FraMCoS-X
Fracture Mechanics of Concrete and Concrete Structures

23-26 June 2019
Bayonne, France

CONFERENCE PROGRAMME

IA-FraMCoS web site: www.framcos.org

Foreword

Dear IA-FraMCoS member, dear Delegate,

It is with great pleasure that I welcome you in Bayonne, France, for the 10th edition of the IA-FraMCoS conference series.

Back in 1991, IA-FraMCoS was established in order to promote a series of international conferences specifically dedicated to the Fracture of Concrete and Concrete Structures. The intent was to organise the community around a landmark event held every three years. One major aim of IA-FraMCoS was, and still is, to promote fracture-based approaches in engineering practice strongly backed by fundamental developments.

Engineering practice covers construction at large (long term assessment, safety analyses,…), but also others fields such as environmental protection or energy related issues. Some of these fields were at the forefront of scientific advances at the time the international association was established, such as computational failure analyses or experimental measurement of fracture energy. New topics emerged such as time-dependent fracture, dynamic fracture, durability mechanics.

At the same time, engineering problems became more diverse and new scientific methods emerged: multiscale – multi-physics approaches toward fracture expanded, new experimental techniques were implemented, including full field measurements, non intrusive imaging techniques (X Ray, NMR, Radar, …), or large scale experimental facilities. Discrete approaches of fracture, often inspired by physical approaches of fracture, became also popular. Fracture analysis expanded also from the macroscale down to the smallest possible scale, that of atoms. Indeed, cementitious materials, if they are archetypal of quasibrittle materials are also among of the oldest nanostructured materials. New ideas and approaches developed in the field of concrete and cementitious materials expanded, e.g. to energy related challenges involved with Oil and Gas Production, deep geothermal energy or carbon dioxide sequestration.

The renewal and diversity of engineering problems to be solved are, no doubt, a sign of vitality, timeliness and importance of IA-FraMCoS. IA-FraMCoS reached also toward emerging scientists and new actors. Contemplating the past 28 years of existence of the Association provides an astonishingly rich picture. The IA-FraMCoS data repository and collection of conference proceedings gathered by our past president, Prof. Victor Saouma, are landmarks of our collective legacy.

With your help and with your contributions, we hope that FraMCoS-X will maintain the high level standards of the IA-FraMCoS conference series, and above all, reach our highest collective scientific expectations.

Welcome to FraMCoS X!

Gilles Pijaudier-Cabot
President of IA-FraMCoS

About IA – FraMCoS

Many conferences include discussions of damage, cracking and fracture of concrete, but mostly outside the context of fracture mechanics. Other conferences cover the subject of fracture mechanics, but rarely focused on its application to concrete and concrete structures. IA-FraMCoS was founded to help fill this gap.

Concrete is an archetypical quasi-brittle material. It consists of brittle constituents and is characterized by a non-negligible material characteristic length, which endows the material with a behavior that is transitional between the stress-strain relations for distributed damage at small scales and linear elastic fracture mechanics at large scales. This transitional behavior poses difficult challenges for theoretical, experimental and computational research.

Originally, IA-FraMCoS activity was the triennial conference series. Today, it seeks to expand its activities to cover not only fundamental developments in concrete but also promotion of fracture-based approaches in engineering practice. This will be accomplished not only through the perennial conferences and endorsements of high quality scientific research.

Previous FraMCoS conferences: 2016 Berkeley (USA), 2013 Toledo (Spain), 2010 Jeju (Korea), 2007 Catania (Italy), 2004 Vail (USA), 2001 Cachan (France), 1998 Gifu (Japan), 1995 Zürich (Switzerland), 1992 Breckenridge (USA)

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Organisation of FraMCoS-X

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Omar Rodriguez Villarreal

CONFERENCE AT A GLANCE

Sunday 23 June

Site Address : Campus de la Nive, 8 Allées des platanes, 64100 Bayonne

15:30-20:00	**Registration**	**Amphitheaters Building First Floor**
18:00-20:00	**Welcome drinks**	

Monday 24 June

8:00-9:00	**Registration**	**Amphitheaters Building First Floor**
9:00-9:20	**Welcome Address**	**Room 400**
9:20-10:50	**Plenary session**	**Room 400**
10:50-11:20	**Coffee break**	

11:20-12:40	**TECHNICAL SESSIONS**				
Room 400	**Room B**	**Room 22**	**Room 23**	**Room A**	**Room 20**
MS2-I: Dynamic failure (I) *Organised by J. Ozbolt and V. Mechtcherine*	**MS6-I: Micro and nano-scale models and experiments (I)** *Organised by M. Vandamme*	**A-I: Theoretical fracture mechanics (I)**	**B-I: Experimental methodologies (I)**	**C-I: Computational modelling (I)**	**D-I: Durability/coupled problems (I)**

12:40-14:00	**Lunch**	

14:00-15:40	**TECHNICAL SESSIONS**				
Room 400	**Room B**	**Room 22**	**Room 23**	**Room A**	**Room 20**
MS2-II: Dynamic failure (II) *Organised by J. Ozbolt and V. Mechtcherine*	**MS6-II: Micro and nano-scale models and experiments (II)** *Organised by M. Vandamme*	**A-II: Theoretical fracture mechanics (II)**	**B-II: Experimental methodologies (II)**	**C-II: Computational modelling (II)**	**D-II: Durability/coupled problems (II)**

15:40-16:10	**Coffee break**	

16:10-18:10	**TECHNICAL SESSIONS**				
Room 400	**Room B**	**Room 20**	**Room 23**	**Room A**	**Room 30**
MS2-III: Dynamic failure (II)I *Organised by J. Ozbolt and V. Mechtcherine*	**MS5: Fracture at early ages** *Organised by A. Loukili*	**E-I: Novel cementitious and/or other quasi-brittle materials (I)**	**B-III: Experimental methodologies (III)**	**C-III: Computational modelling (III)**	

Tuesday 25 June

8:50-10:05	**Plenary session**	**Room 400**
10:05-10:35	**Coffee break**	

10:35-12:40	**TECHNICAL SESSION**				
Room 400	**Room A**	**Room B**	**Room 20**	**Room 23**	**Room 22**
MS11-I: Fracture and durability of structures (I) *Organised by B. Pichler, H. Mang and Y.Yuang*	**MS10-I: Nuclear vessel behaviour under extreme loading (I)** *Organised by F. Dufour*	**MS1-I: Self healing of concrete (I)** *Organised by E. Schlangen*	**MS7: Probabilistic aspects of fracture** *Organised by M. Vorechovsky*	**B-IV: Experimental methodologies (IV)**	**C-IV: Computational modelling (IV)**

12:40-14:00	**Lunch**	

14:00-15:40	TECHNICAL SESSION				
Room 400	**Room A**	**Room B**	**Room 23**	**Room 20**	**Room 22**
MS11-II: Fracture and durability of structures (II) *Organised by B. Pichler, H. Mang and Y.Yuang*	**MS10-II: Nuclear vessel behaviour under extreme loading (II)** *Organised by F. Dufour*	**MS3-II: Non-destructive testing (II)** *Organised by E. Landis*	**MS8: Concrete at high temperatures** *Organised by H. Carre and F. Felicetti*	**MS4-I: Discrete modelling (I)** *Organised by J. Bolander and G. Cusatis*	**C-V: Computational modelling (V)**

15:40-16:10 **Coffee break**

16:10-17:10 **FraMCoS assembly** **Room 400**

19:00-22:00 **Conference dinner**
Address:
Centre de congrès Bellevue, Place Bellevue, 64200 Biarritz

Wednesday 26 June

9:00-10:30 **Plenary session** **Room 400**

10:30-11:00 **Coffee break**

11:00-12:40	TECHNICAL SESSION				
Room 400	**Room A**	**Room B**	**Room 20**	**Room 22**	**Room 30**
MS3-I: Non-destructive testing (I) *Organised by E. Landis*	**MS11-III: Fracture and durability of structures (III)** *Organised by B. Pichler, H. Mang and Y.Yuang*	**MS9-I: Multiscale modeling of brittle damage processes (I)** *Organised by E. Chatzi, S. Triantafyllou and K. Agathos*	**MS4-II: Discrete modelling (II)** *Organised by J. Bolander and G. Cusatis*	**F-I: Structural Concrete Applications (I)**	

12:40-14:00 **Lunch**

14:00-15:45	TECHNICAL SESSION				
Room 400	**Room A**	**Room B**	**Room 20**	**Room 22**	**Room 30**
MS1-II: Self healing of concrete (II) *Organised by E. Schlangen*	**E: Novel cementitious and/or other quasi-brittle materials**	**MS9-II: Multiscale modeling of brittle damage processes (II)** *Organised by E. Chatzi, S. Triantafyllou and K. Agathos*	**MS4-III: Discrete modelling (III)** *Organised by J. Bolander and G. Cusatis*	**F-II: Structural Concrete Applications (II)**	

15:45-17:00 **Coffee break and farewell drinks**

TECHNICAL PROGRAMME

Sunday, 23 June

15:30-20:00	**Registration**	**Amphitheaters Building First Floor**
18:00-20:00	**Welcome drinks**	

Monday 24 June

8:00-9:00	**Registration**	**Amphitheaters Building First Floor**
9:00-9:20	**Welcome Address**	**Room 400**
9:20-10:50	**PLENARY SESSION**	**Room 400**
Chair: G. Pijaudier-Cabot		

