

***International Association of Fracture Mechanics of
Concrete and Concrete Structures (IA-FraMCoS)***

Replies* to Bazant's Proposal to found IA-FratMCoS

REPLIES FOR BRECKENRIDGE CONFERENCE AS OF 10/9/90

<u>Name</u>	<u>Comments</u>
Barr, Benn	(Yes) I am very pleased that you have taken this initiative. It is timely to bring more order to the conferences being arranged in this field of research. I believe that the research workers in this area must address the areas of application of this work in the very near future.
Dr. I. Carol	(Yes) I agree with the idea and, as seen in the workshop in Locarno, it seems not to be too difficult to get someone who would be interested in organizing the "second."
Luigi Cedolin	(Yes) I think this is a good idea.
K. P. Chong	(Yes) I think "first" is OK because it does not place any time constraint on the "2nd" one, which would follow when there are significant interests and findings from the research community.
Dr. Chern	(Yes) Willing to serve on Internatiional Committee in Boulder
Dave Darwin	Telephone -Strong - Abstain
Rolf Eligehausen	Yes
Prof. Hilsdorf	I do not think we can call the Conference "first international conference on fracture mechanics of concretures? simply because it is not the first. I do not oppose the term "first" and I think that it would be useful to use this term for the reason you indicated in your letter. The problem would be solved by adding some other criterion such as "First International Breckenridge Conference," even if it is not held each time in Breckenridge.
A. Hillerborg	Yes
B. L. Karihaloo	(Yes) I like the idea, if it will indeed bring some semblance of sanity to the profusion of conferences on Fracture Mechanics of concrete structures. There will of course be other conferences where this topic will be touched upon. I have particularly in mind the IUTAM for 1993 (August or September) in Queensland, Australia.

* Bazant's letter proposing the idea of FratMCoS, to which these people replied, cannot be found

- A. Kobayashi (Abstain) A similar International Conference on Fracture and Damage of Concrete and Rock was held in Vienna, July 4-6, 1988, and another, Recent Developments on the Fracture of Concrete and Rock Cardiff, September 20-22, 1989. While I have no objection in calling the 1992 Conference the "First," I hope that the following conferences will be coordinated with others in Europe.
- Yiu-Wing Mai (Yes) I think this is an excellent idea. We may follow the structures of International Congress on Fracture, Fracture Mechanics Ceramics Conference, ICCM, etc., which is held once every 4 years and rotated between different countries. Mini-conference can be held in bgetwee, i.e., every 2 years to allow rapid dissemination of knowledgtge in the interim period. (ICF has this provision). In terms of the size of participants, I believe this may be based on the "Fracture Mechanics of Ceramics" format and frequency. Move to be discussed at Breckenridge.
- Zenon Mroz (Yes) It is good start with designation "First" which implies that there will be "Second" and "Third". But the scope of subsequent conferences should be updated to fit actual research interest.
- C. Dean Norman (Yes) I think this committee should define some very clear goals for the conferences and structure the conference and future sessions toward achieving these goals. These goals should include: what really important results are derived from specific research, research needs, standards for research type testing, technology transfer, impacting design criteria, etc.
- Byung Hwan Oh (Yes) The 1992 Breckenridge Conference may be designated as "First" International Conference because no other international conferences on fracture of concrete had the name "First."
- Hajima Okamura Abstain
- Josko Ozbolt Yes - Comments (No!)
- Phillip A. Pfeiffer Yes
- Jaime Planas (Yes)
- Pere C. Prat (Yes) The interval between conferences should no9t be too long. A period of 3 years seems feasible and reasonable.

Stein Sture

(Yes) I think this is appropriate, since there is no other "traditional" numbering of such meetings, and it will help "boost morale"!!

S. E. Swartz

(Yes) It is important to recognize that the proposed conference series has a different focus and will have a different participation (somewhat) than the current conferences devoted to fracture of quasi-brittle materials.

F. H. Wittman

(Yes) I full agree with your arguments. There are too many conferences on F.M., Earthquake engineering, wind engineering, etc. They have all solved the problems in the way you suggest. They have all set up an international "steering committee" which essentially selects the next organizer of a conference.

N O R T H W E S T E R N

U N I V E R S I T Y



ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

January 21, 1991

TO: Members of the International Scientific Advisory Committee of the First International Conference on Fracture Mechanics of Concrete Structures, Breckenridge, June 1-5, 1992

Dear Colleagues:

Enclosed is a copy of the announcement and call for papers for the above-mentioned conference, for which you kindly accepted to serve on the International Scientific Advisory Committee.

Please note that there are several changes compared to the preliminary announcement, the major one being the change of starting date, from June 2 to June 1. Instead of starting Tuesday morning and finishing Friday evening, we decided to start in an evening session on Monday and finish on Friday noon. The starting time will be either 5 or 7 p.m. June 1.

The result of the vote to decide whether our conference should be designated the "first" in a new conference series is as follows: 57 members voted yes; 1 voted no; and 4 members did not vote. Thus it is clear that there is an overwhelming consensus in this committee of worldwide representation to establish such a series of regular conferences, and we will do that.

In the meantime, I have discussed the question with a number of active researchers in the field, both members and non-members of our advisory committee. While in Locarno at the Dam Fracture Workshop, Folker Wittmann, who expressed to me his enthusiastic support for the idea, organized a lunch of some 12 senior specialists to discuss the idea, and generally a very positive support was expressed. While at the fracture workshop organized by Alberto Carpinteri in Torino in October, I talked again to a number of people, and so too at the World Congress of Computational Mechanics in Stuttgart. Again, what I heard was a very positive support.

In the opinion of all the people that I consulted as well as mine, the proposed new organization should be rather modest in scope, having the sole purpose of organizing this conference series and, if desired, helping to advise on the scheduling of other conferences so as to avoid conflict. The organization we have in mind would meet only during the conferences to consider proposals for the next conference. We can follow the example of other organizations recently established in similar fields; for example, IASSAR (International Association on Structural Safety and Reliability) which organizes the well known series of ICOSSAR conferences and brought order into the international conference activity in that field. Many other successful examples abound, for example in wind engineering, earthquake engineering, large dams, etc., however, the example of SMiRT which organizes the SMiRT conferences seems to me too "heavy," since we do not want to become as large as that organization.

Our purpose would be to establish, in an unbiased manner, an order in the scheduling of conferences on our subject. We certainly do not want to interfere with any of the activities that other well-established societies are doing well, for example, ACI, CEB, RILEM, ASTM, SES, etc. However, compared to the alternative that one of these organizations, for example, ACI, would establish a conference series of this kind under its umbrella, we can certainly do it more evenhandedly and impartially, in a truly international format. These are of course the same reasons that have led to the establishment of associations such as IASSAR.

