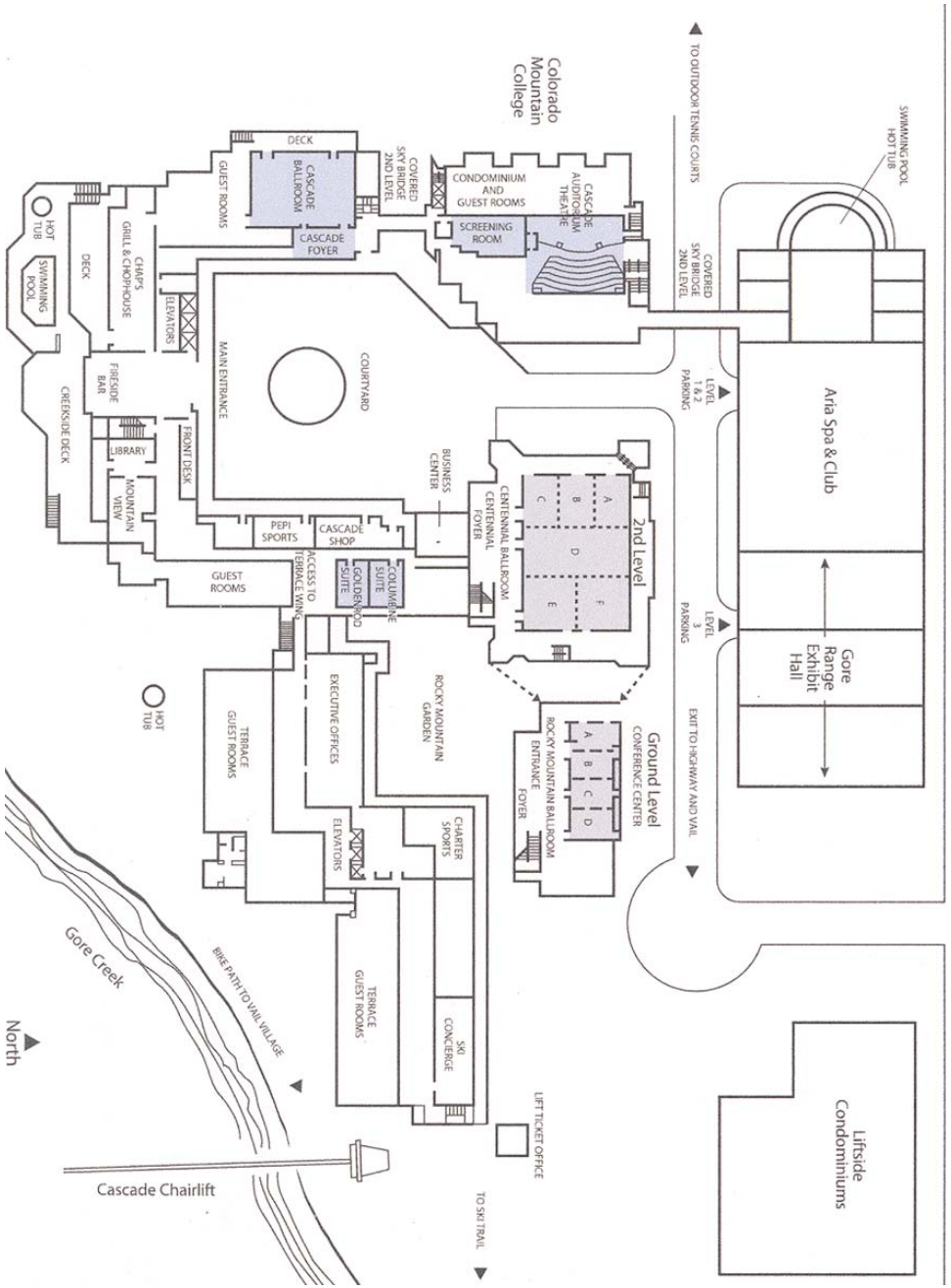
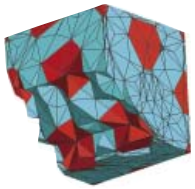


FraMCoS-5

Fifth International Conference on Fracture Mechanics of Concrete and Concrete Structures & Post-Conference Workshops

April 12-16, 2004 Vail Cascade Resort, Vail, Colorado



IA-FraMCoS

International Association for Fracture Mechanics of Concrete and Concrete Structures

PROGRAM

http://www.ust.hk/framcos5

FRAMCOS-5 ORGANIZATION

The FraMCoS-5 Conference is co-organized by the University of Michigan and the University of Colorado under the sponsorship of the International Association of Fracture Mechanics of Concrete and Concrete Structures (IA-FraMCoS). It will be held at the Conference Center of the Vail Cascade Resort, Vail Colorado, USA, a renowned resort area in the Rocky Mountains.

Since 1992, the series of International Conferences on Fracture Mechanics of Concrete and Concrete Structures (FraMCoS) has taken place in different parts of the world on a tri-annual basis. The last FraMCoS was held in Cachan, France in 2001.

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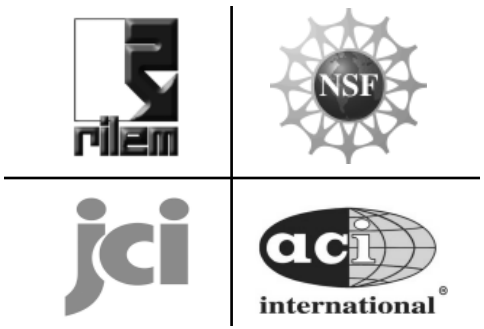