Plenary Lecture Fishnet Statistics for Quasbrittle Materials with Nacre-Like Alternating Series and Parallel Links: Design for Failure Probability $<10^{-6}$
Z. P. Bazant, W. Luo

MS6 Keynote: Phase field method for microcracking simulations in concrete microstructure models obtained from 3D microtomography images
J. Yvonnet, T. T. Nguyen, M. Bornert, C. Chateau

MS2: Keynote: High strain-rate response of UHPFRC in support of impact resistant structural design
E. Cadoni, D. Forni

10:50-11:20	**Coffee break**	
11:20-12:40	**TECHNICAL SESSIONS**	

MS2-I: Dynamic failure of concrete and fibre-reinforced cement-based composites (I)	**Room 400**
Chair: V. Mechtcherine, J. Ozbolt	

Mechanical characterization of strain-hardening cement-based composite (SHCC) under dynamic tensile load
A. A Heravi, V. Mechtcherine

Dynamic characterization of adobe in compression: the effect of fibre fraction in soil matrix
T. Li Piani, J. Weerheijm, M. Peroni, L. Koene, G. Solomo, L. J. Sluys

Measurement of fracture energy of a high performance concrete in dynamic tension and high strain rates
B. Lukic, D. Saletti, P. Forquin

Retrofitting unreinforced masonry buildings with a strain-hardening cement-based composite to enhance seismic resistance
M. Kotze, G. van Zijl, G. C. Van Rooyen, S. Kabati

MS6-I: Micro and nano-scale models and experiments (I)	**Room B**
Chair: D. Gregoire	

Coupling statistical indentation and microscopy to evaluate micromechanical properties of cementitious materials
B. Hilloulin, M. Robira, A. Loukili

Micromechanical modelling of damage induced by delayed ettringite formation
A. Yammine, F. Bignonnet, N. Leklou, M. Choinska, T. Stryszewska

Alteration of the Fracture Behavior in Host Rock during CO2 Geological Sequestration
A.-T. Akono, T. Tsotsis, C. Werth

Numerical and analytical estimation of the ageing linear viscoelastic behavior of a two-phase composite with expansive inclusions
B. Bary

A-I: Theoretical fracture mechanics (I) **Room 22**
Chair: Y. M. Lim

Determination of fracture parameters of coral aggregate concrete after immersion in seawater
S. Yang, X. Zhang, W. Xu

Evaluation of residual elasticity of an internal expansion-induced concrete
F. Chen

Analytical solution for fracture analysis of lightly reinforced concrete beams considering bond-slip effect
Z. Wu, Y. Wang, Y. Liu

Fracture behaviour of alkali activated concrete measured from three-point bending test with Chevron notch
P. Miarka, L. Pan, V. Bilek, H. Cifuentes, S. Seitl

B-I: Experimental methodologies (I) **Room 23**
Chair: G. Pijaudier-Cabot

Complex evaluation of the mechanical and fracture properties of cementitious materials with different water-cement ratio
B. Kucharczykova, H. Simonova, D. Kocab, M. Hodulakova

TRACKING QUASI-BRITTLE FRACTURE BEHAVIOUR OF TEXTILE REINFORCED CEMENTITIOUS COMPOSITES USING ACOUSTIC EMISSION MONITORING METHOD
Dimitrios G. Aggelis, Dept. Mechanics of Materials and Constructions (MeMC), Vrije Universiteit Brussel (VUB)

Interstitial pore pressure in concrete under high confinement pressure: measurement and modelling
A. Accary, L. Daudeville, Y. Malecot,

Analysis of fiber-matrix interaction in FRC using X-ray tomography and digital volume correlation
M. Flansbjer, N. Williams Portal, S. Hall, J. Engqvist

C-I: Computational modelling (I) **Room A**
Chair: J. Planas

A new basic creep model coupled with a thermomechanical model for the numerical simulation of the time-dependent behaviour of concrete structures
T. S. Valente, A. Ventura-Gouveia, J. A. O. Barros

Numerical Study on Shear Behaviours of ECC Beams Reinforced with FRP Bars
D. Gu, J. Pan, J. He

Microplane damage plastic model for plain concrete subjected to compressive fatigue loading
A. Baktheer, M. Aguilar, J. Hegger, R. Chudoba

Neutron-Irradiation-Induced Damage assessment in Concrete Using Combined Phase Characterization and Nonlinear Fast Fourier Transform Simulation
Y. Le Pape, E. Tajuelo Rodriguez, J. D. Arregui Mena, A. Giorla, L. Anovitz, T. M. Rosseel

D-I: Durability/coupled problems (I) **Room 20**
Chair: G. di Luzio

Multiscale modeling of ion transport and ASR induced damage in concrete structures
T. Iskhakov, J. J. Timothy, G. Meschke

Analysis of drying shrinkage's surface cracking in concrete by beam-particle approach
N. Chan, C. Oliver-Leblond, F. Ragueneau, F. Benboudjema

The Influence of Thermal Cycles and Potassium on the Damage Mechanics of Delayed Ettringite Formation
S. Feuze, R. A. Livingston, A. M. Amde

Experimental study of ambient temperature and moisture conditions on fatigue resistance of concrete
Y. Koda, S. Minakawa, I. Iwaki

12:40-14:00 **Lunch**

14:00-15:40 **TECHNICAL SESSIONS**

MS2-II: Dynamic failure of concrete and fibre-reinforced cement-based composites (II) **Room 400**
Chair: J. Ozbolt, V. Mechtcherine

MS2 Keynote: Modelling the dynamic response of concrete with the damage plasticity model CDPM2
P. Grassl

A gradient enhanced viscoplasticity-damage microplane model for concrete under static and transient loading
A. Fuchs, M. Kaliske

Interfacial Fracture Properties of FRCM Composites Bonded to a Quasi-Brittle Material
C. Carloni, G. Baietti, G. Quartarone

Direct tension testing of SFRC - Some peculiar effects of the end restraints
A. Amin, T. Markic, W. Kaufmann

MS6-II: Micro and nano-scale models and experiments (II) **Room B**
Chair: D. Gregoire

Characterisation and modelling of interfacial damage in fibre-reinforced concrete for 3D printing in construction
N. Ducoulombier, C. Chateau, M. Bornert, J.-F. Caron, T. Weitkamp, J. Perrin

Micro-cantilever testing of cementitious materials under various loading conditions
Y. Gan, H. Zhang, B. Savija, E. Schlangen

Microscale fracture properties of alkali-activated fly ash
J. Nemecek, V. Smilauer, J. Nemecek, J. Manak,

Fundamentals of brittle failure at the atomic scale
L. Brochard, S. Souguir, K. Sab

Micromechanical characterization of damage in cement pastes: an experimental-numerical study
A. Rhardane, F. Grondin, S. Y. Alam

A-II: Theoretical fracture mechanics (II) **Room 22**
Chair: Z. P Bazant

Estimation of fracture process zone size in concrete members under fatigue loading
S. Bhowmik, S. Ray

A strength criterion for size effect on quasi-brittle fracture with and without notch
Y. Chen, X. Han, X. Hu, B. Wang, W. Zhu

Experimental investigations on the size effect of fracture energy for concretes of hydraulic structures
J. Lemery, M. B. Ftima, M. Leclerc

Mechanical Model of Roughened Concrete of Existing Members for Shear Failure Mode
Y. Katagiri, Y. Takase, T. Abe, K. Sakamoto, T. Hiwatashi, K. Katori

Effect of Interfacial Transition Zone on Fracture Energy in Concrete
D. K. Samal

B-II: Experimental methodologies (II) **Room 23**
Chair: T. N. Bittencourt

The universality of b-value and size effect in acoustic emission: Experimental investigations in quasi-brittle fracture
N. Burud, J. M. Chandra Kishen,

Flexural creep behavior of steel and polypropylene fiber reinforced concrete
V. Lima, D. Cardoso, F. A. Silva

A study on the fracture of reinforced concrete beams under shear using the AE technique
Prashant M. H., J. M. Chandra Kishen

Size effect in multiaxial double punch tests on fibre reinforced concrete cubes
M. Lee, T. Markic, J. Mata-Falcon, A. Amin, W. Kaufmann

A neural network ensemble for the identification of mechanical fracture parameters of fine-grained brittle matrix composites
D. Lehky, M. Lipowczan, H. Simonová, Z. Kersner

C-II: Computational modelling (II) **Room A**
Chair: A. Delaplace

Simulation of push-out tests of corroded reinforced concrete specimens by means of cohesive interface elements with frictional behaviour
B. Sanz, J. Planas, J. M. Sancho

Experimental and numerical study of crack propagation with the phase field method: application to three-point bending test
A. Tsitova, F. Bernachy-Barbe, B. Bary, F. Hild

Damage-to-fracture transition through an Eikonal Non-Local (ENL) continuum damage formulation with embedded strong discontinuities
F. Thierry, G. Rastiello, C. Giry, F. Gatuingt

Finite elements with an embedded reinforcement for the simulation of reinforced concrete structures strengthened with FRP
F. Riccardi, C. Giry, F. Gatuingt

A rate dependent eigenerosion plasticity model for concrete
A. Qinami, M. Kaliske

D-II: Durability/coupled problems (II) **Room 20**
Chair: G. Meschke

Validation of drying simulations by in-situ RH measurements in concrete in a variable temperature environment
J.-L. Adia, L. Charpin, B. Martin, D. Leroy, B. Masson, A. Courtois

Experimental study of a very high performance concrete slab subjected to fire on its underside and numerical modeling of the temperature field
E. Ouedraogo, S. Djaknoun, H. Bensalem, R. Bouchendouka

Modelling of autogenous healing of cement paste followed by a sustained flexural load
C. Y. Namnoum, B. Hilloulin, F. Grondin, A. Loukili

Durability of high volume fly ash concrete exposed to H2SO4 environment
G. Appa Rao, kanta Rao M, NAGA SATISH KUMAR CH.