See you in Nordwijk!

Sincerely yours,



Zdeněk P. Bažant

Walter P. Murphy Professor of Civil Engineering

ZPB:mm

enclosure

N O R T H W E S T E R N

U N I V E R S I T Y



ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

May 24, 1991

TO: Members of the International Scientific Advisory Committee of
FRAMCOS 1, Breckenridge, June 1992

Dear Friends and Colleagues:

This is just to remind you that, through the courtesy of Prof. Jan van Mier, our Committee will have a meeting in Noordwijk, the Netherlands, on Wednesday, June 19, in the evening. (My previous letter stated correctly "first day," but the date was misprinted--sorry about that!) The room and hour will be posted on the bulletin board in the registration area of the conference in Noordwijk.

We will discuss the preparations for the Breckenridge conference and the organization of the subsequent series of conferences. The agenda which has already been mailed to you remains valid.

See you in Noordwijk!

With best regards.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:mm



Department of the Treasury
Internal Revenue Service

KANSAS CITY, MO 64999

In reply refer to: 0916520740
June 01, 1992 LTR 147C
36-3805063 0000 00 000

00068

INTERNATIONAL ASSN FOR FRACTURE
% ZDENEK P BAZANT
NORTHWESTERN UNIV CIVIL ENG DEPT
EVANSTON IL 60208

il
Robin - please
in form to
Bank. please deposit
Return to me
2 P.B.
How come the bank?
does not know

Taxpayer Identification Number: 36-3805063

Dear Sirs:

We received your application for an employer identification number, but our records indicate you have already been assigned the number shown above.

Your employer identification number is 36-3805063. Please keep this number in your permanent records. You should enter your name and your identification number, exactly as shown above, on all Federal tax forms that require its use, and on any related correspondence or documents.

If you have any questions about this letter, please write us at the address shown on this letter. If you prefer, you may call the IRS telephone number listed in your local directory. An employee there may be able to help you, but the office at the address shown on this letter is most familiar with your case.

When you write, please include your telephone number, the hours you can be reached, and a copy of this letter. You may also want to keep a copy of this letter for your records.

Telephone Number () _____ Hours _____

*Planning for FRAMCS
in Nordwijk*

MEETING OF THE INTERNATIONAL SCIENTIFIC ADVISORY COMMITTEE
OF BRECKENRIDGE CONFERENCE

to be held in Nordwijk, Netherlands, on Monday, June 17, 1991 (in the afternoon or evening, depending on the program). Information on this conference is enclosed. Prof. Jan van Mier, the conference organizer who expressed to me strong support for the present idea, graciously offered to host the meeting. The agenda will be as follows:

1. Welcome and introduction of members, appointment of secretary pro tem.
2. Report on considerations and reasons that have led to the idea of establishing a conference series, along with an international organization that would be responsible for the scheduling of the conferences (Bazant and Wittmann).
3. Discussion and proposal of a name for the organization.
4. Vote on the formation of the organization and its name.
5. Initial membership in the organization.
6. Nomination and vote for the initial officers of the new organization and appointment of a steering committee that would prepare the by-laws to be voted on at the Breckenridge conference.
7. Report on the status of preparations for the first conference to be held in Breckenridge.
8. Reviewing of abstracts of submitted papers and preparation of the proceedings of the first conference.
9. Expression of appreciation to the meeting host and adjournment.

International Association of Fracture Mechanics of Concrete Structures
(IA-FraMCoS)

The First Meeting of the FraMCoS1 Organizing Committee
and the Founding Meeting of IA-FraMCoS

Minutes

June 19, 1991

Hotel Oranje, Noordwijk, The Netherlands

Meeting host: Prof. Jan G.M. van Mier

Attendance: About 35 people were present. A partial list of participants follows the minutes.

I. The meeting was called to order at 8:00 pm by Z.P. Bažant. R. Gettu was appointed as secretary pro-tem, to take the minutes.

II. The first part of the meeting was devoted to FraMCoS1. Bažant reported on the preparations for the conference. He stated that the progress was satisfactory. Negotiations with prospective publishers of the preprints are in progress. He urged those planning to participate in the conference to register before March 1, 1992, so that a reasonable estimate of the attendance could be made. He also informed the committee that the Beaver Run Resort at Breckenridge is providing accommodations at very reasonable prices to the attendees, and that post-conference recreation programs would be organized (including skiing, which is usually possible in the Arapahoe basin area until June 15).

III. The second part of the meeting started by Bažant's outline of the problems caused by a recent overabundance of conferences on concrete fracture. He also summarized discussions of these problems (and of the idea to form an association) that took place among the participants at the Dam Fracture Workshop in Locarno, in September 1990, and at the Fracture

Workshop in Torino, in October 1990. He stated that the question whether to form an association was submitted earlier this year to a mail vote by 61 members of the International Scientific Committee of FraMCoS1; 57 votes were positive, one was negative and 3 members did not mail any vote. Accordingly, Bažant proposed that an association be formed which would organize future FraMCoS conferences at regular intervals. He proposed the name International Association of Fracture Mechanics of Concrete Structures (IA-FraMCoS). The proposal was accepted by the group present by consensus. It was also agreed that IA-FraMCoS should be organized as a formal association. (Bažant argued that only an association with precise by-laws can ensure a democratic process of conference selections and transfer of leadership from one president and board of directors to another without any bias; he and Wittmann described various successful examples of similar associations, e.g. IA-SSAR and IA-SMiRT.) Wittmann proposed that a secretarial office be established, and legally incorporated in Evanston, Illinois, USA, and that Bažant serve as the first president. This proposal was also accepted by consensus. (Initially, the secretarial assistant of the Association will be Marty Moser at Northwestern University.) Bažant stated that he would pay for the costs of incorporation and provide some initial funds to the Association from his endowed Murphy chair at Northwestern University. A steering committee was proposed and its members, listed below, were accepted by consensus.

- | | |
|------------------------------|----------------------------------|
| 1. B. I. G. Barr (secretary) | 7. H. Mihashi |
| 2. Z. P. Bažant (president) | 8. H. Reinhardt |
| 3. L. Cedolin | 9. V. Saouma |
| 4. M. Elices | 10. J. G. M. van Mier |
| 5. Y.-W. Mai | 11. F. H. Wittmann (coordinator) |
| 6. J. Mazars | 12. Y. Z. Zaitsev |

This committee, under the leadership of Wittmann, would draft the by-laws of IA-FraMCoS and guidelines for the organization of future FraMCoS conferences. The tasks of the committee would also include a decision on the frequency of FraMCoS conferences (Wittmann suggested one every three years), recommendations on the source of financial revenues and the rules of membership, and the procedure for proposing future conference venues and for accepting such proposals. It was agreed that proposals for organizing the

second FraMCoS conference should be sent to the secretarial office in Evanston before April 30, 1992. The decision on the site and date of FraMCoS2 will be made at the meeting of IA-FraMCoS members in Breckenridge, probably on June 4, 1992.