FRAMCOS-5
SCHEDULE OF EVENTS

SUNDAY, APRIL 11		
3:00p-6:00p	Registration	East Centennial Foyer
6:00p-7:30p	Icebreaker Reception	Cascade Ballroom
MONDAY, APRIL 12		
8:00a-6:00p	Registration	East Centennial Foyer
8:15a-9:30a	Opening Session and Keynote Address	Centennial D
9:30a-10:00a	COFFEE BREAK	Main Centennial Foyer
10:00a-11:20a	Session 1A: Advances in Modeling Concepts I	Centennial D
	Session 1B: Durability Mechanics I	Centennial E
	Session 1C: Fracture Mechanics and Seismic Design	Centennial F
11:20a-11:40a	COFFEE BREAK	Main Centennial Foyer
11:40a-1:00p	Session 2A: Advances in Modeling Concepts II	Centennial D
	Session 2B: Durability Mechanics II	Centennial E
	Session 2C: Fracture Mechanics and Design I	Centennial F
1:00p-2:00p	LUNCH	
2:00p-4:00p	Session 3A: Size Effect I	Centennial D
	Session 3B: Durability Mechanics III	Centennial E
	Session 3C: Fracture Mechanics and Design II	Centennial F
4:00p-6:00p	Poster Session	East Centennial Foyer
TUESDAY, APRIL 13		
8:00a-6:00p	Registration	East Centennial Foyer
8:30a-9:30a	Keynote Address Session	Centennial D
9:30a-10:00a	COFFEE BREAK	Main Centennial Foyer
10:00a-11:20a	Session 4A: Size Effect II	Centennial D
	Session 4B: Durability Mechanics IV	Centennial E
	Session 4C: Fracture Mechanics and Design III	Centennial F
11:20a-5:20p	FREE TIME ACTIVITIES - Gondola Ride and Lunch	
5:20p-7:00p	Session 5A: Fracture Mechanics of Concrete I	Centennial D
	Session 5B: Durability Mechanics V	Centennial E
	Session 5C: NDE and Repair	Centennial F
WEDNESDAY, APRIL 14		
8:00a-6:00p	Registration	East Centennial Foyer
8:30a-9:30a	Keynote Address Session	Centennial D
9:30a-10:00a	COFFEE BREAK	Main Centennial Foyer
10:00a-11:20a	Session 6A: Fracture Mechanics of Concrete II	Centennial D
	Session 6B: Fracture Mechanics and High Performance I	Centennial E
	Session 6C: Repair and Retrofitting I	Centennial F
11:20a-11:45a	Group Photo Session	Main Centennial Foyer
11:45a-5:20p	FREE TIME ACTIVITIES - Ski Competition	
5:20p-7:00p	Session 7A: Fracture Mechanics of Concrete III	Centennial D
	Session 7B: Fracture Mechanics and High Performance II	Centennial E
	Session 7C: Repair and Retrofitting II	Centennial F

THURSDAY, APRIL 15		
8:00a-6:00p	Registration	East Centennial Foyer
8:30a-9:00a	Keynote Address	Centennial D
9:00a-9:30a	COFFEE BREAK	Main Centennial Foyer
9:30a-11:00a	Session 8A: Fracture Mechanics of Concrete IV	Centennial D
	Session 8B: Fracture Mechanics and High Performance III	Centennial E
	Session 8C: Fracture Mechanics of Concrete V	Centennial F
11:00a-11:15a	COFFEE BREAK	Main Centennial Foyer
11:15a-1:00p	Session 9A: Fracture Mechanics of Concrete VI	Centennial D
	Session 9B: Fracture Mechanics and High Performance IV	Centennial E
	Session 9C: Fracture Mechanics and Design IV	Centennial F
1:00p-2:00p	LUNCH	
2:00p-4:00p	Session 10A: Fracture Mechanics of Concrete VII	Centennial D
	Session 10B: Fracture Mechanics and High Performance V	Centennial E
	Session 10C: Fracture Mechanics of Concrete VIII	Centennial F
4:00p-4:30p	COFFEE BREAK	Main Centennial Foyer
4:30p-5:30p	IA-FRAMCOS General Meeting	Centennial D
6:00p-7:00p	COCKTAILS	Main Centennial Foyer
7:00p-9:30p	CONFERENCE BANQUET	Cascade Ballroom

FRIDAY, APRIL 16		
POST-CONFERENCE WORKSHOPS		
8:00a-6:00p	Registration	East Centennial Foyer
8:15a-8:30a	OPENING SESSION	Centennial D
8:30a-10:00a	Workshop 1: Session 1	Centennial E
8:30a-10:00a	Workshop 2: Session 1	Centennial D
10:00a-10:30a	COFFEE BREAK	Main Centennial Foyer
10:30a-12:00p	Workshop 1: Session 2	Centennial E
10:30a-12:00p	Workshop 2: Session 2	Centennial D
12:00p-1:30p	LUNCH BUFFET	Centennial Ballroom
1:30p-3:30p	Workshop 1: Session 3	Centennial E
1:30p-3:30p	Workshop 2: Session 3	Centennial D
3:30p-4:00p	REFRESHMENTS	Main Centennial Foyer
4:00p-5:30p	Panel Session	Centennial D
5:30p-6:00p	Concluding Remarks	Centennial D

Daily Schedule

Monday, April 12

8:15a — **OPENING SESSION** - K. Willam *(Centennial D)*

8:15a-8:30a — **WELCOME** - *V. C. Li*

8:30a-9:00a — **KEYNOTE 1: Crack Formation and Life Cycle Performance**
F.H. Wittmann

9:00a-9:30a — **KEYNOTE 2: Reality Behind Fictitous Cracks**
J.G.M. Van Mier

9:30a-10:00a — **COFFEE BREAK**

10:00a-11:20a — **PARALLEL SESSIONS 1**

SESSION 1A: Advances in Modeling Concepts I - J.G. Rots, L.J. Sluys *(Centennial D)*

Fracturing Material Models based on Micromechanical Concepts: Recent Advances
Z.P. Bažant, F.C. Caner, L. Cedolin, G. Cusatis & G. Di Luzio

Failure Characterization in Regularized Media
A. Simone, H. Askes & L.J. Sluys

Continuum Strong Discontinuity Approach to Fracture of Concrete
J. Oliver, A.E. Huespe, M.D.G. Pulido & S. Blanco

An Embedded Cohesive Crack Model for Finite Element Analysis of Concrete Fracture
J.M. Sancho, J. Planas & D.A. Cendon

SESSION 1B: Durability Mechanics I - C.P. Ostertag, J.G.M. Van Mier *(Centennial E)*

Multi-Scale Poro-Elastic Properties of Cement-Based Materials
G. Constantinides & F.J. Ulm

Non Local Damage Model with Evolving Internal Length: Motivations and Applications to Coupled Problems
G. Pijaudier-Cabot, K. Haidar, M. Omar & A. Loukili

A Coupled Hygro-Chemo-Mechanical Damage Model for ASR-Affected Concrete
F. Bangert & G. Meschke

CANCELLED: An Open System Approach towards the Simulation of Chemomechanically Induced Concrete Failure
E. Kuhl, A. Menzel & P. Steinmann

SESSION 1C: Fracture Mechanics and Seismic Design - I. Carol, P. Gambarova *(Centennial F)*

Using Damage Mechanics to Model a Four Story RC Framed Structure Submitted to Earthquake Loading
V. Abbasi, L. Daudeville, P. Kotronis & J. Mazars

Dynamic Analysis of a Reinforced Concrete Structure using Plasticity and Interface Damage Models
I. Rhee, K. Willam & P.B. Shing

Enhanced 3D Multifibre Beam Element Accounting for Shear and Torsion
G. Casaux, F. Ragueneau, P. Kotronis & J. Mazars

Effect of Fiber Reinforcement on the Response of Structural Members
G. Fischer & V.C. Li

11:20a-11:40a — **COFFEE BREAK**

11:40a-1:00p — **PARALLEL SESSIONS 2**

SESSION 2A: Advances in Modeling Concepts II - L. Cedolin *(Centennial D)*

A Discrete Strong Embedded Discontinuity Approach
J. Alfaiate & L.J. Sluys

Stress Hybrid Finite Elements with Multiple Embedded Cracks
O. Manzoli & P.B. Shing