Experimental study on mechanical behaviors of mechanical behavior of shcc under triaxial compressive stress loading
Jiajia Zhou, Department of Civil and Environmental Engineering, Hong Kong University of Science and Technology, Hong Kong,

15:40-16:10 **Coffee break**

16:10-18:10 **TECHNICAL SESSIONS**

MS2-III: Dynamic failure of concrete and fibre-reinforced cement-based composites (III) **Room 400**
Chair: J. Ozbolt, V. Mechtcherine

Mineral-bonded composites for enhanced structural impact safety - Overview of the format, goals and achievements of the research group GRK 2250
I. Curosu, V. Mechtcherine, Marcus Hering, Manfred Curbach

Simplified Design Approach of Steel Fiber Reinforced Concrete Under Flexural Fatigue Load
M. A. M. Adel, K. Nagai, K. Matsumoto

Impact response of UHPC and UHPFRC: experimental study and numerical simulation
C. Pontiroli, B. Erzar

Dynamic fracture of concrete in compression: 3D FE analysis at macro and meso scale
S. Gambarelli, J. Ozbolt

Interphases in polypropylene and glass fiber reinforced cementitious model composites under dynamic loading
E. Wölfel, C. Scheffler

Dynamic Mixed-Mode Fracture of Self-Compacting Steel-Fiber Reinforced Concrete
G. Ruiz, A. de la Rosa, L. C. Almeida, E. Poveda, X. Zhang, M. Tarifa, Z. Wu, R. C. Yu

MS5: Fracture at early ages **Room B**
Chair: A. Loukili, L. Lacarrière

Tensile strength of concrete at early-age: New experimental procedure and influence of mix-design parameters
E. Roziere, A. Loukili

Influence of cyclic movement on the hardening process of grout: case of offshore wind turbine installation
B. Delsaute, R. Furnemont, M. Königsbeger, S. Staquet

Biaxial Creep of High-strength Concrete at Early Ages Assessed from Restrained Ring Test
S. Liang, Y. Wei

Numerical requirements for the use of a THCM material model to the prediction of early age cracking risk of massive reinforced concrete structures
P. Chhun, L. Lacarriere, A. Sellier

Numerical simulation of microcracking induced by drying shrinkage in early age cement pastes
A. Rhardane, F. Grondin, S. Y. Alam

E-I: Novel cementitious and/or other quasi-brittle materials (I) **Room 20**
Chair: Y. Malecot

A numerical and experimental investigation into the cracking of fibre reinforced cementitious materials
I. C. Mihai

The effect of graphene oxide coating on the performance of SHCC
J. Yao, Z. Lu, C. K. Y. Leung

Experimental study and numerical modeling on bond between steel reinforcements and strain-hardening cementitious composites (SHCC)
Y. Chen, C. K. Y. Leung

Shear strengthening of reinforced concrete beams with High Strength Strain-Hardening Cementitious Composites (HS-SHCC)
J. Wei, Y. Chen, C. Wu, C. K.Y. Leung

Influence of loading rate on the fracture behaviour of natural hydraulic and aerial lime mortars
X. Zhang, L. Garijo, G. Ruiz, J. J. Ortega

Effect of softening function type in double-K Fracture Model: Alkali-activated fly ash mortar with hemp fibres
E: H. Simonova, B. Kucharczykova, Z. Kersner, I. Merta, B. Poletanovic, L. Malikova, S. Seitl

B-III: Experimental methodologies (III) **Room 23**
Chair: F. Caner, G.A. Rao

Anisotropic properties of fiber/matrix interface transition zone
S. He, E.-H. Yang

Development of damage parameter for concrete by using acoustic emission and X ray computed tomography
S. Tetsuya, S. Yuma, C. H. Kian

Cyclic over loads on life of bond anchorages in reinforced concrete
P. Abhishek, H. Kumar, G. A. Rao

Double cantilever indirect tension fracture testing of concrete
F. Caner, A. A. Donmez, S. Sener, V. Koc

Behaviour of reinforced concrete squat shear walls with utility openings
V. Sivaguru, G. Appa Rao

Shear carrying capacity of reinforced concrete beams with various a/d ratios damaged due to the Alkali-Silica reaction
T. Miki, T. Arakawa, Y. Koshiba

C-III: Computational modelling (III) **Room A**
Chair: F. Ragueneau

Size effect for samples with blunt and sharp notches using linear cohesive crack law
G. Di Luzio, G. Cusatis

Investigation of local opening-sliding relationship in the vicinity of deformed bar in concrete by using DIC technique
A. Okeil,R. Upadhyay, K. Matsumoto, K. Nagai

Analysis of XFEM and Hashin techniques capability to model fibre-cement boards
G. R. Boriolo, T. N. Bittencourt

Modelling the stochastic tensile behavior and multiple cracking of strain-hardening cementitious composites (SHCCs)
J. Li, J. Weng, E.-H. Yang

Damage Assessment of Reinforced Concrete Structural Walls Using Fracture Based Fractal Analysis
A. Devi.S., G. Appa Rao

A First Approach to Comparing Cohesive Traction-Separation Laws for Concrete
J. Planas, B. Sanz, J. M. Sancho

Tuesday 25 June

8:50-10:05 **PLENARY SESSION** **Room 400**
Chair: P. Grassl

MS11 Keynote: Durable concrete structures: cracks & corrosion and corrosion & cracks
U. Angst

MS10 Keynote: Modelling of pre-stressed concrete behaviour in the temperature range 20-40°C
A. Sellier, T. Vidal, F. Manzoni, L. Lacarrière, H. Cagnon

MS1 Keynote: 3D printed capsules for self-healing concrete applications
G. Anglani, P. Antonaci, S. I. Carillo Gonzales, G. Paganelli, J.-M. Tulliani

10:05-10:35 **Coffee break**

10:35-12:40 **TECHNICAL SESSIONS**

MS11-I: Fracture and durability of structures (I) **Room 400**
Chair: B. Pichler, U. Angst

MS11 Keynote: Thermoelastic multiscale analysis of concrete pavements subjected to hail showers
H. Wang, R. Höller, M. Aminbaghai, C. Hellmich, Y. Yuan, H. Mang, B. Pichler

Does the water to cement ratio of concrete impact the value of its critical degree of saturation?
R. M. Ghantous, W. J. Weiss

Mechanical evaluation of 3D printable nano-silica incorporated fibre-reinforced lightweight foam concrete
S. Cho, J. Kruger, S. Zeranka, A. van Rooyen, G. van Zijl

Effect of Loading Frequency on Flexural Fatigue Behaviour of Concrete
K. Keerthana, J. M. Chandra Kishen

Energy Equivalence Approach for Analysis of Reinforced Concrete Beams under Mixed Mode Loading
V. Radhika, J. M. Chandra Kishen

Influence of softening rock mass behavior in 3D simulations of deep tunnelling
M. Schreter, M. Neuner, P. Gamnitzer, G. Hofstetter

MS10-I: Nuclear vessel behaviour under extreme loading (I) **Room A**
Chair: F. Dufour, A. Sellier

Minerals expansions in aggregates: a micromechanics-based investigation of damage
J. Sanahuja, Y. L. Pape, F. Chen

Cracking at early age of a massive reinforced concrete structure case of the gusset of the VeRCoRs mock-up
J. Mazars

Fracture propagation in nuclear graphite
L. Kaczmarczyk, H. Nguyen, C. J. Pearce

Uncertainty propagation through Thermo-Hydro-Mechanical modelling of concrete cracking and leakage – Application to containment buildings
J. Baroth, D. E.-M. Bouhjiti, F. Dufour, M. Briffaut

Effect of the spatial correlation of damage properties of concrete on the structural cracking patterns
D. Bouhjiti, J. Baroth, M. Briffaut, F. Dufour

MS1-I: Self healing of concrete (I) **Room B**
Chair: E. Schlangen

An experimental and numerical investigation into the behaviour of vascular self-healing cementitious materials
A. Jefferson, B. L. Freeman, R. E. Davies, T. Selvarajoo

Modelling the carbonation reactions in self-healing concrete
E. Javierre, F. J. Gaspar, C. Rodrigo

Strength recovery of nano-reinforced cement mortars as parameter of self-healing evaluation: a methodological approach
M. Amenta, Z. S. Metaxa, S. Papaioannou, M. S. Katsiotis, D. Gournis, V. Kilikoglou, I. Karatasios

Autogenous healing of fibre/matrix interface and its enhancement
J. Qiu, S. He, Q. Wang, H. Su, E.-H. Yang

On the role of soft inclusions on the fracture behaviour of cement paste
L. Mercuri, C. Romero Rodriguez, Y. Xu, S. Chaves Figueiredo, R. Mors, E. Rossi, G. Anglani, P. Antonaci, B. Savija, E. Schlangen