IV. Appreciation for providing the room for the meeting was expressed to Prof. J.G.M. van Mier

V. The meeting adjourned at 9:00 pm.

Partial List of Participants:

(The attendance sheet was presented for signing only after adjournment, after many had left!)

- B. I. G. Barr (Univ. of Wales, UK)
- Z. P. Bažant (Northwestern Univ., USA)
- I. Carol (Tech. Univ. of Catalonia, Spain)
- V. Cervenka (Czech Tech. Univ., Prague)
- R. de Borst (Delft Univ. of Tech., The Netherlands)
- A. di Tommaso (Univ. of Bologna, Italy)
- L. Elfgren (Lulea Univ. of Tech., Sweden)
- M. Elices (Universidad Politecnica, Madrid, Spain)
- R. Gettu (Tech. Univ. of Catalonia, Spain)
- N. Hawkins (Univ. of Illinois at Urbana-Champaign, USA)
- H. Horii (Univ. of Tokyo, Japan)
- A. R. Ingraffea (Cornell Univ., USA)
- H. N. Linsbauer (Tech. Univ. Vienna, Austria)
- Y.-W. Mai (Sydney Univ., Australia)
- O. Manfroni (Univ. of Bologna, Italy)
- J. Mazars (E.N.S. de Cachan, France)
- H. Mihashi (Tohoku Univ., Japan)
- J. Ožbolt (Stuttgart Univ., Germany)
- J. Planas (Universidad Politecnica, Madrid, Spain)
- P. C. Prat (Tech. Univ. of Catalonia, Spain)
- J. G. Rots (TNO Building and Constr. Res., The Netherlands)

S. P. Shah (Northwestern Univ., USA)
S. E. Swartz (Kansas State Univ., USA)
J. G. M. van Mier (Delft Univ. of Tech., The Netherlands)
J. Weerheijm (Prins Maurits Lab. TNO, The Netherlands)
F. H. Wittmann (Swiss Federal Inst. of Tech., Switzerland)
Y. V. Zaitsev (Moscow Polytechnic Inst., USSR)

Respectfully submitted,

Ravindra Gettu

Ravindra Gettu, Secretary pro-tem
Technical University of Catalonia
Barcelona, Spain

and

Ben Barr, Secretary
University of Wales
Cardiff, U.K.

June 26, 1991



From FraMCoS Founding

Following the organizing meeting of the **International Association for Fracture Mechanics of Concrete Structures**, hosted by Prof. Jan van Mier at the Hotel Oranje in Noordwijk, The Netherlands, on June 27, 1991, some founding members gathered in front of the hotel. *First row*, from left: Ravindra Gettu, Barcelona, Spain; Jaime Planas, Madrid, Spain; Manuel Elices (member of the steering committee), Madrid, Spain; Rene de Borst, Delft, The Netherlands; Z.P. Bazant (president), Evanston, IL; Folker H. Wittmann (coordinator of the steering committee), Zurich, Switzerland; Yuri V. Zaitsev, Moscow, U.S.S.R.; Stuart E. Swartz, Manhattan, KS; Ben I.G. Barr (secretary), Cardiff, Wales. *Second row*, from left: Herbert N. Linsbauer, Vienna, Austria; Neil M. Hawkins, Seattle, WA; Hideyuki Horii, Tokyo, Japan; Yiu-Wing Mai, Sydney, Australia; Jan van Mier, Delft, The Netherlands; Pere C. Prat, Barcelona, Spain; Ignacio Carol, Barcelona, Spain; Jan G. Rots, Delft, The Netherlands; Hirozo Mihashi (member of the steering committee), Sendai, Japan; Lennart Elfgren, Lulea, Sweden. *Third row*, from left: Unidentified; Josko Ozbolt, Stuttgart, Germany; and Unidentified.

N O R T H W E S T E R N
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ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

June 20, 1991

Mr. Wei Yi Gan
Northwest Investigation & Design Institute
Ministry of Energy Resources
South St. Xian, 710001
People's Republic of China

Dear Mr. Gan:

Pursuant to your letter of May 29, 1991, I confirm herewith that the period of your stay at Northwestern University has been fixed as Sept. 1, 1991 - March 1, 1992.

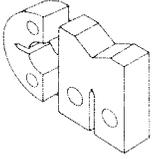
I am looking forward to welcoming you here.

With best regards.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:mm



DEPARTAMENTO DE
CIENCIA DE MATERIALES

UNIVERSIDAD POLITÉCNICA DE MADRID. E.T.S.I. CAMINOS
CIUDAD UNIVERSITARIA. - 28040 MADRID
TELEF. (91) 549 42 00 - 243 39 74 - FAX: 549 22 89

DIRECTOR

Madrid, 27th. June, 1991

Prof. Dr. Zdenek P. Bazant
NORTHWESTERN UNIVERSITY
The Technological Institute
Dept. of Civil Engineering
EVANSTON, IL 60208-3109

U.S.A.

*Example of
Bylaws
sent to Bazant*

Dear Zdenek,

As I mentioned to you during our meeting at Noordwijk, hereby are included the Statutes of the ICF (International Congress on Fracture). I hope they will be useful for our purposes.

Yours sincerely,

Manuel Elices

c.c.: Prof. Dr. Folker H. Wittman
Prof. Dr. Ben I.G. Barr

NUEVO TEL.: (34-1) 543 39 74
336 66 79

NUEVO FAX: (34-1) 543 78 45

Example of Bylaws 7/15/91

J. Z. Barant
from Ted
(Pelytko)

ARTICLES OF INCORPORATION

OF

U.S. ASSOCIATION FOR COMPUTATIONAL MECHANICS

We, the undersigned natural persons of the age of eighteen (18) years or more, acting as incorporators of a corporation under the Texas Non-Profit Corporation Act, do hereby adopt the following Articles of Incorporation for such corporation:

ARTICLE ONE

The name of the corporation is U.S. ASSOCIATION FOR COMPUTATIONAL MECHANICS.

ARTICLE TWO

The corporation is a non-profit corporation.

ARTICLE THREE

The period of its duration is perpetual.