Analysis of Shear Capacity of Brittle Lightweight Concrete Beams using Interface Elements
H.D. Basche, I. Rhee, K.J. Willam & B.P. Shing

Embedded Rough Surfaces in a 3D Constitutive Model for Concrete
S. Chang Hee, A. Jefferson & T. Bennett

SESSION 2B: Durability Mechanics II - G. Meschke, F.J. Ulm *(Centennial E)*

Modelling the Mechanical Evolution of a Chemically Degraded Cement Paste at the Microstructure Scale
E. Guillon, F. Benboudjema & M. Moranville

Experimental and Numerical Analysis of Discrete Damage Processes and Fluid Transport in Porous Materials
J. Carmeliet, S. Roels & K. De Proft

Origin of Chloride Diffusivity of Cement Pastes-A Scale Transition Analysis
P. Pivonka, D. Smith & C. Hellmich

Homogenization Analysis of Calcium Leaching in Concrete: A Separation of Scales Approach
V.H. Nguyen, B. Nedjar, H. Colina & J.M. Torrenti

SESSION 2C: Fracture Mechanics and Design I - W. Gerstle, H. Stang *(Centennial F)*

Experimental Investigation of Fatigue in a Steel-Concrete Interface
R. Walter, B.H. Jansen, M. R. Østergaard & J.F. Olesen

3D FE Analysis of Anchor Bolts with Large Embedment Depths
J. Ožbolt, R. Eligehausen, G. Periškić & U. Mayer

Stiffness Requirements for Baseplates
S. Fichtner & R. Eligehausen

Bond of RC Members using Nonlinear 3D FE Analysis
S. Lettow, J. Ožbolt, R. Eligehausen & U. Mayer

1:00p-2:00p — **LUNCH**

2:00p-4:00p — **PARALLEL SESSIONS 3**

SESSION 3A: Size Effect I - T. Kanda *(Centennial D)*

Size Effect in Fracture of Concrete Specimens and Structures: New Problems and Progress
Z.P. Bažant & Q. Yu

Strength Size Effect in Quasi-Brittle Structures
B. Karihaloo, Q.Z. Xiao & H. Abdalla

Computational Analysis of the Size Effect in Concrete Fracture using Gradient Plasticity
J. Chen, H. Yuan & F. Wittmann

Asymptotic Analysis of Boundary-Effect on Strength of Concrete
K. Duan & X. Hu

Scaled Hollow-Cylinder Tests for Studying Size Effect in Fracture Processes of Concrete
A. Elkadi, & J.G.M. Van Mier

Fracture Studies in Notched Concrete Disc Specimens with Various Sizes
O.F. Eser, M.A. Tasdemir, H.N. Atahan & S. Akyuz

SESSION 3B: Durability Mechanics III - J. Carmeliet, R. Massabo *(Centennial E)*

Effect of Internal Transition Zone and Aggregates on the Delayed Behavior of Mortar and Concrete
F. Benboudjema, E. Guillon & J.M. Torrenti

Influence of Freeze-Thaw Micro-Cracks on Tension Stiffening
L. Petersen, L. Lohaus & M.A. Polak

Creep Load Influence on the Residual Capacity of Concrete Structures: Experimental Investigation
M. Omar, K. Haidar, A. Loukili & G. Pijaudier-Cabot

Mechanical Influences of Drying: Experimental Analysis on a Mortar
I. Yurtdas, F. Skoczylas & N. Burlion

Fracture Properties of Concrete Exposure to Delayed Ettringite Formation
C. Rocco, F. Giangrasso, L. Bergol, G. di Pace & J. Planas

Hydrate Dissolution Influence on the Young's Modulus of Cement Pastes
S. Kamali, M. Moranville, E. Garboczi, S. Prene & B. Gerard

SESSION 3C: Fracture Mechanics and Design II - R. Eligehausen, S. Sture *(Centennial F)*

Local Bond Stress-Slip Law and Size Effect in High Bond Bars
P. Bamonte, D. Coronelli & P.G. Gambarova

The Effect of Tensile Fracture Energy on the Size Effect for Shear Strength of Reinforced Concrete Beam Members Utilizing High Strength Concrete
Y. Takaki, M. Fujita & R. Sato

Size Effect on Flexural Compressive Strength of Reinforced Concrete Flexural Members
J.K. Kim, S.T. Yi, J.H.J. Kim & K.M. Lee

Size Effect of Compressed Concrete in Four Point Bending RC Beams
A. Fantilli, P. Vallini & I. Iori

A Fracture Mechanics Approach to Over-Reinforced Concrete Beams
A. Carpinteri, G. Ferro & G. Ventura

Experimental Study on the Influence of the Rebar Arrangement and of the Shape of the Cross Section on the Fracture of Lightly Reinforced Beams
G. Ruiz & J.R. Carmona

4:00p-6:00p	**POSTER SESSION** *(East Centennial Foyer)*

Fracture Mechanics Based Bending Failure Analysis of Strain Hardening Type FRC Panel
Y. Kitsutaka & Y. Takahashi

Numerical Modeling of the Bond Layer Failure Between Multi-Filament Yarn and Concrete
R. Chudoba, M. Konrad, O. Bruckermann & B. Banholzer

Complete Understanding of Secondary Flexure in Uniaxial Tension Test of Concrete
H. Akita, H. Koite & H. Mihashi

Shear Strength of Reinforced Concrete Circular Cross Section Members
I. Merta

A Study on Reinforced Concrete Haunched Beams Behavior
M.R. Salamy, S. Saito & T. Higai

Local Bond-slip Phenomenon regarding Global Behavior of Industrial Large Scale Structures
F. Ragueneau, N. Dominguez, A. Ibrahimbegović, S. Michel-Ponelle & S. Ghavamian

Shear Resistance of Reinforced Concrete Structural Walls with a Window Opening Strengthened by CFS
O. Joh, Y. Goto & A. Kitano

Nanoindentation of Cement Pastes
J. Nemecek & Z. Bittnar

Seismic Torsional Analysis of Reinforced Concrete Columns based on 3D Lattice Model
T. Miki & J. Niwa

The Effects of Sunflower Oil Acid on the Compressive Strength and the Grindability of Cement
A.T. Albayrak & M. Yasar

Crack Width Predictions in Reinforced Concrete Beams using Bi-Linear Strain Softening Relations
S. Shamu, N. Pranay, L. Rao & D. Menon

Fracture Analysis of the Debonding between FRP and Concrete
K.V. Subramaniam

TUESDAY, APRIL 13

8:30a-9:30a	**KEYNOTE SESSION** - J. Mazars *(Centennial D)*
8:30a-9:00a	**KEYNOTE 3: Damage Diagnosis and Life-Time Assessment of Concrete and Masonry Structures by an AE Technique** *A. Carpinteri, G. Lacidogna & N. Pugno*
9:00a-9:30a	**KEYNOTE 4: Toughness in Testing and Design, the FRC Experience** *H. Stang*
9:30a-10:00a	**COFFEE BREAK** *(Main Centennial Foyer)*
10:00a-11:20a	**PARALLEL SESSIONS 4**