MS7: Probabilistic aspects of fracture **Room 20**
Chair: M. Vorechovsky, P. Grassl

MS7 Keynote: Size Dependence of CoV of Shear Strength of RC Beams and Comparison with Fishnet and Hierarchical Models
Z. P. Bazant, W. Luo, M. Rasoolinejad

Error in the probabilistic characterisation of concrete fatigue
J. J. Ortega, G. Ruiz, R. C. Yu, N. Afanador-GarcÌa, M. Tarifa, E. Poveda, X. Zhang

Reliability analysis of concrete beams reinforced with carbon fiber-reinforced polymer bars
F. A. Da Silva Barbosa, T. N. Bittencourt

Analytical random field-based model for fracture in concrete
M. Vorechovsky, J. Elias

Increasing the design shear strength of concrete bridge decks by tests and statistical analysis of a shear database
G. A. Rombach, M. Harter, G. A. Rombach

Full normalization of the cyclic creep curve of steel-fiber reinforced concrete
E. Poveda, S. Blason, G. Ruiz, H. Cifuentes, A. Fernandez-Canteli

B-IV: Experimental methodologies (IV) **Room 23**
Chair: C. K. Leung

B: Fracture behaviour of ultra-high performance concrete
A. Sharma, S. Ray, M. A. Iqbal

Repairing of short reinforced concrete corbel by bonding composite material under continuous load
I. Ivanova, J. Assih, D. Dontchev

Shear behaviour of polyolefin and steel fibre-reinforced concrete
M. G. Alberti, A. Picazo, A. Enfedaque, J. C. Galvez

Monitoring micro-structure evolution using low cost digital microscope
S. D. Jaiswal, H. S. Patel, C. J. Desai, H. M. Patel, M. P. Mungule

The effect of elevated temperatures on the tensile properties of steel fiber reinforced concrete by means of double edge wedge splitting (DEWS) test: Preliminary results
R. Serafini, R. R. Agra, R. Monte, A. D. Figueiredo

Low temperature tensile strength and fracture toughness of asphalt concrete determined from small notched 3-P-B samples
B: B. Wang, O. Xu, B. Ma, X. Hu, P. Lu

C-IV: Computational modelling (IV) **Room 22**
Chair: J. Mazars

Numerical modeling of crack propagation using zero-thickness interfaces elements and configurational mechanics
L. Crusat, I. Carol

Numerical modelling of fracture in polyolefin fibre reinforced concrete specimens under mixed-mode loading (I+II)
F. Suarez, J. Galvez, A. Enfedaque, M. G. Alberti

Lattice model for numerical analysis of fracture process of concrete material under various loading conditions
Z. Chang, H. Zhang, E. Schlangen, B. Savija

Modelling of high-cycle fatigue crack growth in concrete
J. Cervenka, A. Al-Saudi, D. Pryl

Nonlinear behavior assessment of reinforced concrete frames by carbon fiber reinforced polymers under blast loading using finite element method
M. Kolbadi

Numerical Simulation of HS-SHCC under Quasi-static Tensile Loading
A. Shehni, U. Häussler-Combe, I. Curosu, T. Gong, V. Mechtcherine

12:40-14:00 **Lunch**

14:00-15:40 **TECHNICAL SESSIONS**

MS11-II: Fracture and durability of structures (II) **Room 400**
Chair: B. Pichler, U. Angst

Modeling corrosion of steel reinforcement in concrete: natural vs. accelerated corrosion
J. Ozbolt, A. Brajkovic, H. Lin

Numerical investigation of factors influencing the experimental determination of concrete fracture energy
G. Daisse, I. Boumakis, C. Carloni, R. Wan-Wendner

Mesoscale investigation of the FPZ length-Crack length correlation in quasi-brittle materials like concrete
N. Aissaoui, M. Matallah

Strain development of high strength grouts under compressive fatigue loading and determination of fatigue properties from self-heating measurements
E. Myrtja, O. Rateau, J. Soudier, E. Prat, M. Chaouche

Phenomenological modelling of impact of temperature on sorption isotherms and induced effects on tensile strength
L. Lacarrière, A. Sellier, P. Souyris, P. Chhun

MS10-II: Nuclear vessel behaviour under extreme loading (II) **Room A**
Chair: F. Dufour, A. Sellier

Study of the containment history of the VeRCoRS mock-up and prediction of the leakage rate under pressurization tests
T. Thénint, V. Le Corvec, S. Ghavamian

Predicting the Permeability and Relative Permeability of Concrete
I. Ecay, D. Grégoire, G. Pijaudier-Cabot,

Critical overview and new conform matching law to assess permeability of concrete as a function of damage accounting for unloading path
F. Dufour, D. E.-M. Bouhjiti, M. Briffaut, H. C. Sleiman, M. E. El Dandachy, S. Dal Pont, J. Baroth

Contribution of ENS Paris-Saclay to SINAPS@ project: Structural modelling of RC structures for seismic assessment
F. Ragueneau, C. Giry, B. Richard, T. Heitz, E. Kishta

Overview of mitigation models dedicated to severe accidents and consequences on flow rate through containment concrete structures
S. Mimouni, P. Baconnier, G. Davy

MS3-II: Non-destructive testing (II) **Room B**
Chair: E. Landis, M. Li

MS3 Keynote: A quantitative analysis of toughening mechanisms in steel fibre reinforced ultra-high-performance concrete through multimodal nondestructive evaluation
D. Loshkov, Y. Peng, R. Kravchuk, E. Landis

Improvement of impact-echo method by applying image recognition of sound spectrogram
H. Shimbo, T. Mizobuchi, J.-I. Nojima

Support vector machine procedure and Gaussian mixture modelling of acoustic emission signals to study crack classification in reinforced concrete structures
R. Vidya Sagar

Acoustic emission-based analysis of damage mechanisms in steel fibre reinforced concrete under monotonic and cyclic loading
M. de Smedt, K. de Wilder, L. Vandewalle, E. Verstrynge

Clustering of acoustic emission signals for fracture monitoring during accelerated corrosion of reinforced concrete prisms
C. van Steen, M. Wevers, E. Verstrynge

MS8: Concrete at high temperatures **Room 23**
Chair: H. Carre, R. Felicetti

Assessment of fire exposed concrete with full-field strain determination and predictive modelling
N. Williams Portal, M. Flansbjer

Finite element analysis of hygro-thermal behaviour of concrete during controlled fire spalling
R. Baydoun, F. Meftah, S. Guezouli, B. Moreau, L. Ballesteros

Multi-scale modelling of deteriorating concrete at elevated temperature and collapse simulation of underground ducts
K. Iwama, K. Higuchi, K. Maekawa

Toward a fully coupled THM mesoscopic modelling of the behaviour of concrete at high temperature
D. Dauti, M. Briffaut, S. Dal Pont

Explosive spalling in concrete exposed to high temperature: influence of pore pressure on tensile behaviour and role of mix design
Francesco Lo Monte, Jihad Miah, Roberto Felicetti

MS4-I: Discrete modelling (I) **Room 20**
Chair:J. Bolander

Simulating Hydraulic Fracturing Processes in Cement Composites using TOUGH-RBSN
D. Asahina, M. Takeda, K. Nagai

Analytical Investigation of the Influence of Rebar Arrangement on Corrosion Crack Pattern by RBSM
P. Jiradilok, K. Vikas, K. Nagai, K. Matsumoto

On macroscopic elastic properties of isotropic discrete systems: effect of tessellation geometry
J. Elias

Multiphysics Lattice Discrete Particle Model for the Simulation of Concrete Thermal Spalling
L. Shen, W. Li, X. Zhou, J. Feng, G. Di Luzio, Q. Ren, G. Cusatis

Fracture simulation of concrete with ASR and DEF expansions by RBSM
Y. Meng, P. Jiradilok, K. Matsumoto, K. Nagai, S. Asamoto

C-V: Computational modelling (V) **Room 22**
Chair: J. Cervenka

Meshfree modelling of dynamic fracture in fiber reinforced concrete
R. C Yu, P. Navas, G. Ruiz

Discrete element modelling of high performance concretes: effect of aggregates properties
A. Delaplace, F. Toussaint

Effect of Fibers, Distributed Net Reinforcement and Sharp Corners on Fracture and Size Effect in Concrete Structures
Z. P. Bazant, M. Rasoolinejad, A. Donmez, W. Luo

Modelling of the behavior of steel-concrete-steel composite beams with a full or a partial composite action
R. Calixte, L. Jason, L. Davenne

15:40-16:10	**Coffee break**	
16:10-17:10	**FraMCoS assembly**	**Room 400**
19:00-22:00	**Conference dinner** *Address:* *Centre de congrès Bellevue, Place Bellevue, 64200 Biarritz*	

Wednesday 26 June

9:00-10:30 **PLENARY SESSION** **Room 400**
Chair: C. La Borderie

Plenary Lecture: Digital transformation - A great opportunity to bring civil engineers and researchers closer together and attract talented graduates for upcoming challenges
Shahrokh Ghavamian

MS9 Keynote: Meso-scale finite element modeling of Alkali-Silica-Reaction (ASR) effect in concrete
R. Rezakhani, E. Gallyamov, J.-F. Molinari

MS3 Keynote: Spatial damage sensing based on multifunctional cementitious materials
M. Li, X. Li

