Italy
18:20		"Influence of cement type and curing conditions on the flexural strength and microstructure of mortars reinforced with sheep wool fibers" – Alessandro Fantilli, Turin Polytechnic, Italy
20:00	<b>Italian Aperitivo (sponsored by Master Builders Solutions)</b> 	

**July 14, 2022 - Sala Faggio**

09:40	Session R2b Chair: F.Lollini	<i>"Evaluation of the Potential Use of a New Aluminum Silicate in Green Concrete Products" – Pierre-Claver Nkinamubanzi, NRC Construction, Canada</i>
10:00		<i>"Equivalent durability of Concretes Manufactured with a Ground Mineral Addition from MIBA" - Silvia Collepardi, ENCO, Italy</i>
10:20		<i>"Supersulphated cements from waste materials" – Vlastimil Bilek Sr, Technical University of Ostrava, Czech Republic</i>
10:40		<i>"Ambient cured geopolymer binder in road pavement-subgrade stabilisation as a replacment of conventional cement" – Didar Cheema, Curtin University, Australia</i>

12:10	Session R3b Chair: D.Cheema	<i>"Fresh Properties of Alkali-Activated Slag Pastes with Sodium and Potassium Hydroxide" - Vlastimil Bilek jr, Brno University, Czech Republic</i>
12:30		<i>"Effect of aggregates and layer height on the acoustic absorption of pervious concrete" – Nicolai Klein, TU Munich, Germany</i>
12:50		<i>"Defined Performance Pervious Concrete: New Challenges in the Era of Sustainable Development" - Ivan Bondarenko, Russian Engineering Academy, Russia</i>

15:10	Session R4b Chair: E.Cadoni	<i>"Effective protection of concrete against carbonation by a protective render coating" – Michal Bacuvcik, Building Testing and Research Institute Bratislava, Slovakia</i>
15:30		<i>"Rehabilitation of buildings polluted by the radon radioactivity" - Silvia Collepardi, ENCO, Italy</i>
15:50		<i>"Measurement of the radiation shielding performance of GRC composite materials" – Kohen Beni, Fibrobeton, Turkey</i>
16:10		<i>"Effect of different environmental exposures on the mechanical behavior of enhanced carbon FRCC systems" – Jacopo Donnini, Marche Polytechnic University, Italy</i>

17:40	Session R5b Chair: E.Redaielli	<i>"Superplasticizers for Calcined Clay Blended Cements" – Ran Li, TU Munich, Germany</i>
18:00		<i>"Microstructure of Cement/Clay paste with Aluminum bar after 1 year storage in Fresh Water and in 6% NaCl" - Harald Justnes, SINTEF, Norway</i>
18:20		<i>"A Review of Current Superplasticizers Highlighting Their Specific Properties and Advantages" – Johann Plank, TU Munich, Germany</i>
18:40		<i>"Concrete workability improvement with the knowledge of the physical chemical characteristics of the admixtures" – Fabio Curto, Mapei, Italy</i>

July 15, 2022 - Sala Magnolia		
09:00	Session R6a Chair: Y. Villagran Zaccardi	<b>KEYNOTE: "Pumping of concrete: Understanding a common placement method with lots of challenges" - Dimitri Feys, Uni. Missouri, USA</b>
09:40		"New Test Method for Alkali-Silica Reaction (ASR) and the Role of Additional Calcium Ions in the Reaction Process" – Frank Ong, Master Builders Solutions, US
10:00		"Data-driven decision-making to inform sustainable performance-based specifications" - Renee Rios, Georgia Institute of Technology, US
10:20		"Innovative Admixtures to Address Operational and Sustainability Issues with Returned Concrete" – Charles Nmai, Master Builders Solutions, US
10:40		"Low-Grade Kaolinite Clays for Sustainable Binders – Effect of mineralogy and curing temperature on hydration products" – Tobias Danner, SINTEF, Norway
11:00	<b>Coffee break (sponsored by ACI Italy Chapter)</b>	
11:30	Session R7 Chair: D. Feys	"Synergistic effect of CDW's as eco-pozzolans: ternary cements" – Rosario Garcia-Gimenez, Universidad Autonoma de Madrid, Spain
11:50		"Influence of bitumen-based coatings on the penetration of radon gas emanating from ground through different concrete types" – Ines Antunes, Polyglass, Italy
12:10		"Different solutions for microbiologically induced corrosion resistant concrete: a concrete study" – Danilo Passalacqua, Mapei, Italy