SESSION 4A: Size Effect II - B. Karihaloo, J.K. Kim *(Centennial D)*

Statistical Size Effect in Quasibrittle Materials: Computation and Extreme Value Theory
Z.P. Bažant, S.D. Pang, M. Vorechovskýa, D. Novákb & R. Pukl

Size Effect Experiments on Granular Materials in Compression
S. Burtscher & J. Kollegger

Boundary Effect on Specific Fracture Energy of Concrete
K. Duan, X. Hu, & F.H. Wittmann

Interfacial Fracture Parameters and Size Effect in Concrete-Concrete Cold Joints
P. Subba Rao & J. M. Chandra Kishen

SESSION 4B: Durability Mechanics IV - F. Wittmann, P.B. Shing *(Centennial E)*

Mitigation of Expansive Alkali Silica Reaction with Microfibers
C.P. Ostertag & C.K. Yi

Stress-Strain Relationships of Concrete Damaged by Freezing and Thawing Cycles
T. Ueda, M. Hasan, K. Nagai & Y. Sato

Effect of Fiber Fatigue Rupture on Bridging Stress Degradation in Fiber Reinforced Cementitious Composites
T. Matsumoto, P.J. Chun & P. Suthiwarapirak

3D Fatigue Analysis of RC Bridge Slabs and Slab Repairs by Fiber Cementitious Materials
P. Suthiwarapirak & T. Matsumoto

SESSION 4C: Fracture Mechanics and Design III - J. Ožbolt, R.Gettu *(Centennial F)*

Peridynamic Modeling of Concrete Structures
W. Gerstle & N. Sau

Fracture Mechanics in the Design of Precast Connections
M. di Prisco, F. Iorio, M. Mauri & M. Scola

Design of Channel Bars under Shear Load
M. Potthoff, Y. Grewin & R. Eligehausen

Designing Strengthening of Structures Given the Uncertainty of Fracture Mechanics
A. de Boer & P. Waarts

11:20a - 5:20p	**FREE TIME ACTIVITIES**
	Gondola Ride and Lunch *(see Social Program)*

5:20p-7:00p	PARALLEL SESSION 5

SESSION 5A: Recent Advances in Fracture Mechanics of Concrete I - Z.P. Bažant *(Centennial D)*

Continuum-micromechanics Approach for Determination of Autogenous Shrinkage of Cement-based Materials
C. Pichler, R. Lackner & H. Mang

Formation of Eigenstress and Cracks Due to Autogenous Shrinkage
E. Schlangen, E. Koenders & K. von Breugel

On Mesh Bias of Local Damage Models for Concrete
P. Grassl & M. Jirasek

Homogenized Crack Model for Finite Element Analysis of Concrete Fracture
H.W. Song, C.S. Bang, J.W. Nam & K.J. Byun

Plastic-Damage Model for Concrete
S. Ananiev & J. Ožbolt

SESSION 5B: Durability Mechanics V - M. diPrisco, J. Planas *(Centennial E)*

An Elastic Plastic Damage Formulation for the Behavior of Concrete
L. Jason, G. Pijaudier-Cabot, A. Huerta, R. Crouch, & S. Ghavamian

Non-Local Damage Modeling of High Performance Concrete Exposed to High Temperature
L. Ferrara & R. Felicetti

Cracked Concrete Structures under Cyclic Load
F. Barpi & S. Valente

Simulation of Loading Test for Corroded Reinforced Concrete Box Culvert
T. Matsuo, T. Matsumura & T. Kanazu

The Prediction of Cracking Time for Reinforced Concrete Structure Due to Corrosion of Reinforcement
S.Y. Jang, Y.C. Kim, S.M. Lee & Y.T. Kho

SESSION 5C: NDE and Repair - V. Mechtcherine, T. Kamada *(Centennial F)*

Combining Experimental and Numerical Methods for the Safety Evaluation of Extisting Concrete Structures
V. Slowik

Nonlinear Simulation and Damage Assessment of an Historical Masonry Tower
A. Carpinteri, S. Invernizzi & G. Lacidogna

Residual Fatigue Life of RCC: Deterministic and Probabilistic Approach
T. Sain & K. Chandra

A Fiber Optic Sensor for Cracks in Concrete Structures
C. Leung, K.T. Wan & Y. Jiang

Ingress Monitoring in Concrete Structures
M. Ghandehari

WEDNESDAY, APRIL 14	
8:30a-9:30a	KEYNOTE SESSION - H. Mihashi *(Centennial D)*
8:30a-9:00a	**KEYNOTE 5: Damage-Tolerant Cement-Based Materials for Performance-Based Earthquake Engineering Design: Research Needs** *S. Billington*
9:00a-9:30a	**KEYNOTE 6: Fracture Mechanics of Debonding Failure in FRP Strengthened Concrete Beams** *C.K.Y. Leung*
9:30a-10:00a	COFFEE BREAK
10:00a-11:20a	PARALLEL SESSIONS 6

SESSION 6A: Recent Advances in Fracture Mechanics of Concrete II - Y. Kitsutaka, A. Carpinteri *(Centennial D)*

Failure Mechanism of Concrete under Biaxial Fatigue Load
B. Mu & S. Shah

Computational Aspects of Concrete Fracture Simulations in the Framework of the SDA
C. Feist & G. Hofstetter

Composite Damage Mechanics and Applications to Modeling of Degradation of Concrete
M. Eskandari-Ghadi, Y. Xi & S. Sture

Over-Nonlocal Microplane Model M4: Mode I Fracture Simulations
G. Di Luzio

SESSION 6B: Fracture Mechanics and High Performance Cementitious Composites I - M. Kunieda, S. Billington *(Centennial E)*

Tailoring of Pre-Existing Flaws in ECC Matrix for Saturated Strain Hardening
S. Wang & V.C. Li

Tensile Properties of ECC in Full-Scale Production
T. Kanda, M. Hiraishi & N. Sakata

Optimizing Fracture Toughness of Matrix for Designing Ductile Fiber Reinforced Cementitious Composites
H. Mihashi, J. Paulo B. Leite, S. Yamakoshi & A. Kawamata

Realistic Prediction of Post-Cracking Behavior for New Structural Synthetic Fiber Reinforced Concrete
B.H. Oh, J.C. Kim, D.K. Park & Y.C. Choi

SESSION 6C: Repair and Retrofitting I - J. Bolander, H. Schreyer *(Centennial F)*

CARDIFRC -- Properties and Application to Retrofitting
S. Benson, B. Karihaloo & F. Alaee

Textile Reinforced Concrete: Overview, Experimental and Theoretical Investigations
U. Haeussler-Combe, F. Jesse & M. Curbach