10:30-11:00 **Coffee break**

11:00-12:40 **TECHNICAL SESSIONS**

MS3-I: Non-destructive testing (I) **Room 400**
Chair: *E. Landis, M. Li*

Evaluation of interface fracture in model concrete
T. Natsume, S. Ichimaru, H. Naito, J. E. Bolander

Non-destructive evaluation of the fibre content and anisometry in thin UHPFRC elements
M. Pimentel, A. Sine, S. Nunes

Use of X-ray computed tomography as input for fracture modelling of cement paste-aggregate interface
H. Zhang, E. Schlangen, B. Savija

Study on estimation of distribution of chloride ions content on surface area of concrete member combining electromagnetic wave method and X-ray fluorescence method
T. Mizobuchi, J. Nojima, H. Ito

Nondestructive measurement of concrete deterioration by simultaneous neutron and X-Ray quantitative computed tomograph
R. Livingston, S. Feuze, A. Amde, J. LaManna, D. Hussey, D. Jacobson

MS11-III: Fracture and durability of structures (III) **Room A**
Chair: B. Pichler

The Development of Mesoscopic Structural Analysis for Mechanical Property Reduction of Concrete Damaged by Expansion Cracking due to ASR
T. Miura, Y. Yamamoto, H. Nakamura

Ductile-to-brittle transition in fiber-reinforced brittle-matrix composites: Scale and fiber volume fraction effects
A. Carpinteri, F. Accornero

Frost damage progression studied through X-Ray tomography in mortar with Phase Change Materials
C. Romero Rodriguez, S. Chaves Figueiredo, F. Franca de Mendonca Filho, E. Schlangen, B. Savija

Fracture properties of alkali activated mortars
G. Baietti, L. Carabba, G. Quartarone, C. Carloni, S. Manzi, M. C. Bignozzi

Study of the effect of flax fibers on the fracture behavior of earth concrete by simultaneous application of digital image correlation and acoustic emission
N. Kouta, J. Saliba, B. El Oifi, N. Saiyouri

MS9-I: Multiscale modeling of brittle damage processes (I) **Room B**
Chair: R. Resakhani, G. Etse

Experiments-based multi-scale modeling of the alkali-silica reaction in concrete
E. Gallyamov, M. Corrado, R. Rezakhani, J.-F. Molinari

FE mesoscopic modelling of a micro-concrete based on X-Ray scan morphologies
O. Stamati, E. Roubin, E. Andò, Y. Malecot

On the micro-to-macro transition of reinforcement slip in two-scale modelling
A. Sciegaj, F. Larsson, K. Lundgren, K. Runesson

Multiscale concrete failure analysis with virtual elements and interfaces
G. Etse, F. Lopez Rivarola, N. Labanda

MS4-II: Discrete modelling (II) **Room 20**
Chair: J. Elias

Quasi-Visco-Elasto-Plastic Constitutive Model of Concrete for Fatigue Simulation
N. Ueda, M. Konishi, H. Ono

Investigations of size effect in concrete during splitting using DEM combined with X-Ray Micro-CT scans
J. Suchorzewski, J. Tejchman

DEM investigations of effect of Interfacial transition zones on concrete fracture
M. Nitka, J. Tejchman

Bond Behavior Simulation using RBSM with Beam Element and Voronoi Mesh,
U. Farooq, H. Nakamura, Y. Yamamoto, T. Miura

Mesoscale numerical study of aggregate size in concrete by discrete element method
R. Zhu, S. Y. Alam, A. Loukili

F-I: Structural Concrete Applications (I) **Room 22**
Chair: G. Ruiz

Fiber reinforced concrete: from flexural tests to solid slabs
M. Di Prisco, A. Pourzarabi, M. Colombo

Planar crack assumption as an alternative to Navier's hypothesis in the modelling of fibre-reinforced concrete sections
J. R. Carmona, J. Rey-Rey, G. Ruiz, J. M. Rodriguez-Madueno

Local axial compressive behaviours of ECC ring-beam connections
B. Dong, J. Pan

Study of the relationship between residual flexural and compressive strengths in steel fibre-reinforced concrete by means of the response surface methodology
A. de la Rosa, G. Ruiz, E. Poveda

Performance Characteristics of Cement Grout in Precast Construction
G. Appa Rao and K. Manikandan

12:40-14:00 **Lunch**

14:00-15:45 **TECHNICAL SESSIONS**

MS1-II: Self healing of concrete (II) **Room 400**
Chair: A. Jefferson

MS1-Keynote: Understanding self-healing process and robustness along crack depth in cementitious materials
M. Li, S. Fan

Enhanced concrete crack closure with hydrid shape memory polymer tendons
B. Balzano, R. Davies, J. Sweeney, G. Thomson, A. Jefferson

Modelling of autogenous healing for regular concrete via a discrete model
A. Cibelli, G. Di Luzio, L. Ferrara, G. Cusatis, M. Pathirage

Why nominal cracking strength can be lower for later cracks in strain-hardening cementitious composites with multiple cracking?
J. Yu, C. K. Leung, V. C. Li

E: Novel cementitious and/or other quasi-brittle materials **Room A**
Chair: J. M. Chandra Kishen

Compression behaviors of cementitious cellular composites with negative Poisson's ratio
Y. Xu, B. Savija, E. Schlangen

Anisotropic tensile behaviour of UHPFRC: meso-scale model and experimental validation
M. Pimentel, A. Abrishambaf, S. Nunes

New cementitious composite developments with three dimensional fabric meshes
J. Woon Park, J. Lee, H. Su Moon, Y. Mook Lim

On the synergetic action between strain-hardening cement based composites (SHCC) and carbon textile reinforcement under tensile loading
T. Gong, A. A. Hamza, I. Curosu, V. Mechtcherine

Creating strain hardening cementitious composites (SHCCs) through use of additively manufactured polymeric meshes as reinforcement
Y. Xu, E. Schlangen, B. Savija

MS 9-II: Multiscale modeling of brittle damage processes (II) **Room B**
Chair: C. La Borderie

Test independent identification of fracture parameters of plain concrete based on a cohesive XFEM formulation
Y. E. Harmanci, K. Agathos, G. Jacot-Descombes, E. Chatzi

A microscopically-informed modelling approach of damage in cement-based materials
A. Rhardane, S. Y. Alam, F. Grondin

Micromechanical analysis of fatigue damage in concrete caused by matrix microcracks
S. Dutta, J. M. Chandra Kishen

Comparison between the cracking process of reinforced concrete and fibres reinforced concrete railway tracks by using non-linear finite element analysis
J.-L. Tailhan, P. Rossi, T. Sedran

A scaled boundary multiscale approach to crack propagation
A. Egger, S. Triantafyllou, E. Chatzi

MS4-III: Discrete modelling (III) **Room 20**
Chair: J. Bolander

Mesoscale analysis for the bond behavior of concrete under active confinement using coupled RBSM and solid FEM
M. S. Karam, Y. Yamamoto, H. Nakamura, T. Miura

Simulations of Split Hopkinson Pressure Bar by Discrete Mesoscale Model
J. Kveton, J. Elias

Collapse simulation of reinforced concrete including localized failure and large rotation using extended RBSM
Y. Yamamoto, Y. Isaji, H. Nakamura, T. Miura

A concurrent two-scale approach for high strength concrete
L. A. G. Bitencourt Jr., M. Gimenes, E. A. Rodrigues, O. L. Manzoli

Semi-discrete simulation of interface behavior during single fiber pull-out with application to dynamically loaded fiber-reinforced cementitious composites
B. Choo, K. Kim, M. K. Kim, Y. M. Lim

F-II: Structural Concrete Applications (II) **Room 22**
Chair: M. Di Prisco

Fracture mechanism of reinforced concrete non-structural wall
M. Matsubayashi, M. Takahashi, R. Kubota, Y. Takase, M. Mizoguchi

Strut efficiency factors in design of reinforced concrete deep beams
R. Kondalraj, G. Appa Rao

The contribution of steel fibers to increase the ductility and service life in RC beams and slabs
T. Buttignol, T. N. Bittencourt, J. F. Fernandes, J. L. Antunes de Oliveira e Sousa