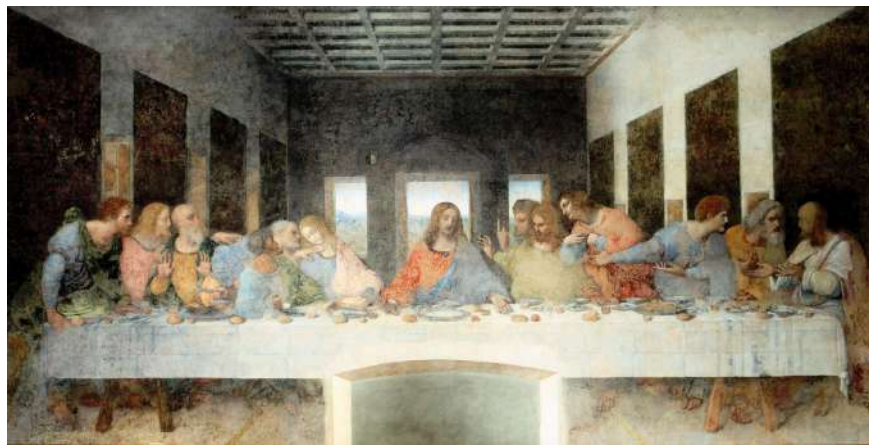
July 15, 2022 - Sala Faggio		
09:40	Session R6b Chair: H. Justnes	"Flexural Behavior of Concrete Mixtures with Waste Tyre Recycled Aggregates" - Vincenzo Romanazzi, University of Salento, Italy
10:00		"Known properties of concrete to produce high quality recycled cementitious material for buildings" - Christian Paglia, SUPSI University, Switzerland
10:20		"Preliminary study of lightweight concrete with recycled EPS aggregates" – Maddalena Carsana, Milan Polytechnic, Italy
10:40		"Iron ore dust as a natural pigment in concrete with RCA for artwork applications" – Iveta Novakova, The Arctic University of Norway, Norway

July 15, 2022 - Sala Magnolia		
12:30	<b>Closing remarks RACTSI</b>	

# About Milan

## Museum and art gallery

Milan is home to many cultural institutions, museums and art galleries, that account for about a tenth of the national total of visitors and receipts. The Pinacoteca di Brera is one of Milan's most important art galleries. It contains one of the foremost collections of Italian painting, including masterpieces such as the Brera Madonna by Piero della Francesca. The Castello Sforzesco hosts numerous art collections and exhibitions, especially statues, ancient arms and furnitures, as well as the Pinacoteca del Castello Sforzesco, with an art collection including Michelangelo's last sculpture, the Rondanini Pietà, Andrea Mantegna's Trivulzio Madonna and Leonardo da Vinci's Codex Trivulzianus manuscript. The Castello complex also includes The Museum of Ancient Art, The Furniture Museum, The Museum of Musical Instruments and the Applied Arts Collection, The Egyptian and Prehistoric sections of the Archaeological Museum and the Achille Bertarelli Print Collection. Milan's figurative art flourished in the Middle Ages, and with the Visconti family being major patrons of the arts, the city became an important center of Gothic art and architecture (Milan Cathedral being the city's most formidable work of Gothic architecture). Leonardo worked in Milan from 1482 until 1499. He was commissioned to paint the Virgin of the Rocks for the Confraternity of the Immaculate Conception and The Last Supper for the monastery of Santa Maria delle Grazie.