Utilization of Ductile Cementitious Composites for Repairing of Reinforced Concrete Flexural Member
J.H.J. Kim, D.W. Kim, Y. Lim & S.K. Shin

Formation and Propagation of Cracks in Cement-Based Repair Systems Induced by Drying Shrinkage
I. Burkart, V. Mechtcherine & H.S. Mueller

11:20a-11:45a	GROUP PHOTO *(Main Centennial Foyer)*
11:45a-5:20p	FREE TIME ACTIVITIES **Ski Competition** *(see Social Program)*

5:20p-7:00p	PARALLEL SESSION 7

SESSION 7A: Recent Advances in Fracture Mechanics of Concrete III - J. Mazars, J. Oliver *(Centennial D)*

A Dynamically Consistent Dispersive Gradient-Enhanced Continuum Model
H. Askes & A.V. Metrikine

Rate Dependent Interface Model Formulation for Quasi-Brittle Materials
G. Etse, R. Lorefice, A. Carosio & I. Carol

Rate Effect of Concrete with a Simplification of Crack Interaction
D. Zheng, Q. Li & T. Hua

Tensile Failure of Concrete at High Loading Rates: Instrumented Spalling Tests
J. Weerheijm & A. Doormaal

Large Displacement Modeling for Dynamic Failure of Concrete Structure
A. Delaplace & A. Ibrahimbegović

SESSION 7B: Fracture Mechanics and High Performance Cementitious Composites II - H. Mihashi, G. Fischer *(Centennial E)*

Size Effect on Flexural Strength of Porous Concrete
M. Kunieda, T. Otono, T. Yoshida, T. Kamada & K. Rokugo

Size Effect in ECC Structural Members in Flexure
M. Lepech & V.C. Li

Size Independence of UHPC Ductility
E. Chuang & F.J Ulm

On Size Effect in Tension of SFRC Thin Plates
M. di Prisco, R. Felicetti, M. Lamperti & G. Menotti

Size Effect in Structural High Strength Concrete
G. Appa Rao & B.K. Raghu Prasad

SESSION 7C: Repair and Retrofitting II - T. Matsumoto, V. Slowik *(Centennial F)*

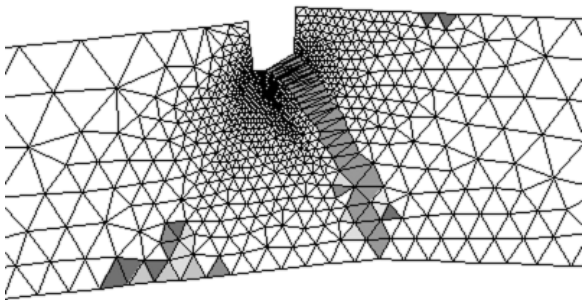
The Influence of the Mode II Fracture Energy on the Behaviour of Composite Plate Reinforced Concrete
P. Neto, J. Alfaiate, J.R. Almeida, E. B. Pires, & J. Vinagre

Fracture Analysis of the Debonding between FRP and Concrete using Digital Image Correlation
M. Ali-Ahmad, K. Subramaniam & M. Ghosn

An Experimental Study on FRP -Concrete Delamination
C. Mazzotti, B. Ferracuti & M. Savoia

Localized Fracture of Repair Material in Patch Repair Systems
M. Kunieda, T. Kamada, K. Rokugo & J. Bolander

Fracture Behaviors of Cementitious Materials and Renewed RC Box Culverts
S.Ishiguro, M.Ishii, T.Nonaka & H.Nakagawa



THURSDAY, APRIL 16

8:30a-9:00a	KEYNOTE SESSION - A. Carpinteri *(Centennial D)*
	KEYNOTE 7: Linking Scales in Modeling of Fracture in High Performance Fiber Reinforced Cementitious Composites *P. Kabele*
9:00a-9:30a	COFFEE BREAK *(Main Centennial Foyer)*
9:30a-11:00a	PARALLEL SESSIONS 8

Session 8A: Recent Advances in Fracture Mechanics of Concrete IV - K. Willam, E. Schlangen *(Centennial D)*

3D Meso-Structural Analysis of Concrete Specimens under Uniaxial Tension
A. Caballero, C.M. Lopez & I. Carol

Simulation of Concrete Fracture by using Mesolevel Truss and Particle Models
J.P.B. Leite & V. Slowik

Mesolevel Analysis of Fracture Tests for Concrete
G. Cusatis, M. Polli & L. Cedolin

Three-Dimensional Meso-Scopic Analyses of Mortar and Concrete Model by Rigid Body Spring Model
K. Nagai, Y. Sato & T. Ueda

Section 8B: Fracture Mechanics and High Performance Cementitious Composites III - B.H. Oh, P. Kabele *(Centennial E)*

Tensile Behavior of High Performance Hybrid Fibre Concrete
I. Markovic, J. Walraven & J.G.M. Van Mier

High-Velocity Impact Resistance of Hybrid-Fibre Engineered Cementitious Composites
M. Maalej, J. Zhang, S.T. Quek & S.C. Lee

Three-Fibre-Type Hybrid Fibre Concrete
P. Staehli & J.G.M. van Mier

An Optimum Design for Steel Fiber Reinforced Concretes under Cyclic Loading
F. Bayramov, T.Aydoner, A. Ilki, C. Tasdemir & M.A. Tasdemir

Section 8C: Recent Advances in Fracture Mechanics of Concrete V - T. Hasegawa, H. Askes *(Centennial F)*

Double-K Parameters and the Cohesive-Stress-Based KR Curve for the Negative Geometry
S. Xu & H.W. Reinhardt

Determination of Double-G Energy Fracture Criterion for Concrete Materials
Y. Zhao & S. Xu

Determination of Softening Curves by Backward Analyses of Experiments and Optimization using an Evolutionary Algorithm
B. Villmann, T. Villmann & V. Slowik

Parameter Identification of Computational Fracture Models
C. Iacono, L.J. Sluys & J.G.M. van Mier

11:00a-11:15a	COFFEE BREAK *(Main Centennial Foyer)*
11:15a-1:00p	PARALLEL SESSIONS 9

Session 9A: Recent Advances in Fracture Mechanics of Concrete VI - J.Alfaiate, K. Nemati *(Centennial D)*

Saw-Tooth Softening/Stiffening Model
J.G. Rots & S. Invernizzi

Numerical Study on Mechanism of Diagonal Tension Failure of Reinforced Concrete Beams
T. Hasegawa

Using Post-Peak Unload Cycles with the Two-Parameter Data Reduction Method
J.H. Hanson & R J. Morton

Resistance Surface Concept for Concrete Fracture
V. Vesely & Z. Kersner

Normal/Shear Cracking of Brickwork Masonry
E. Reyes, M.J. Casati & J. Galvez

Section 9B: Fracture Mechanics and High Performance Cementitious Composites IV - M. Maalej, G. Plizzari *(Centennial E)*