ARTICLE FOUR

The purposes for which this corporation is organized are
(1) To promote, foster, organize, and coordinate various activities concerning computational mechanics in the United States and to represent U. S. interests in computational mechanics as an affiliate of the International Association for Computational Mechanics (IACM);
(2) To serve as a formal vehicle for overseeing and coordinating conferences, colloquia, symposia, and other technical meetings, and to promote research, commercial and academic activities in the general area of computational mechanics that take place within the United States on behalf of IACM; (3) To provide the United States representation in the organizational planning and hosting of international IACM congresses and to periodically coordinate and organize U. S. conferences on computational mechanics; (4) To purchase, lease or otherwise acquire, improve, construct, sell, use, maintain and operate real and personal property of every kind or description as may be necessary or desirable to promote the primary purposes of the corporation; (5) To make and perform contracts of every kind for any lawful purpose and to do all other acts necessary or expedient for the administration of the affairs and attainment of the purposes

of the corporation; (6) To have and exercise all the rights and powers conferred on non-profit corporations under the Texas Non-Profit Corporation Act, as such law is now in effect or may at any time hereafter be amended; (7) Notwithstanding any of the above statements of purposes and powers, the corporation shall not, except to an insubstantial degree, engage in any activities or exercise any powers that are not in furtherance of the primary purposes of the corporation.

This corporation is organized pursuant to the Texas Non-Profit Corporation Act and does not contemplate pecuniary gain or profit to the members thereof and is organized for non-profit purposes.

ARTICLE FIVE

The street address of the initial registered office of the corporation is The University of Texas at Austin, College of Engineering, Texas Institute for Computational Mechanics, TICOM Office, WRW 305, Austin, Texas 78712-1085, and the name of the initial registered agent at such address is J. Tinsley Oden.

ARTICLE SIX

The number of directors constituting the original board of directors of the corporation is three, and the names and addresses of the persons who are to serve as the initial board of directors are:

<u>Name</u>	<u>Address</u>
J. Tinsley Oden	The University of Texas, College of Engineering, Texas Institute for Computational Mechanics, TICOM Office, WRW 305, Austin, Texas 78712-1085.
R. H. Gallagher	15 Regent Street, Worcester, Mass. 01609
T. Belytschko	Department of Civil Engineering, Northwestern University, Evanston, Ill. 60201

ARTICLE SEVEN

The name and street address of each incorporator is:

<u>Name</u>	<u>Address</u>
J. Tinsley Oden	The University of Texas, College of Engineering, Texas Institute for Computational Mechanics, TICOM Office, WRW 305, Austin, Texas 78712-1085
R. H. Gallagher	15 Regent Street, Worcester, Mass. 01609
T. Belytschko	Department of Civil Engineering, Northwestern University, Evanston, Ill. 60201

IN WITNESS WHEREOF, we have hereunto set our hand this
the 25TH day of FEBRUARY, 1988.

J. Tinsley Oden
J. TINSLEY ODEN

R. H. Gallagher
R. H. GALLAGHER

T. Belytschko
T. BELYTSCHKO

THE STATE OF

COUNTY OF

I, JUDY L. KEY, a notary public do hereby
certify that on this 25TH day of FEBRUARY, 1988,
personally appeared before me, J. TINSLEY ODEN, who being by me
duly sworn, declared that he is the person who signed the foregoing
document as incorporator, and that the statements therein contained
are true.

IN WITNESS WHEREOF, I have hereunto set my hand and seal of
office.

My commission expires:

5-16-89

Judy L. Key
NOTARY PUBLIC in and for the State
of TEXAS

Printed Name: JUDY L. KEY

THE STATE OF MASSACHUSETTS

COUNTY OF Worcester

I, Helen B. Walsh, a notary public do hereby
certify that on this seventh day of March, 1988,
personally appeared before me, R. H. GALLAGHER, who being by
me duly sworn, declared that he is the person who signed the fore-
going document as incorporator, and that the statements therein
contained are true.

IN WITNESS WHEREOF, I have hereunto set my hand and seal of
office.

My commission expires:
October 2, 1992

Helen B. Walsh
NOTARY PUBLIC in and for the State
of Massachusetts

Printed Name: Helen B. Walsh

N O R T H W E S T E R N
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ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

July 24, 1991

Mr. Clement J. Carroll, Jr.
Gordon & Glickson
444 N. Michigan Ave. #3600
Chicago, IL 60611

Dear Mr. Carroll:

Pursuant to our telephone conversation, I would like to ask you to set up for us our international association as a non-profit corporation in Illinois. Enclosed is my initial suggestion for the articles of incorporation, which is patterned after the example of a similar association recently formed in Texas. Please revise it as you see necessary and call me with any questions (office: 708-491-4025; home: 708-256-4370). After you send your proposal to me, I have to get approval of my partners in Switzerland and Japan, and then we can actually carry out the incorporation. I understand that your estimate of the legal bill is between \$700 and \$1,000, which is an amount that we can pay. I hope that the availability of the enclosed example might reduce the cost.

With best regards.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:mm

enclosures

GORDON & GLICKSON P.C.

A Professional Corporation of Attorneys at Law

444 North Michigan Avenue
36th Floor, Chicago, Illinois 60611
312/321-1700
Telecopier: 312/321-9324

600 South Second Street
Suite 100, Springfield, Illinois 62704
217/789-1040
Telecopier: 217/789-1077

Writer's Direct Dial Number

(312) 321-7658

July 29, 1991

Robert C. Bailey
Alan R. Borlack
Gregory J. Bueche
Clement J. Carroll, Jr.
Richard L. Fogel
Françoise Gilbert
Scott L. Glickson
George N. Gordon
Mark L. Gordon
Eric G. Grossman
Lance T. Jones

Thomas R. Lamont
Terrence J. McKenna
Michael E. C. Moss
Sarah K. Nadelhoffer
Karen J. O'Connor
Jean Marie R. Pechette
Daniel L. Siegfried
Stuart Smith
Sanford M. Stein

Dr. Zdenek P. Bazant
Northwestern University
Department of Civil Engineering
Evanston, Illinois 60208

Re: International Association For Fracture Mechanics of
Concrete (IA FramCoS)

Dear Dr. Bazant:

It was a pleasure meeting with you to discuss our representation of you in connection with the incorporation of International Association For Fracture Mechanics of Concrete as an Illinois not-for-profit corporation. This letter is to set forth the arrangements concerning fees for our services to be rendered on your behalf.

Our fees will be charged on an hourly rate basis for the services rendered, and we have opened or will be opening separate files for each of the projects that we are requested to handle from time to time. Our hourly rates, which may change during the course of our relationship, currently range from \$65.00 for paralegals' time, \$85.00 through \$140.00 for associates' time and \$170.00 through \$250.00 for partners' time. We will, in our discretion, staff the work on these projects as efficiently as possible, considering the nature of the particular project and the time period in which it must be completed, so that the professionals assigned to the project are the ones who can perform the work competently at the lowest hourly rates. Rates for individuals will vary within the appropriate range given the nature of the work and their experience.