*The Duomo (left) and the Leonardo Da Vinci's Cenacolo (right)*

The city was affected by the Baroque in the 17th and 18th centuries, and hosted numerous formidable artists, architects and painters of that period, such as Caravaggio and Francesco Hayez, which several important works are hosted in Brera Academy. The Museum of Risorgimento is specialized on the history of Italian unification. Its collections include iconic paintings like Baldassare Verazzi's Episode from the Five Days and Francesco Hayez's 1840 Portrait of Emperor Ferdinand I of Austria. The Triennale is a design museum and events venue located in Palazzo dell'Arte. It hosts exhibitions and events highlighting contemporary Italian design, urban planning, architecture, music, and media arts, emphasizing the relationship between art and industry.

Milan in the 20th century was the epicentre of the Futurist artistic movement. Today, Milan remains a major international hub of modern and contemporary art, with numerous modern art galleries. The Modern Art Gallery, situated in the Royal Villa, hosts collections of Italian and European painting from the 18th to the early 20th centuries. The Museo del Novecento, situated in the Palazzo dell'Arengario, is one of the most important art galleries in Italy about 20th-century art; of particular relevance are the sections dedicated to Futurism, Spatialism and Arte povera. In the early 1990s architect David Chipperfield was invited to convert the premises of the former Ansaldo Factory into a Museum. Museo delle Culture (MUDEC) opened in April 2015. The Gallerie di Piazza Scala, a modern and contemporary museum located in Piazza della Scala in the Palazzo Brentani and the Palazzo Anguissola, hosts 195 artworks from the collections of Fondazione Cariplo with a strong representation of nineteenth-century Lombard painters and sculptors, including Antonio Canova and Umberto Boccioni. A new section was opened in the Palazzo della Banca Commerciale Italiana in 2012. Other private ventures dedicated to contemporary art include the exhibiting spaces of the Prada Foundation and HangarBicocca. The Nicola Trussardi Foundation is renewed for organising temporary exhibition in venues around the city. Milan is also home to many public art projects, with a variety of works that range from sculptures to murals to pieces by internationally renowned artists.



## Music

Milan is a major national and international centre of the performing arts, most notably opera. The city hosts La Scala operahouse, considered one of the world's most prestigious, having throughout history witnessed the premieres of numerous operas, such as Nabucco by Giuseppe Verdi in 1842, La Gioconda by Amilcare Ponchielli, Madama Butterfly by Giacomo Puccini in 1904, Turandot by Puccini in 1926, and more recently Teneke, by Fabio Vacchi in 2007. Other major theatres in Milan include the Teatro degli Arcimboldi, Teatro Dal Verme, Teatro Lirico and formerly the Teatro Regio Ducal. The city is also the seat of a renowned symphony orchestra and musical conservatory, and has been, throughout history, a major centre for musical composition: numerous famous composers and musicians such as Giuseppe Caimo, Simon Boyleau, Hoste da Reggio, Verdi, Giulio Gatti-Casazza, Paolo Cherici and Alice Edun lived and worked in Milan. The city is also the birthplace of many modern ensembles and bands, including Camaleonti, Camerata Mediolanense, Gli Spioni, Dynamis Ensemble, Elio e le Storie Tese, Krisma, Premiata Forneria Marconi, Quartetto Cetra, Stormy Six and Le Vibrazioni.

## Fashion and design

Milan is widely regarded as a global capital in industrial design, fashion and architecture. In the 1950s and 60s, as the main industrial centre of Italy and one of Europe's most dynamic cities, Milan became a world capital of design and architecture. There was such a revolutionary change that Milan's fashion exports accounted for US\$726 million in 1952, and by 1955 that number grew to US\$72.5 billion. Modern skyscrapers, such as the Pirelli Tower and the Torre Velasca were built, and artists such as Bruno Munari, Lucio Fontana, Enrico Castellani and Piero Manzoni gathered in the city. Today, Milan is still particularly well known for its high-quality furniture and interior design industry. The city is home to FieraMilano, Europe's largest permanent trade exhibition, and Salone Internazionale del Mobile, one of the most prestigious international furniture and design fairs.