Creep Modelling of Ductile Fibre Reinforced Composites
B. Boshoff & G. Van Zijl

Influence of Concrete Material Ductility on the Behavior of Stud Shear Connection
S. Qian, Y.Y. Kim & V.C. Li

Fracture Mechanical Behaviour of Lightweight Aggregate Concrete
F. Dehn

Use Of R-Curves for Characterization of Toughening in Fiber Reinforced Concrete
B. Mobasher & A. Peled

Analytical Evaluation of Softening Behavior of Fine Grained Concrete
W. Brameshuber, T. Brockmann & B. Banholzer

Section 9C: Fracture Mechanics and Design IV - Z. Bittnar, G. Ruiz *(Centennial F)*

Fracture Analyses of Walls under Non-Proportional Loadings
M. Boonpichetvong & J.G. Rots

Numerical Modeling of Rockfall Impacts on Reinforced Concrete Slabs for the Design of New Rock Sheds
P. Berthet-Rambaud, J, Mazars & L. Daudeville

Horizontal and Slanting Reinforced Concrete Slabs for Structurally Dissipating Rock Shed: Experiment
M. Mommessin, A. Agbossou, F. Delhomme, J.P. Mougin & N. Henriet

Cohesive Zone Modeling of Fracture in Irregular Lattices
J. Bolander & S. Berton

Testing and Modeling the Behavior of Concrete under Cyclic Tensile Loading
C. Kessler-Kramer, V. Mechtcherine & H.S. Müller

1:00p-2:00p	**LUNCH**
2:00p-4:00p	**PARALLEL SESSIONS 10**

Session 10A: Recent Advances in Fracture Mechanics of Concrete VII - S. Shah, Y. Xi*(Centennial D)*

Comparative Study of Fracture Mechanical Test Methods for Concrete
L. Østergaard & J.F. Olesen

Influence of Aggregate Grading upon Concrete Tensile Strength: A Stereological Analysis
A. Carpinteri, P. Cornetti & S. Puzzi

A New Technique for Characterization of Early Age Cracking of Mortars
V. Lamour, A. Haouas, M. Moranville & R. Schell

Non-Destructive Evaluation of Interface Fracture between Matrix and Aggregate
T. Wilhelm, O. Kroggel & P. Gruebl

Experiments for Determining the Double-K Fracture Parameters of Concrete of the Three Gorges Dam
Q. Li, Z. Zhao, H. Zhou & S. Xu

Shear Failure of Plain Concrete in Strain Localized Area
Y. Kaneko, H. Mihashi & S. Ishihara

Predicting Elastic Moduli of Concrete using Molten Metal Injection Method
K. Nemati

Section 10B: Fracture Mechanics and High Performance Cementitious Composites V - B. Mobasher, V.C. Li *(Centennial E)*

Experimental and Numerical Analyses of FRC Slabs on Grade
B. Belletti, R. Cerioni, A. Meda & G.A. Plizzari

The Wedge Splitting Test: A Test Method for Assessment of Fracture Parameters of FRC
I. Lofgren

Effect of Perlite Addition on Fracture Properties of Discontinuous Fiber-Reinforced Cementitious Composites Manufactured by Extrusion Modeling
H. Takashima, N. Nishimatsu, K. Miyagai & T. Hashida

Uni-Axial and Bending Test for the Determination of Fracture Properties of Fiber Reinforced Concrete
A. Meda, G.A. Plizzari & L. Sorelli

Testing and Modelling of Steel Fibre Reinforced Concrete Beams Designed for Moment Failure
T. Kanstad & Å.L. Døssland

Numerical Modeling of Prestressed Fiber Reinforced High Performance Concrete Beams Subjected to Shear
P. Riva & F. Minelli

Constitutive Modeling of Reinforced Steel Fiber Reinforced Concrete Composite Material

Section 10C: Recent Advances in Fracture Mechanics of Concrete VIII - C.K.Y. Leung, H. Akita *(Centennial F)*

Representative Volume Size as a Macroscopic Length Scale Parameter
I. Gitman, H. Askes & L.J. Sluys

A Model For Concrete Perforation Based on the Concept of Drilling Strength
M. Brunetto, A. Carpinteri & B. Chiaia

Static Multi-Crack Modelling in Concrete by a Modified DR Method
R.C. Yu & G. Ruiz

Heat Influence on Micromechanical Properties of Cement Pastes
J. Nemecek, L. Kopecký & Z. Bittnar

The Effect of Heat Source on Upper and Lower Bounds of Effective Conductivity of Anisotropic Composites
M. Eskandari-Ghadi, Y. Xi & S. Sture

Multi-Scale Approach of Thermal Damage: Applications to Concrete at High Temperature
G. Mounajed, A. Menou, H. Boussa, C. La Borderie & H. Carré

4:00p-4:30p	**COFFEE BREAK** *(Main Centennial Foyer)*
4:30p-5:30p	**GENERAL MEETING OF IA-FRAMCOS** *(Cascade Ballroom)*
6:00-7:00p	**COCKTAILS** *(Main Centennial Foyer)* Awarding of Ski Competition Prizes
7:00p-9:30p	**CONFERENCE BANQUET** **Sustainability in the Cement and Concrete Industry** *J.C. Roumain*

FRIDAY, APRIL 16

8:00a-6:00p	**REGISTRATION** *(East Centennial Foyer)*
8:15a-8:30a	**OPENING SESSION** *(Centennial D)*
	Opening Remarks *K. Willam, R. Eligehausen*

WORKSHOP 1
Connections Between Steel and Concrete - Numerical Applications

8:30a-10:00a **SESSION 1** - L. Cedolin ***(Centennial E)***

Anchorages Subjected to Static and Dynamic Loading
G. Di Luzio, G. Cusatis & L. Cedolin

3D FE Study of the Influence of Edge Effects on the Failure of Anchor Bolts
D.S. Watson, N. Bićanić & C.J. Pearce

Predicting the Pull-out-behavior of Studs in Concrete: Advances in Commercial Finite Element Codes
A. Haufe, L.E. Schwer & E. Ramm

WORKSHOP 2
Interface Modeling

8:30a-10:00a **SESSION 1 - Experimental Observations** - Y. Xi ***(Centennial D)***

Digital Image Correlation Analysis of Interfacial Debonding Properties and Fracture Behavior in Concrete
M. Accardi, D. Corr & S. Shah

On the Experimental Study of the Interface Between a Fiber Composite Lamina and Concrete
R Gettu, J.S. Cruz, J. Barros, A.C. dos Santos & T. Bittencourt

Interface Characteristics Necessary for Confinement of Expansive Reaction Products
C.P. Ostertag

10:00a-10:30a **COFFEE BREAK** *(Main Centennial Foyer)*

WORKSHOP 1
Connections Between Steel and Concrete - Numerical Applications

10:30a-12:00p **SESSION 2** - N. Bićanić ***(Centennial E)***

Transient Thermal 3D FE Analysis of Headed Stud Anchors Exposed to Fire
J. Ožbolt, I. Kožar, R. Eligehausen, & G. Periškić