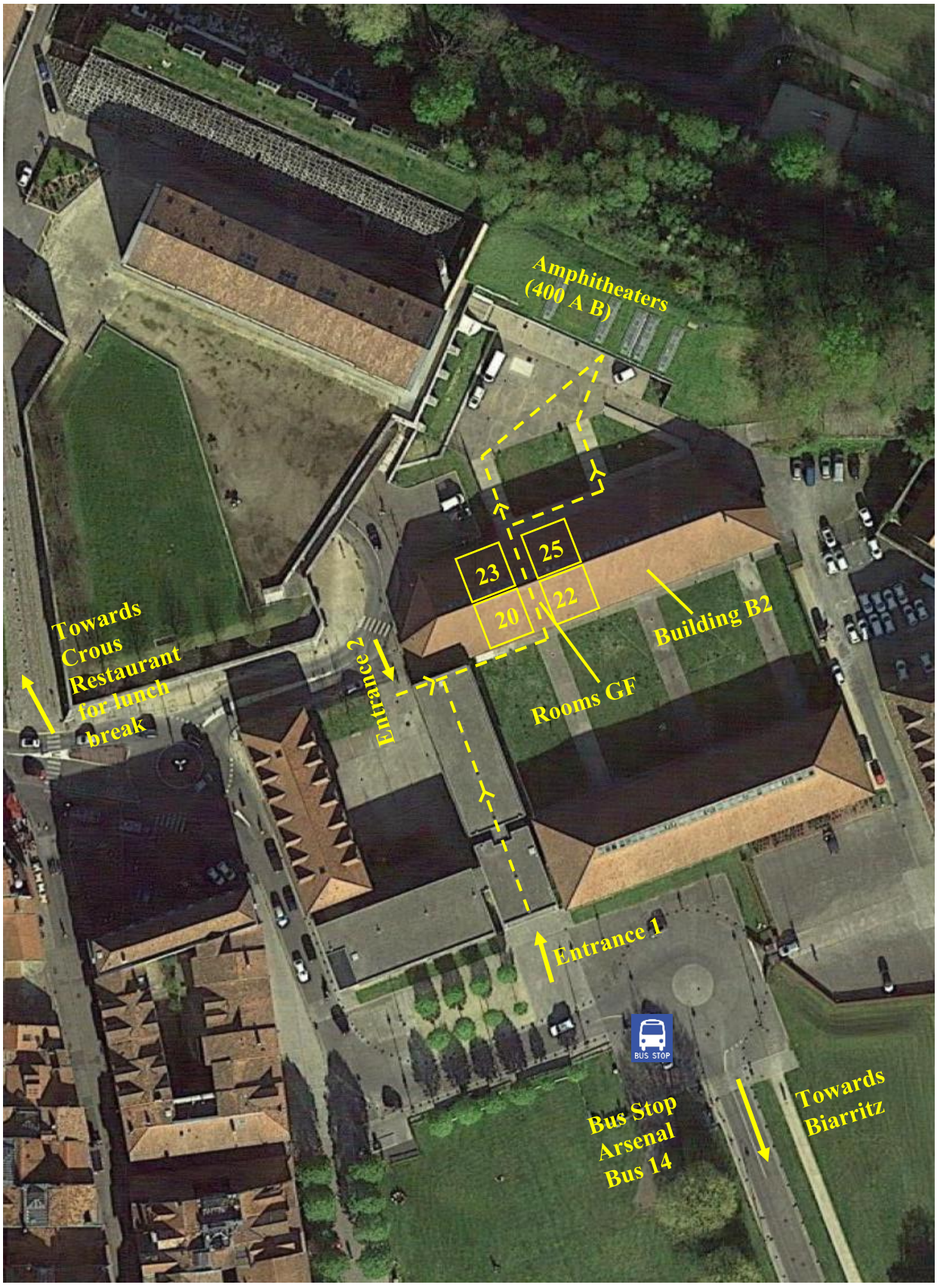
A Literature Review about the head-size effect on the capacity of cast-in anchors
G. Di Nunzio, G. Muciaccia

Fracture mechanics based design of reinforced concrete beams-An analytical study
J. Sri Kalyana Rama, M. Ram Sagar, A. Ramachandra Murthy

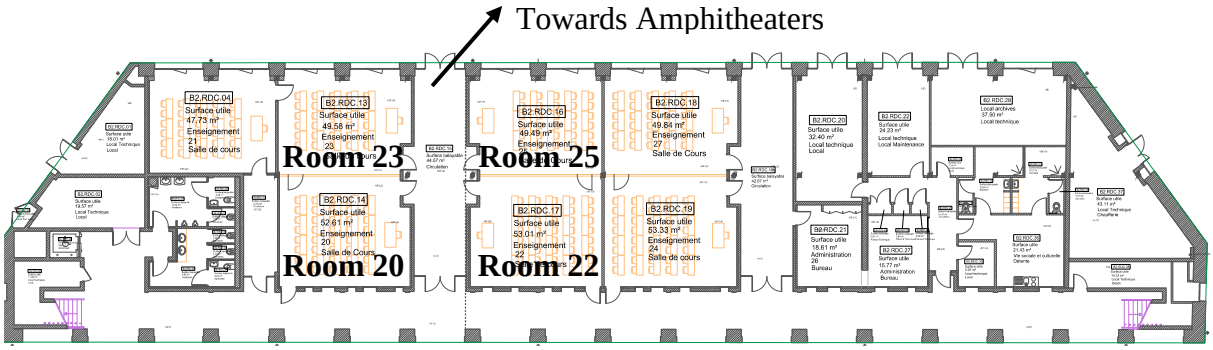
15:45-17:00 **Coffee break and farewell drinks**

Conference site

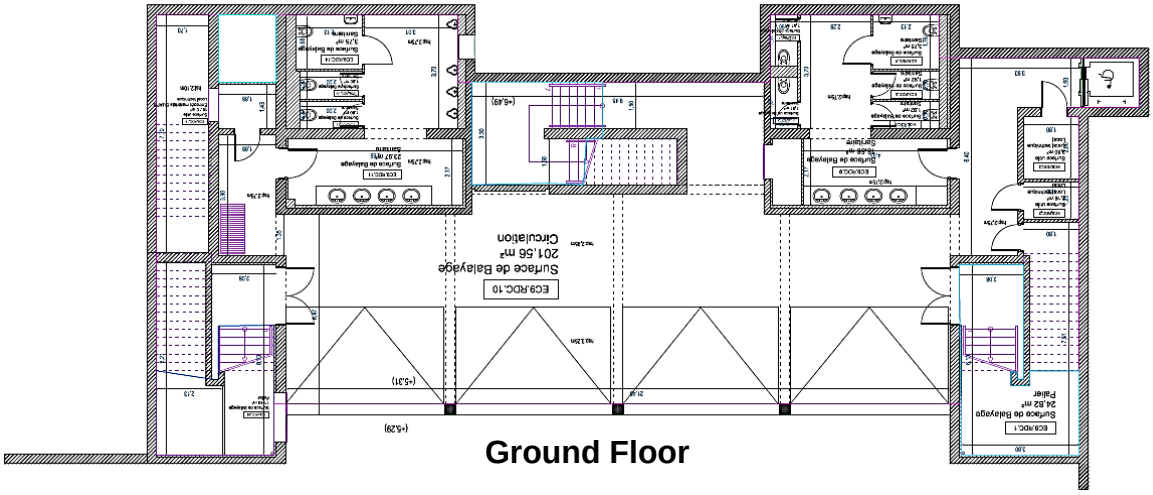
Site Address : Campus de la Nive
8 Allées des Platanes
64100 Bayonne