Milan is also regarded as one of the fashion capitals of the world, along with New York City, Paris, and London. Milan is synonymous with the Italian prêt-à-porter industry, as many of the most famous Italian fashion brands, such as Valentino, Gucci, Versace, Prada, Armani and Dolce & Gabbana, are headquartered in the city. Numerous international fashion labels also operate shops in Milan. Furthermore, the city hosts the Milan Fashion Week twice a year, one of the most important events in the international fashion system. Milan's main upscale fashion district, quadrilatero della moda, is home to the city's most prestigious shopping streets (Via Monte Napoleone, Via della Spiga, Via Sant'Andrea, Via Manzoni and Corso Venezia), in addition to Galleria Vittorio Emanuele II, one of the world's oldest shopping malls.



*Unicredit Skyscraper (left) and Torre Velasca (right)*



## Languages and literature

In the late 18th century, and throughout the 19th, Milan was an important center for intellectual discussion and literary creativity. The Enlightenment found here a fertile ground. Cesare, Marquis of Beccaria, with his famous *Dei delitti e delle pene*, and Count Pietro Verri, with the periodical *Il Caffè* were able to exert a considerable influence over the new middle-class culture, thanks also to an open-minded Austrian administration. In the first years of the 19th century, the ideals of the Romantic movement made their impact on the cultural life of the city and its major writers debated the primacy of Classical versus Romantic poetry. Here, too, Giuseppe Parini, and Ugo Foscolo published their most important works, and were admired by younger poets as masters of ethics, as well as of literary craftsmanship. Foscolo's poem *Dei sepolcri* was inspired by a Napoleonic law that—against the will of many of its inhabitants—was being extended to the city. In the third decade of the 19th century, Alessandro Manzoni wrote his novel *I Promessi Sposi*, considered the manifesto of Italian Romanticism, which found in Milan its center; in the same period Carlo Porta, reputed the most renowned local vernacular poet, wrote his poems in Lombard Language.

After the Unification of Italy in 1861, Milan lost its political importance; nevertheless, it retained a sort of central position in cultural debates. New ideas and movements from other countries of Europe were accepted and discussed: thus, Realism and Naturalism gave birth to an Italian movement, Verismo. The greatest verista novelist, Giovanni Verga, was born in Sicily but wrote his most important books in Milan.

## Cuisine

Like most cities in Italy, Milan has developed its own local culinary tradition, which, as it is typical for North Italian cuisines, uses more frequently rice than pasta, butter than vegetable oil and features almost no tomato or fish. Milanese traditional dishes include *cotoletta alla milanese*, a breaded veal (pork and turkey can be used) cutlet pan-fried in butter (similar to Viennese *Wiener Schnitzel*). Other typical dishes are *cassoeula* (stewed pork rib chops and sausage with Savoy cabbage), *ossobuco* (braised veal shank served with a condiment called *gremolata*), *risotto alla milanese* (with saffron and beef marrow), *busecca* (stewed tripe with beans), and *brasato* (stewed beef or pork with wine and potatoes).

Season-related pastries include *chiacchiere* (flat fritters dusted with sugar) and *tortelli* (fried spherical cookies) for Carnival, *colomba* (glazed cake shaped as a dove) for Easter, *pane dei morti* ("bread of the Dead", cookies flavoured with cinnamon) for All Souls' Day and *panettone* for Christmas. The *salame Milano*, a salami with a very fine grain, is widespread throughout Italy. Renowned Milanese cheeses are *gorgonzola* (from the namesake village nearby), *mascarpone*, used in pastry-making, *taleggio* and *quartirollo*.

Milan is well known for its world-class restaurants and cafés, characterized by innovative cuisine and design. As of 2014, Milan has 157 Michelin-selected places, including three 2-Michelin-starred restaurants; these include *Cracco*, *Sadler* and *il Luogo di Aimo e Nadia*. Many historical restaurants and bars are found in the historic center, the Brera and Navigli districts. One of the city's oldest surviving cafés, *Caffè Cova*, was established in 1817.



*Navigli (left) and Galleria Vittorio Emanuele II (right)*