Numerical Simulation of Connectors Used for Concrete Composite Constructions
B. Winkler, P. Bianchi & M. Siemers

3D FE Analysis of Group of Bonded Anchors
J. Appl, R. Eligehausen & J. Ožbolt

WORKSHOP 2
Interface Modeling

10:30a-12:00p **SESSION 2 - Theoretical Aspects** - I. Carol *(Centennial D)*

Interfaces: Homogeneous or Heterogeneous Micro-Structure?
E. Schlangen

Interface Crack Propagation in Concrete Composites: Theoretical Analysis of Stress-Singularities
A. Carpinteri & M. Paggi

Interfacial Fracture of Layered Structures Subject to Static and Dynamic Loading
R. Massabo, M. Andrews & B. Cox

12:00p-1:30p **Lunch Buffet** *(Creekside Room)*

WORKSHOP 1
Connections Between Steel and Concrete - Numerical Applications

1:30p-3:30p **SESSION 3** - A. Ibrahimbegović ***(Centennial E)***

Are Bond Models Needed for Fracture Analyses in Practice?
J. Červenka & V. Červenka

Development of a New 2D Model of Bonding in Reinforced Concrete Structures and FE Implementation for Industrial Applications
N. Dominguez, F. Ragueneau, A. Ibrahimbegović, S. Michel-Ponnelle & S. Ghavamian

Steel-Concrete Decohesion Phenomena Studied by Means of Interface Elements
G. Ruiz, J.R. Carmona & D.A. Cendon

Development of a New Tangent Damage Model MODEV for Concrete in SYMPHONIE CSTB - Application to Industrial Structures in Concrete
H. Ung Quoc, G. Mounajed & H. Boussa

WORKSHOP 2
Interface Modeling

1:30p-3:30p **SESSION 3 - Computational Issues** - G. Meschke ***(Centennial D)***

A Brief Overview of Cohesive Models and Methods of Numerical Implementation
H. Schreyer

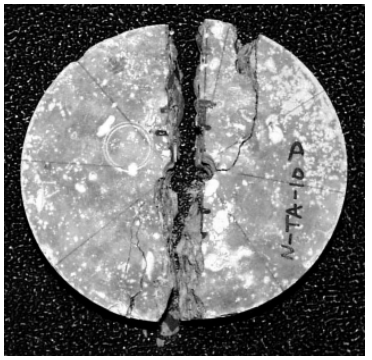
Meso- and Macromechanic Approaches for Rate-Dependent Analysis of Concrete Behavior
G. Etse, R. Lorifice, C. Lopez & I. Carol

Modelling Concrete-Steel Bond
L. Lowes & G. Turkiyyah

Fracture at Bi-Material Interface between Concrete-Concrete Cold Joints
K. Chandra

Performing of Solid Finite Elements with Embedded Interfaces
B. Spencer & B. Shing

3:30p-4:00p	**REFRESHMENTS** *(Main Centennial Foyer)*
4:00p-5:30p	**PANEL SESSION** - B. Balaguru *(Centennial D)* ***A. Carpinteri, R. Eligehausen, V.C. Li, J. Ožbolt, S. Shah, K. Willam***
5:30p-6:00p	**CLOSING SESSION** *(Centennial D)*
	Concluding Remarks *Y. Xi*



Social Program

Sunday, April 11 - Icebreaker Reception

Conference Participants are invited to join the Icebreaker Reception in the Cascade Ballroom starting at 6:00pm. This opening event is sponsored by the University of Colorado at Boulder and will feature Professor Kurt Gerstle presenting the historical background of the 10th Mountain Division in the development of Vail Mountain.

Tuesday, April 13 - Gondola Ride and Lunch

Registered Conference Participants are invited to join us for a Gondola Ride to Eagle's Nest starting at 12:00 noon at the Lionshead base station. This event will feature a survey at the top of the mountain and a special Lunch Buffet at the Blue Moon Restaurant.

Wednesday, April 14 - Skiing Competition

Following a tradition of FraMCoS-1 in Breckenridge, Colorado (1992) and the Euro-C series of meetings in Austria (1990, 1994, 1998, 2003), a skiing competition has been organized for this venue. The `friendly' competition will take place on the NASTAR course of Vail Mountain, in the Afternoon of Wednesday April 14. A modest registration fee of $15.00 will be charged to participate and be eligible for trophies/souvenirs for eveybody. Sign-up sheets and additional details will be available at the Conference Registration Desk.

While formal registration for this event is not required, if you plan to participate in the skiing competition, it is suggested to notify the local conference organizers for planning purposes (and for discounts in rental/lift tickets if minimum number of participants are ensured). In this case, please email Ignacio.Carol@Colorado.EDU and indicate tentative days you need a lift ticket (Tue/Wed, Weekend days before or after the conference), and if you need to rent equipment.

Vail Cascade Resort and Spa

Vail is the largest ski resort in North America famous for vast alpine skiing and snowboarding terrain, scenic splendor and a village buzzing with shopping, dining and entertainment. Over 30 lifts serve skiers of every ability and only one lift serves a ski-in ski-out resort- Chair 20 at the Vail Cascade Resort & Spa. Non-skiing activities include snowmobiling, snowshoeing, ice skating, sleigh rides and all of the activities at Adventure Ridge at the top of Vail's Gondola.

Throughout the resort you will find many creature comforts. We are always ready to serve you with 24-hour front desk services, in-room dining, ski concierge, valet and covered parking and complimentary hotel shuttle (7:00am- 12:00am). Get fit or get pampered at Aria Spa & Club, shop the general store or see what films are playing in our theater. Dine in the Rocky Mountain elegance of Chap's Grill & Chophouse. Enjoy live entertainment in the Fireside Bar or ski out to the famous back bowls. The hotel pool and hot tubs are open from 7:00am- 11:00pm and the club pool and tubs from 5:30am- 9:00pm Monday through Friday and 6:00am- 9:00pm on weekends.

Vail Cascade Resort & Spa is served by Chair 20, connecting you to Vail's 5,164 skiable acres, including Blue Sky Basin with 520 acres of gladed and backcountry slopes. You can inquire about equipment rentals and even pre-purchase lift tickets. The charming Tyrolean-style village, just a short ride on the resort's free shuttle, offers the best in cuisine, art, music, shopping and activities. For more information contact our friendly Guest Services staff.

RESTAURANTS: Some guests have referred to **Chap's Grill & Chophouse** as the highlight of their visit. This is where Rocky Mountain atmosphere and luscious steaks and seafood reach their peak. The décor, menu, wine list and desserts rival any of the top restaurants in the west. Chap's serves breakfast, lunch and dinner. Musical performances in the **Fireside Bar** invite guests to mingle near the fireplace. The Vail Cascade's restaurants have been recipients of AAA's Four-Diamond Restaurant rating from 1991- 2000 and the Wine Spectator's Award of Excellence 1994-2000.