Our invoices will be sent to you monthly to allow you to track the fees as our work progresses. Each invoice will include a detailed description of the services that have been rendered and of any disbursements made on your behalf for items such as duplications, long distance telephone charges, filing fees, computer-assisted research, messenger charges and the like. Invoices are due and payable upon presentation.

Dr. Zdenek P. Bazant
Northwestern University
July 29, 1991
Page 2

Though we certainly hope we never have to face the situation, in the event any amount due us at any time is not promptly paid, we reserve the right to discontinue our services upon notice to you.

Unless otherwise agreed upon at the time, this letter will also serve as our fee agreement for any matters which we may be privileged to handle for you in the future.

We look forward to working with you and establishing a long-term relationship. I would appreciate your signing the accompanying copy of this letter and returning it to us to acknowledge your acceptance of this fee arrangement.

Very truly yours,

GORDON & GLICKSON P.C.


Clement J. Carroll, Jr.

CJC/sg

Enclosure

ACCEPTED AND AGREED:



Zdenek P. Bazant

Dated: 8/2/91

As updated by
Clem Carroll,
Chicago

Received by President 8/8/91

**BY-LAWS
OF**

**INTERNATIONAL ASSOCIATION FOR FRACTURE MECHANICS
OF CONCRETE STRUCTURES**

**ARTICLE I
OFFICES**

The principal office of the corporation in the State of Illinois shall be located in Evanston, Illinois. The corporation may have such other offices, either within or without the State of Illinois, as the business of the corporation may require from time to time.

The registered office of the corporation required by the General Not For Profit Corporation Act to be maintained in the State of Illinois may be, but not need be, identical with the principal office in the State of Illinois, and the address of the registered office may be changed from time to time by the board of directors.

**ARTICLE II
PURPOSES**

This corporation is one which does not contemplate pecuniary gain or profit to the directors, officers, or any private individual, and the purposes for which this corporation is formed are:

(a) To organize, coordinate and schedule at regular intervals of several years, international conferences addressing fracture mechanics of concrete structures and related subjects. The Corporation shall also coordinate the scheduling of other conferences in this or related fields as well as promote, foster, organize and coordinate various research, academic and commercial activities in the general field. The Corporation shall be operated exclusively for scientific, testing for public safety and educational purposes, as defined in Section 501(c)(3) of the Internal Revenue Code of 1986, as amended.

(b) To do each and everything necessary, suitable or proper at any time or place for the accomplishment of any one of the purposes or the attainment of any one or more of the subjects herein enumerated or conducive to or expedient to the interest or benefit of the corporation.

(c) To exercise and possess all powers, rights and privileges necessary to or incidental to the purposes for

which the corporation is organized, including any rights, powers and privileges granted by the laws of the State of Illinois to not-for-profit corporations.

ARTICLE III
MEMBERS

The corporation shall not have members; but rather, the affairs of the corporation shall be conducted by the board of directors of the corporation.

ARTICLE IV
DIRECTORS

SECTION 1. DIRECTORS. Except as otherwise provided by law or the Articles of Incorporation or in these by-laws, management of the corporation and its business and affairs shall be vested in its board of directors and the directors shall have the sole voting power with respect to such matters.

SECTION 2. NUMBER, TENURE AND QUALIFICATIONS. The number of directors of the corporation shall be a minimum of 3 directors and a maximum of 5 directors. The number of directors may be fixed or changed from time to time, within the minimum and maximum, by the directors. The directors need not be residents of Illinois. The number of directors may be increased or decreased as provided hereafter. Each director shall hold office until the next annual meeting of directors or until his successor shall have been elected and qualified. The members of the board of directors shall be elected at the annual meeting of directors or as otherwise prescribed by statute.

SECTION 3. ANNUAL AND REGULAR MEETINGS. An annual meeting of the board of directors shall be held on the second Tuesday in March of each year, at the hour of 10:00 a.m. for the purpose of electing the directors and such other business as may come before the meeting. If the election of the directors shall not be held on the day designated herein for an annual meeting, the board of directors shall cause the election to be held at a meeting of the directors as soon thereafter as may be convenient. The board of directors may provide, by resolution, the time and place, either within or without the State of Illinois, for the holding of additional regular meetings without other notice than such resolution.

SECTION 4. SPECIAL MEETINGS. Special meetings of the board of directors may be called by or at the request of the president, or a majority of the board of directors. The person or persons authorized to call special meetings of the board of directors may fix any place, either within or without the State of Illinois, as

the place for holding any special meeting of the board of directors called by them.

SECTION 5. CHAIRMAN OF THE BOARD OF DIRECTORS. At all meetings of the board of directors, the chairman of the board of directors, or in his or her absence the president, or in their absence an alternate chairman chosen by the board of directors, shall preside.

SECTION 6. NOTICE. Notice of any special meeting shall be given at least thirty (30) days previous thereto by written notice delivered personally or mailed to each director at his or her business address, or by telegram, telex or telefax. Any notice shall be deemed delivered two (2) days after the date of mailing of said notice. Any director may waive notice of any meeting. The attendance of a director at any meeting shall constitute a waiver of notice of such meeting, except where a director attends a meeting for the express purpose of objecting to the transaction of any business because the meeting is not lawfully called or convened. Neither the business to be transacted at, nor the purpose of, any regular or special meeting of the board of directors need be specified in the notice or waiver of notice at such meeting. At any meeting at which all of the directors shall be present, although held without notice, any business may be transacted which might have been transacted if the meeting had been duly called.

SECTION 7. QUORUM. One-third of the number of directors fixed by these by-laws, or fixed by the directors from time to time if a variable range of directors is provided, shall constitute a quorum for the transaction of business at any meeting of the board of directors, provided, that if less than a majority of such number of directors are present at said meeting, a majority of the directors present may adjourn the meeting from time to time without further notice. The members of the board of directors or of any committee of the board of directors may participate in and act at any meeting of such board or committee through the use of a conference telephone or other communications equipment by means of which all persons participating in the meeting can hear each other. Participation in such meeting shall constitute attendance and presence in person at the meeting of the person or persons so participating.

SECTION 8. MANNER OF ACTING. The act of the majority of the directors present at a meeting at which a quorum is present shall be the act of the board of directors, unless the act of a greater number is required by the General Not For Profit Corporation Act, these by-laws, or the Articles of Incorporation.

SECTION 9. REMOVAL OF DIRECTORS. One or more of the directors may be removed, with or without cause, at a meeting of directors by the affirmative vote of a majority of the directors

then in office present and voting at a meeting at which quorum is present.