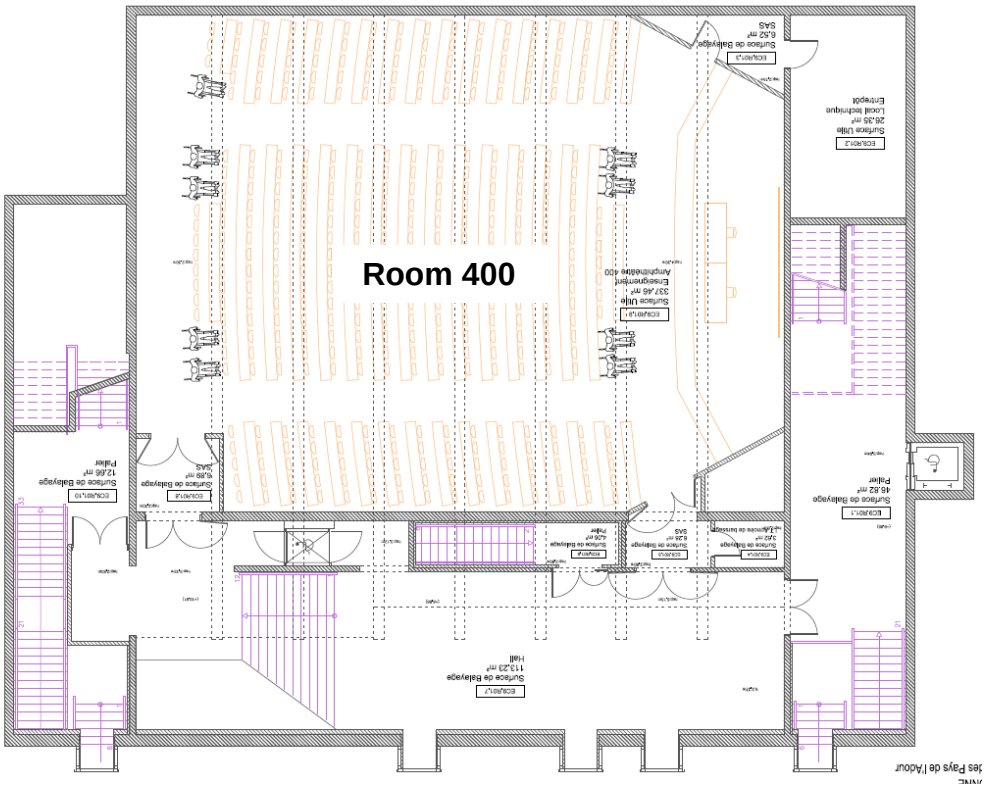
Building 2 Ground Floor Details



Amphitheaters Building Details

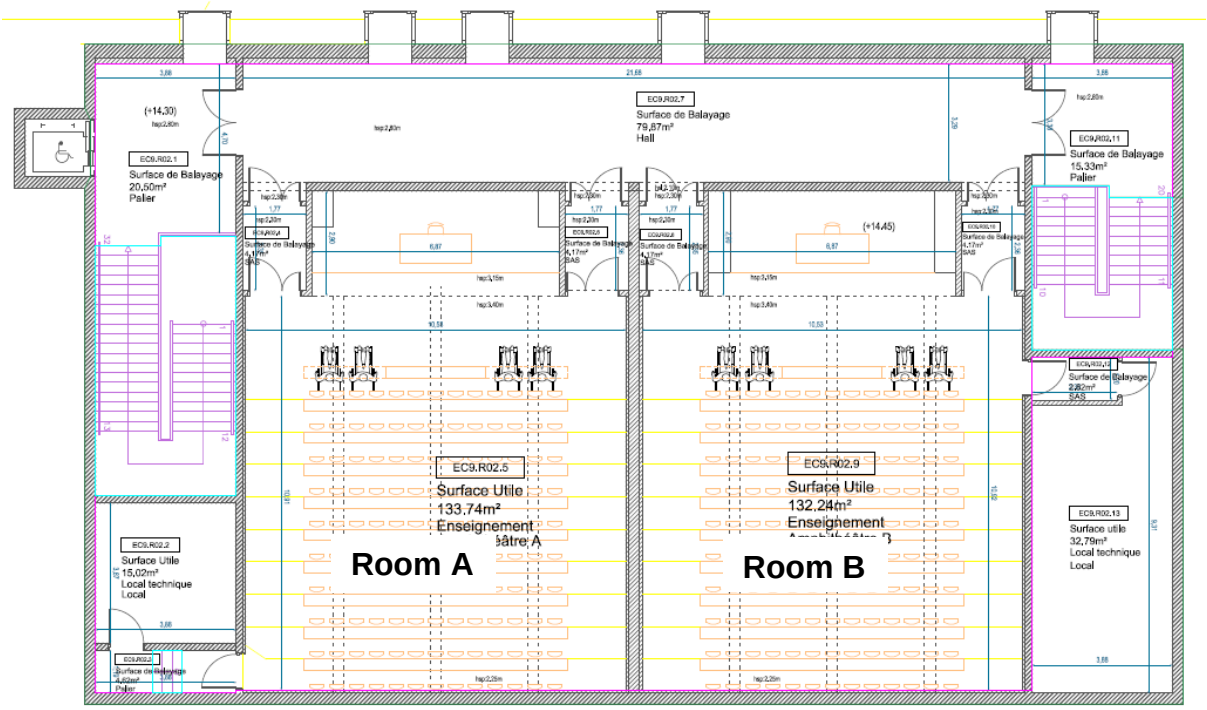


Ground Floor



First Floor

Amphitheaters Building Details



Second Floor

Access to the Restaurant for Lunch Break

Restaurant Address : Crous Resto U' de la Nive
79 Rue Bourgneuf
64100 Bayonne

Instructions about the conference dinner

Location Address: **Centre de Congrès Bellevue**
Place Bellevue
64200 Biarritz

Access Map

Facade View

How to get to the Conference Dinner?

First itinerary:

For those who want to go directly from the conference to the dinner location, to enjoy the beauty of the Atlantic Ocean, they have to take the **bus 14 (Direction: Cité Scolaire Biarritz)** from the bus Stop "**Arsenal**" near the Entrance 1 of the university on the roundabout, and get off at the bus Stop "**Larralde**".

Once you arrive to **Larralde** Bus Stop, walk for 5 minutes to arrive to the dinner location "**Centre de Congrès Bellevue, Place Bellevue, 64200 Biarritz**".

Key Information:

Departure Bus Station: Arsenal

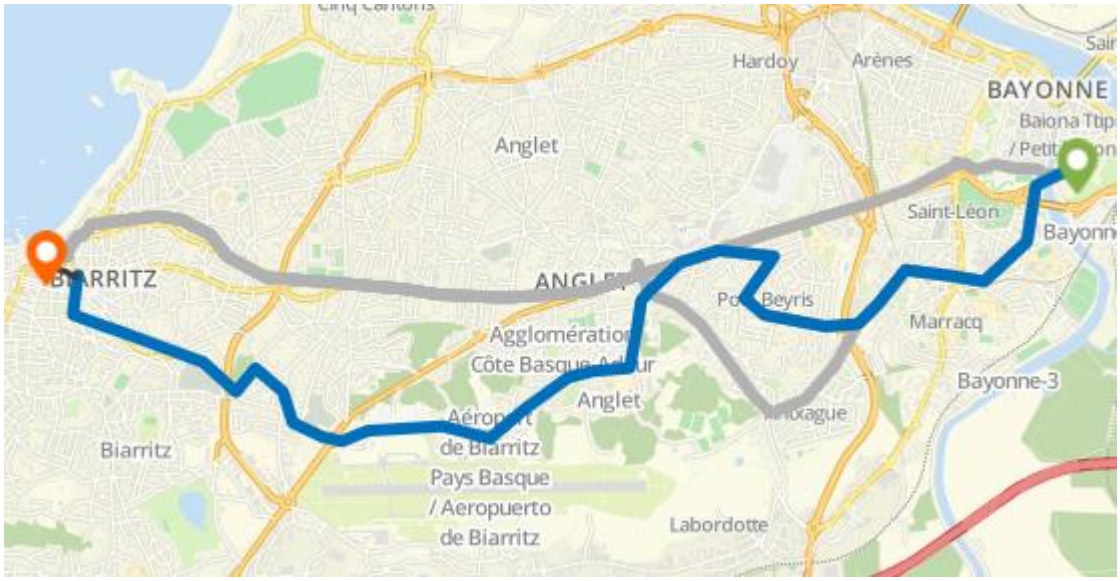
Arrival Bus Station: Larralde

Walking Time: 4-6 mins

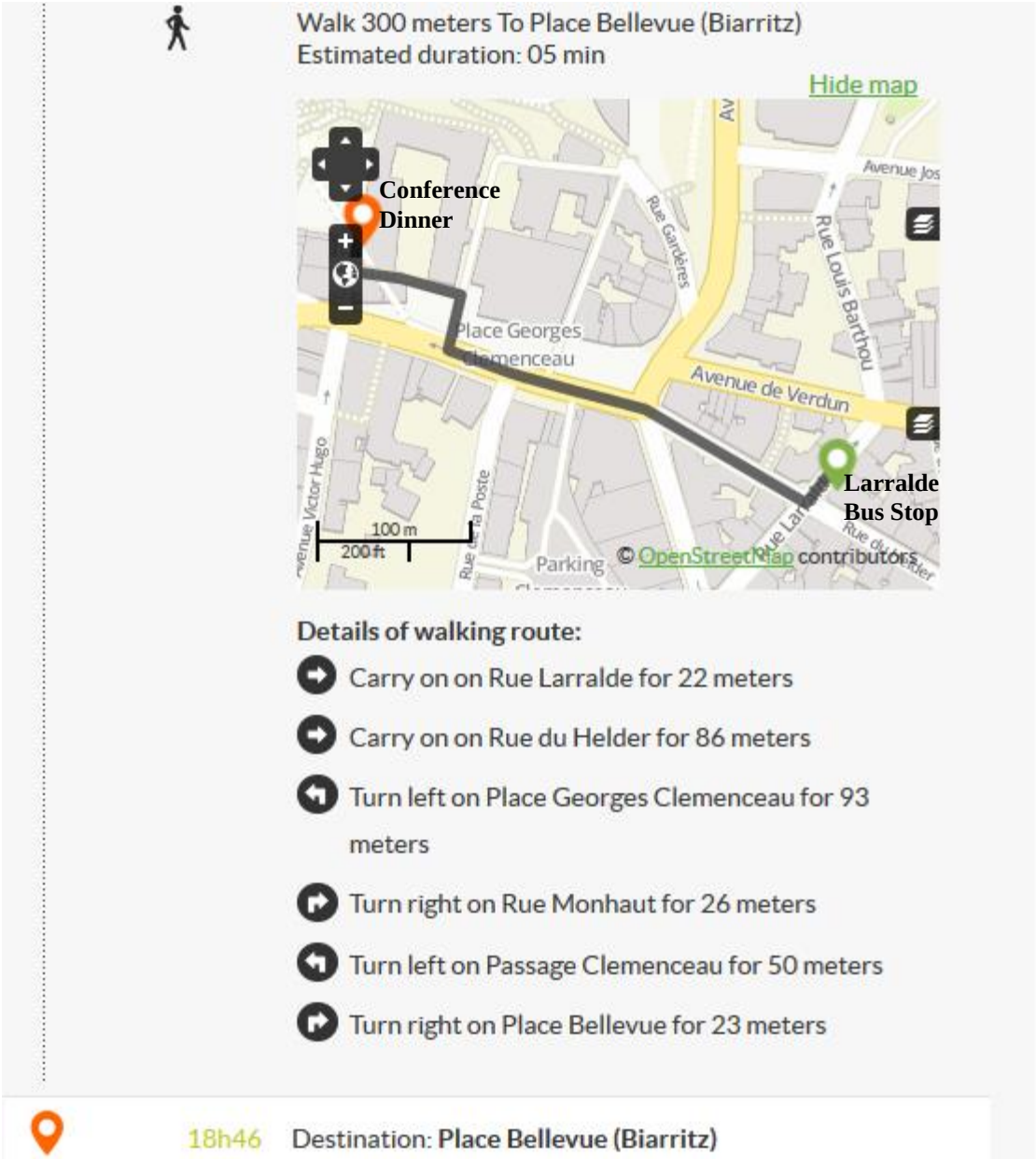
Bus 14 Schedule:

Departure Time	Arrival Time	Arrival Time to the Dinner
5:07 Pm	5:55 Pm	5:59 Pm
5:33 Pm	6:20 Pm	6:24 Pm
5:57 Pm	6:42 Pm	6:46 Pm
6:23 Pm	7:04 Pm	7:08 Pm
6:52 Pm	7:30 Pm	7:34 Pm

Bus 14 Way on Map:



Walking Path Details: (Larralde → Conference Dinner)

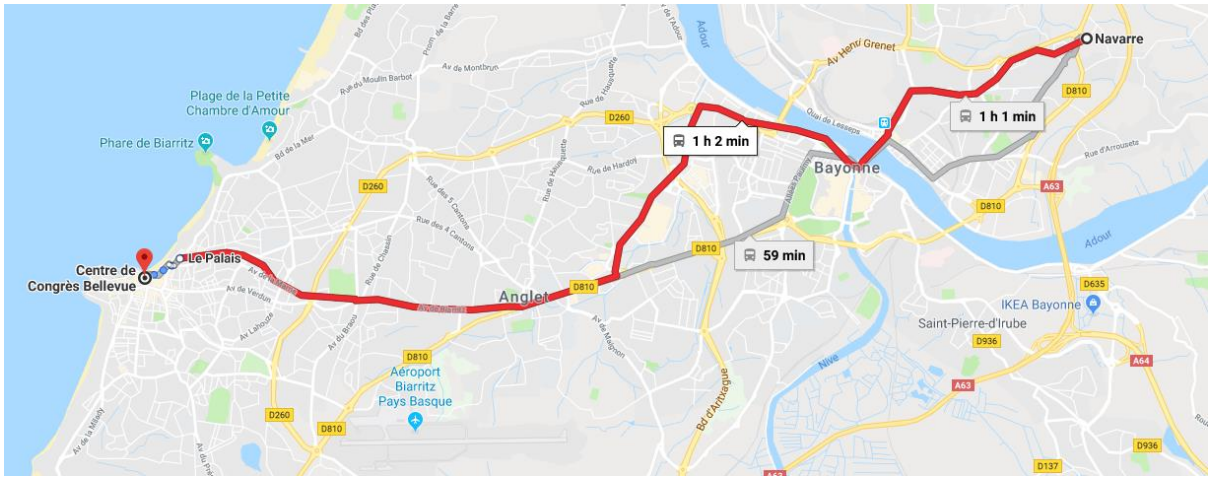


Second itinerary:

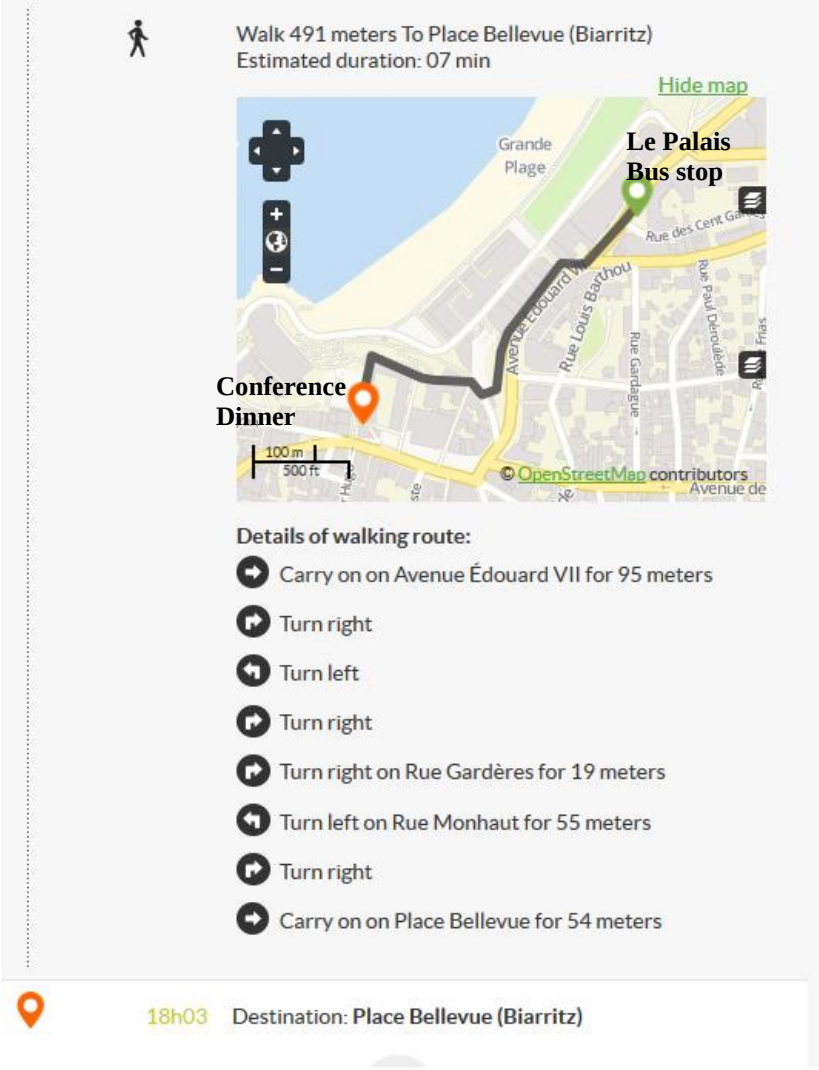
For those who want to go from their Hotels or another place not far from the main national road (D810), they have to take the **bus A1 (Direction: Biarritz Continental)** from the bus Stops listed below:

Once you arrive to **"Le Palais"** Bus Stop, walk for 7 minutes to arrive to the dinner location "**Centre de Congrès Bellevue, Place Bellevue, 64200 Biarritz**".

Bus A1 Way on Map between two terminal Stops:



Walking Path Details: (Le Palais → Conference Dinner)

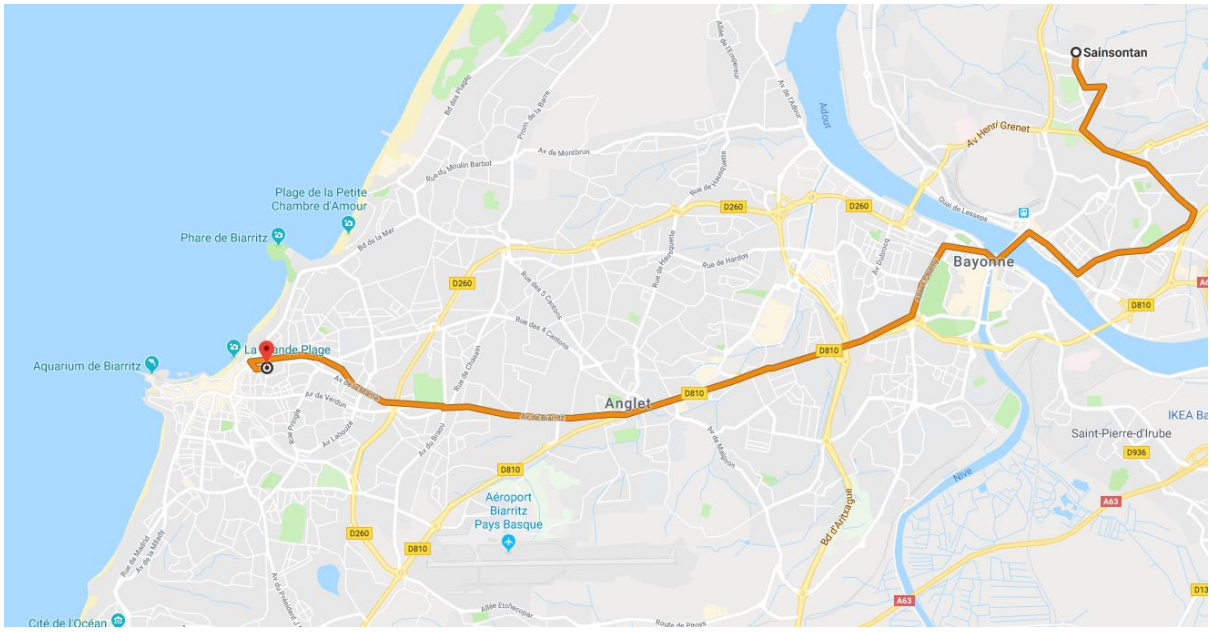


Third itinerary:

For those who want to go from their Hotels or another place not far from the main national road (D810), they have to take the **bus A2 (Direction: Biarritz Continental)** from the bus Stops listed below:

Once you arrive to **"Le Palais"** Bus Stop, walk for 7 minutes to arrive to the dinner location "**Centre de Congrès Bellevue, Place Bellevue, 64200 Biarritz**".

Bus A2 Way on Map between two terminal Stops:



Walking Path Details: (Le Palais → Conference Dinner)

Same as the bus A1.

For more information about the bus lines, please visit the website of the public transportation company: https://www.chronoplus.eu/en . (An application is available on Google Play store)

Otherwise, you can use Google Maps to check your Itinerary (Public Transportation Data is synchronized with Google Maps)

23-26 June 2019- Bayonne, France