EVENTS

April 14 - Wednesday Night Free Concert
Boogie Machine brings on the groove at 6pm in Vail Village for the Free Concert Series finale! Get ready to groove to this high-energy disco band.

April 15 - Karl Denson's Tiny Universe at 8150
End of the season blow out party with Karl Denson's Tiny Universe. Tickets are only $25. 8150 - Vail Village.

April 16 - Lionshead Lawn Concert (5:00p-7:00p)
Experience joyous Reggae while soaking up the sun at at Lionshead.

Acknowledgements

The Organizers of FraMCos-5 wish to acknowledge the following for their Financial Support:

~ **MTS Material Testing Systems**

~ **Holcim Inc**.

~ **John Wiley & Sons**

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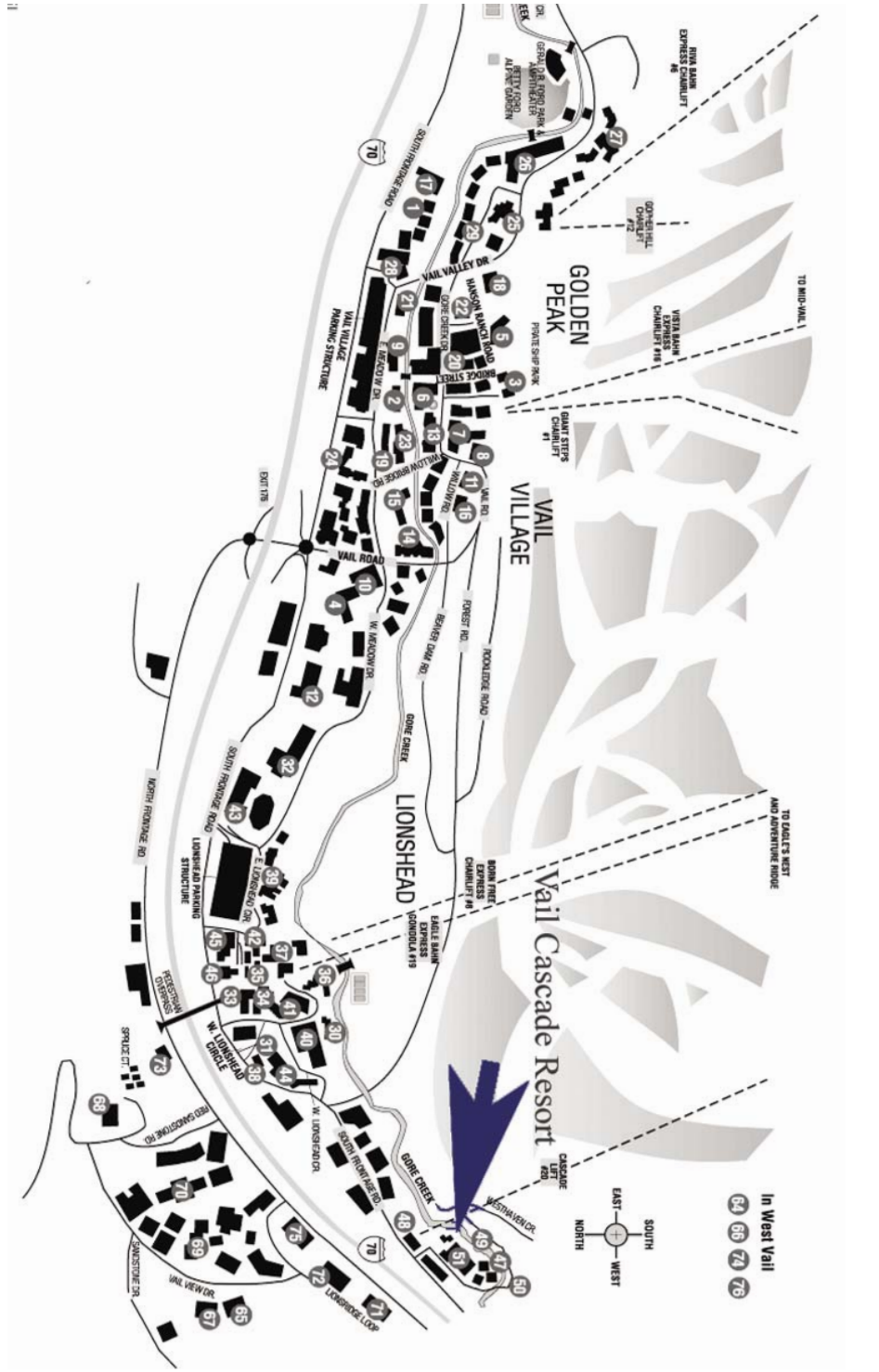
~ **Door Prizes of Educational Software ATENA, ANSYS and DIANA**

Vail Village Map



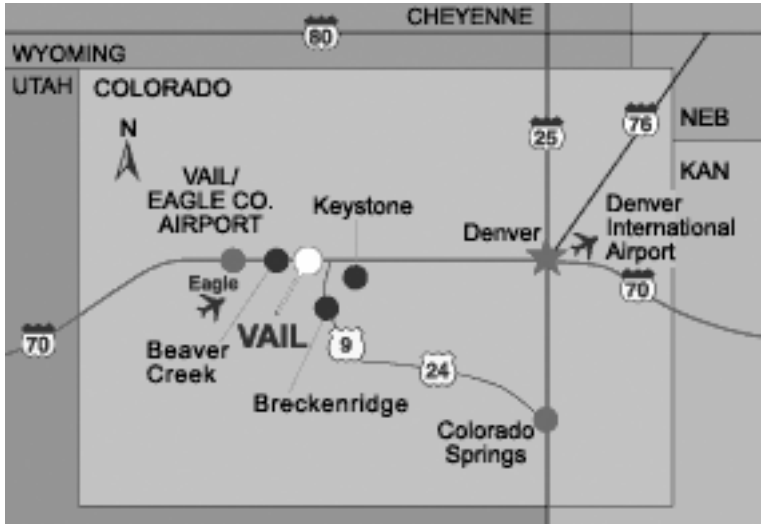
Driving Directions

Major airlines have frequent service to both Denver International Airport and Eagle County Regional Airport.

Driving from DIA- Take I-70 west approximately 120 miles. Exit 176 (main Vail exit). At end of ramp enter roundabout and go to the left under the Interstate. Enter the second roundabout and turn right on South Frontage Road (towards Lionshead). The resort is about 1.5 miles on the left.

Driving from Eagle, take I-70 east for approximately 40 minutes. Exit at 173 in West Vail. Enter the roundabout and follow signs to South Frontage Road/ Vail Village/ Lionshead. We are located 1 mile on the right.

CME shuttle service and car rentals are available to and from both airports: 800-525-6363, www.cmex.com.



Cover photo courtesy of Figg Engineering Group