SECTION 10. VACANCIES. Any vacancy occurring in the board of directors and any directorship to be filled by reason of an increase in the number of directors, shall be filled by the board of directors. A director elected to fill a vacancy shall be elected for the unexpired term of his predecessor in office.

SECTION 11. INFORMAL ACTION BY DIRECTORS. Unless specifically prohibited by the Articles of Incorporation or these by-laws, any action required to be taken at a meeting of the board of directors, or any other action which may be taken at a meeting of the board of directors or a committee thereof, may be taken without a meeting if a consent, in writing, setting forth the action so taken, shall be signed by all the directors entitled to vote with respect to the subject matter thereof, or by all the members of such committee, as the case may be. Any such consent signed by all the directors or all the members of a committee shall have the same effect as a unanimous vote, and may be stated as such in any document filed with the Secretary of State.

SECTION 12. COMPENSATION. Directors as such shall not receive any stated salaries for their services, but by resolution of the board of directors a fixed sum and expenses of attendance, if any, may be allowed for attendance at each regular or special meeting of the board; but nothing herein contained shall be construed to preclude any director from servicing the corporation in any other capacity and receiving compensation therefor.

SECTION 13. PRESUMPTION OF ASSENT. A director of the corporation who is present at a meeting of the board of directors at which action on any corporate matter is taken shall be conclusively presumed to have assented to the action taken unless the director's dissent shall be entered in the minutes of the meeting or unless the director shall file written dissent to such action with the person acting as the secretary of the meeting before the adjournment thereof or shall forward such dissent by certified mail to the secretary of the corporation immediately after the adjournment of the meeting. Such right to dissent shall not apply to a director who voted in favor of such action.

SECTION 14. RESIGNATION. Any director may resign as a director at any time by giving notice to the board of directors, its chairperson, or to the president or secretary of the corporation. A resignation is effective when the notice is given unless the notice specifies a future date. The pending vacancy may be filled before the effective date, but the successor shall not take office until the effective date.

ARTICLE V
OFFICERS

SECTION 1. NUMBER. The officers of the corporation shall be a president, one or more vice-presidents (the number thereof to be determined by the board of directors), a treasurer, a secretary, and such assistant treasurers, assistant secretaries or other officers as may be elected by the Board of Directors. Any two or more offices may be held by the same person, except the offices of president and secretary.

SECTION 2. ELECTION AND TERM OF OFFICE. The officers of the corporation shall be elected annually by the board of directors at the annual meeting of the board of directors. If the election of officers shall not be held at such meeting, such election shall be held as soon thereafter as may be convenient. Vacancies may be filled or new officers elected at any meeting of the board of directors. Each officer shall hold office until a successor shall have been duly elected and shall have qualified, until the officer's death, until the officer resigns or shall have been removed in the manner hereinafter provided. Election or appointment of an officer or agent shall not of itself create contract rights.

SECTION 3. REMOVAL. Any officer or agent may be removed by the board of directors whenever in its judgment the best interests of the corporation would be served thereby, but such removal shall be without prejudice to the contract rights, if any, of the person so removed.

SECTION 4. VACANCIES. A vacancy in any office because of death, resignation, removal, disqualification or otherwise, may be filled by the board of directors for the unexpired portion of the term.

SECTION 5. PRESIDENT. The president shall act in a general executive capacity and shall assist the chairman of the board, and, subject to the direction and control of the chairman of the board and the board of directors, the president shall assist the chairman of the board in the management, administration, and operation of the corporation's business and in the supervision of its policies and affairs and over its several officers, agents and employees. At the request of the chairman of the board, or in the case of his or her absence or inability to act, the president shall perform the duties of the chief executive officer of the corporation, and, when so acting, shall have all the powers of the chairman of the board and shall be subject to all the restrictions upon the chairman of the board and shall not act contrary to the policies set by the board of directors or the chairman of the board. Except in those instances in which the authority to execute is expressly delegated to another officer or agent of the corporation or a different mode of execution is

expressly prescribed by the board of directors or these by-laws, the president may execute, for the corporation, any contracts, deeds, mortgages, bonds or other instruments which the board of directors has authorized to be executed, and he or she may accomplish such execution either under or without the seal of the corporation and either individually or with the secretary, any assistant secretary, or any other officer thereunto authorized by the board of directors, according to the requirements of the form of the instrument. He or she shall perform such other duties as from time to time may be assigned to him or her by the board of directors, the chairman of the board or these by-laws.

SECTION 7. VICE PRESIDENTS. The vice-president (or in the event there be more than one vice-president, each of the vice-presidents) shall assist the chairman of the board and the president in the discharge of their duties and shall perform such other duties as from time to time may be assigned to him by the chairman of the board, the president or the board of directors. At the request of, or in the absence of, the chairman of the board and the president, or in the event of their inability to act the vice-president (or in the event there may be more than one vice-president, the vice presidents in the order designated by the board of directors, or by the chairman of the board or by the president if the board of directors or the chairman of the board has not made such a designation, or in the absence of any designation, then in the order of seniority of tenure as vice-president) shall perform the duties of the chief executive officer of the corporation, and when so acting, shall have the powers of the chairman of the board and shall be subject to all the restrictions upon the chairman of the board and shall not act contrary to the policies set by the board of directors, the chairman of the board or the president. Except in those instances in which the authority to execute is expressly delegated to another officer or agent of the corporation or a different mode of execution is expressly prescribed by the board of directors or these by-laws, the vice-president (or each of them if there are more than one) may execute, for the corporation, any contracts, deeds, mortgages, bonds or other instruments which the board of directors has authorized to be executed, and he or she may accomplish such execution either under or without the seal of the corporation and either individually or with the secretary, any assistant secretary, or any other officer thereunto authorized by the board of directors, according to the requirements of the form of the instrument.

SECTION 8. TREASURER. The treasurer shall, under the direction of the chairman of the board, (a) have charge and custody of all funds and securities of the corporation, and be responsible therefor and for the receipt and disbursement thereof; and (b) perform all the duties incident to the office of treasurer and such other duties as from time to time may be assigned to him by the chairman of the board or by the board of

directors. If required by the board of directors, the treasurer shall give a bond for the faithful discharge of his duties in such sum and with such surety or sureties as the board of directors may determine.

SECTION 9. SECRETARY. The secretary shall: (a) record the minutes of the board of directors' meetings, if invited, in one or more books provided for that purpose; (b) see that all notices are duly given in accordance with the provisions of these by-laws or as required by law; (c) be custodian of the corporate records and of the seal of the corporation; (d) sign with or any other officer thereunto authorized by the board of directors, any contracts, deeds, mortgages, bonds, or other instrument, except when a different mode of execution is expressly prescribed by the board of directors or these by-laws; (e) perform all duties incident to the office of secretary and such other duties as from time to time may be assigned to him or her by the chairman of the board or by the board of directors.

SECTION 10. ASSISTANT TREASURERS AND ASSISTANT SECRETARIES. The assistant treasurers shall, if required by the chairman of the board or the board of directors, give bonds for the faithful discharge of their duties in such sums and with such sureties as the board of directors shall determine. The assistant treasurers and assistant secretaries, in general, shall perform such duties as shall be assigned to them by the chairman of the board, the treasurer or the secretary, respectively, or by the president or the board of directors.

ARTICLE VI COMMITTEES

SECTION 1. COMMITTEES. A majority of the directors may create one or more committees and appoint members of the board to serve on the committee or committees. Each committee shall have two or more members, who serve at the pleasure of the board. Unless the appointment by the board of directors requires a greater number, a majority of any committee shall constitute a quorum and a majority of a quorum is necessary for committee action. A committee may act by unanimous consent in writing without a meeting and the committee by majority vote of its members shall determine the time and place of meetings and the notice required thereof. Subject to those limitations in the Articles of Incorporation and the General Not For Profit Corporation Act, to the extent specified by the board of directors each committee may exercise the authority of the board of directors under Article V herein.

SECTION 2. REVIEW OF THE COMMITTEES. Any actions of the committees shall be reported to the board of directors at the next meeting of the board of directors succeeding such action,

and shall be subject to revision or alteration by the board of directors.

ARTICLE VII
CONTRACTS, LOANS, CHECKS AND DEPOSITS

SECTION 1. CONTRACTS. The board of directors may authorize any officer or officers, agent or agents, to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances.

SECTION 2. LOANS. No loans shall be contracted on behalf of the corporation and no evidences of indebtedness shall be issued in its name unless authorized by a resolution of the board of directors. Such authority may be general or confined to specific instances.

SECTION 3. CHECKS, DRAFTS, OTHER. All checks, drafts or other orders for the payment of money, notes or other evidence of indebtedness issued in the name of the corporation, shall be signed by such officer or officers, agent or agents of the corporation and in such manner as shall from time to time be determined by resolution of the board of directors.

SECTION 4. DEPOSITS. All funds of the corporation not otherwise employed shall be deposited from time to time to the credit of the corporation in such banks, trust companies or other depositories as the board of directors may select.

ARTICLE VIII
FISCAL YEAR

The fiscal year of the corporation shall be determined by resolution of the board of directors.

ARTICLE IX
SEAL

The board of directors may provide a corporate seal which shall be in the form of a circle and shall have inscribed thereon the name of the corporation and the words, "Corporate Seal, Illinois."

ARTICLE X
WAIVER OF NOTICE

Whenever any notice whatever is required to be given under the provisions of these by-laws or under the provisions of the General Not For Profit Corporation Act, a waiver thereof in writing, signed by the person or persons entitled to such notice, whether before or after the time stated therein, shall be deemed equivalent to the giving of such notice.

ARTICLE XI
INDEMNIFICATION OF OFFICERS, DIRECTORS,
EMPLOYEES AND AGENTS; INSURANCE

SECTION 1. AUTHORIZATION FOR INDEMNIFICATION.

(a) The corporation may indemnify any person who was or is a party, or is threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative (other than an action by or in the right of the corporation) by reason of the fact that such person is or was a director, officer, employee or agent of the corporation, or who is or was serving at the request of the corporation as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against expenses (including attorneys' fees), judgments, fines and amounts paid in settlement actually and reasonably incurred by such person in connection with such action, suit or proceeding, if such person acted in good faith and in a manner he or she reasonably believed to be in, or not opposed to the best interests of the corporation, and, with respect to any criminal action or proceeding, had no reasonable cause to believe his or her conduct was unlawful. The termination of any action, suit or proceeding by judgment, order, settlement, conviction, or upon a plea of nolo contendere or its equivalent, shall not, of itself, create a presumption that the person did not act in good faith and in a manner which he or she reasonably believed to be in or not opposed to the best interests of the corporation, or, with respect to any criminal action or proceeding, that the person had reasonable cause to believe that his conduct was unlawful.

(b) The corporation may indemnify any person who was or is a party, or is threatened to be made a party to any threatened, pending or completed action or suit by or in the right of the corporation to procure a judgment in its favor by reason of the fact that such person is or was a director, officer, employee or agent of the corporation, or is or was serving at the request of the corporation as a director,

officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against expenses (including attorneys' fees) actually and reasonably incurred by such person in connection with the defense or settlement of such action or suit, if he or she acted in good faith and in a manner he or she reasonably believed to be in, or not opposed to the best interests of the corporation, and except that no indemnification shall be made in respect of any claim, issue or matter as to which such person shall have been adjudged to be liable for negligence or misconduct in the performance of his duty to the corporation, unless, and only to the extent that the court in which such action or suit was brought shall determine upon application that, despite the adjudication of liability, but in view of all the circumstances of the case, such person is fairly and reasonably entitled to indemnity for such expenses as the court shall deem proper.

(c) To the extent that a director, officer, employee or agent of a corporation has been successful, on the merits or otherwise, in the defense of any action, suit or proceeding referred to in paragraphs (a) and (b), or in defense of any claim, issue or matter therein, he or she may be indemnified against expenses (including attorneys' fees) actually and reasonably incurred by him in connection therewith.

SECTION 2. AUTHORIZATION BY DIRECTORS OR LEGAL COUNSEL. Any indemnification under this by-law (unless ordered by a court) shall be made by the corporation only as authorized in the specific case, upon a determination that indemnification of the director, officer, employee or agent is proper in the circumstances because he or she has met the applicable standard of conduct set forth in SECTION 1 of this Article. Such determination shall be made: (1) by the board of directors by a majority vote of a quorum consisting of directors who were not parties to such action, suit or proceeding; or (2) if such a quorum is not obtainable, or, even if obtainable, a quorum of disinterested directors so directs, by independent legal counsel in a written opinion.

SECTION 3. NOT EXCLUSIVE OF OTHER RIGHTS. The indemnification provided by this Article shall not be deemed exclusive of any other rights to which those seeking indemnification may be entitled under any other by-law, agreement, vote of disinterested directors, or otherwise, both as to action in his or her official capacity and as to action in another capacity while holding such office, and shall continue as to a person who has ceased to be a director, officer, employee or agent, and shall inure to the benefit of the heirs, executors and administrators of such a person.

SECTION 4. INSURANCE. The corporation may purchase and maintain insurance on behalf of any person who is or was a director, officer, employee or agent of the corporation, or who is or was serving at the request of the corporation as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against any liability asserted against such person and incurred by such person in any such capacity, or arising out of his or her status as such, whether or not the corporation would have the power to indemnify such person against such liability under the provisions of the General Not For Profit Corporation Act.

ARTICLE XII
AMENDMENTS

The power to make, alter, amend, or repeal the by-laws of this corporation shall be reserved to board of directors, who may do so by a majority vote.

ARTICLE XIII
GENDER AND NUMBER

The use of the masculine, feminine or neuter gender and the use of the singular and plural shall not be given the effect of any exclusion or limitation herein; and the use of the word "person" or "party" shall mean and include any individual, trust, corporation, partnership or other entity.

CONCLUSION OF BY-LAWS

N O R T H W E S T E R N
U N I V E R S I T Y



ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

September 6, 1991

F.H. Wittmann
Hirozo Mihashi

Dear Friends:

Enclosed for your information is a proposal for articles of incorporation in the state of Illinois for our newly formed International Association for Fracture Mechanics of Concrete Structures (FraMCoS). Incorporation in the state of Illinois is a very simple matter, and it is not necessary that the bylaws be formulated prior to incorporation. In fact, this is normally expected to be done afterwards. We have to provide in the articles of incorporation the name of one initial incorporator residing in Illinois, which is myself, and we should also provide the names of the initial board of directors (which can, of course, be changed afterwards).

At SMiRT II in Tokyo, I asked you to serve with me as the initial directors, and I am glad you accepted. With this initial board of directors, we would have the proper balance among Europe, America and Asia.

Please read the articles of incorporation, which are quite standard for our kind of association (they are nearly identical to the articles of incorporation of the Computational Mechanics Association, which was recently incorporated in the U.S. by my friend J.T. Oden. If you see need for any significant corrections, please fax or phone (tel: 708-491-4025; fax: 708-467-1078) as soon as possible, and please no later than Sept. 20. I will then sign the document and pass it to our lawyer, Mr. Clement J. Carroll, to actually carry out incorporation.

With best regards.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:mm

enclosure

N O R T H W E S T E R N

U N I V E R S I T Y



ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering
Professor Zdeněk P. Bažant, PhD, SE

Mr. Clem Carroll
Chicago

Oct. 9, 1991

Dear Mr. Carroll:

Enclosed are the Articles of
Incorporation, with my signature.

Please go ahead with the incorporation.

Sincerely yours,

Zdeněk P. Bažant

ARTICLES OF INCORPORATION

(Do Not Write in This Space)

SUBMIT IN DUPLICATE
Payment must be made by Certified Check, Cashier's
Check, Illinois Attorney's Check, Illinois C.P.A.'s Check
or Money Order, payable to "Secretary of State."
DO NOT SEND CASH!

Date 12-9-91
Filing Fee \$50
Approved RD

TO: GEORGE H. RYAN, Secretary of State

Pursuant to the provisions of "The General Not For Profit Corporation Act of 1986", the undersigned incorporator(s) hereby adopt the following Articles of Incorporation.

Article 1. The name of the corporation is: International Association For Fracture Mechanics of Concrete Structures

Article 2: The name and address of the initial registered agent and registered office are:

Registered Agent Zdenek P. Bazant
First Name Middle Name Last Name
Registered Office Northwestern University, Department of Civil Engineering
Number 2145 Sheridan Rd Street (Do Not Use P.O. Box)
Evanston IL 60208
City Zip Code County

Article 3: The first Board of Directors shall be 3 in number, their names and addresses being as follows: (SEE ATTACHED LIST) (Not less than three)

Director's Names	Number	Street	Address City	State
Zdenek P. Bazant,		Northwestern University, Department of Civil Engineering,	Evanston, IL	60208
Folker H. Wittmann,		Institut fur Baustoffe, Werkstoffchemie und Korrosion,	ETH-Honggerberg,	CH-8093 Zurich, Switzerland
Hirozo Mihashi,		Tohoku University, Department of Architecture,	Sendai,	Japan 980

EE
Hatched
A150

Article 4. The purposes for which the corporation is organized are:
To form any professional, commercial, trade or industrial association.
See attached.

FILED

DEC 09 1991

GEORGE H. RYAN
SECRETARY OF STATE

Is this corporation a Condominium Association as established under the Condominium Property Act?
 Yes No (Check one)

Is this corporation a Cooperative Housing Corporation as defined in Section 216 of the Internal Revenue Code of 1954?
 Yes No (Check one)

Is this a Homeowner's Association which administers a common-interest community as defined in subsection (c) of Section 9-102 of the code of Civil Procedure?
 Yes No

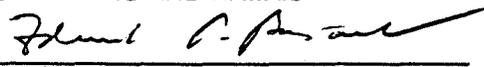
Article 5. Other provisions (please use separate page):
See attached.

NAMES & ADDRESSES OF INCORPORATORS

The undersigned incorporator(s) hereby declare(s), under penalties of perjury, that the statements made in the foregoing Articles of Incorporation are true.

Dated October 9, 19 91.

SIGNATURES AND NAMES

1. X 
 Signature
Zdenek P. Bazant
 Name (please print)
2. _____
 Signature

 Name (please print)
3. _____
 Signature

 Name (please print)
4. _____
 Signature

 Name (please print)
5. _____
 Signature

 Name (please print)

POST OFFICE ADDRESS

1. Northwestern University, Dept. of
Street Civil Engineering
Evanston, IL 60208
 City/Town State Zip
2. _____
 Street

 City/Town State Zip
3. _____
 Street

 City/Town State Zip
4. _____
 Street

 City/Town State Zip
5. _____
 Street

 City/Town State Zip

(Signatures must be in ink on original document. Carbon copy, xerox or rubber stamp signatures may only be used on the true copy.)

NOTE: If a corporation acts as incorporator, the name of the corporation and the state of incorporation shall be shown and the execution shall be by its President or Vice-President and verified by him, and attested by its Secretary or an Assistant Secretary.

The registered agent cannot be the corporation itself.

The registered agent may be an individual, resident in this State, or a domestic or foreign corporation, authorized to act as a registered agent.

The registered office may be, but need not be, the same as its principal office.

A corporation which is to function as a club, as defined in Section 1-3.24 of the "Liquor Control Act" of 1934, must insert in its purpose clause a statement that **it will comply with the State and local laws and ordinances relating to alcoholic liquors.**

FOR INSERTS – USE WHITE PAPER – SIZE 8 1/2 x 11

File No. _____

FORM NFP-102.10

ARTICLES OF INCORPORATION

under the

GENERAL NOT FOR PROFIT

CORPORATION ACT

of

SECRETARY OF STATE

DEPARTMENT OF BUSINESS SERVICES

CORPORATION DIVISION

SPRINGFIELD, ILLINOIS 62756

TELEPHONE (217) 782-9522

782-9523

(These Articles Must Be Executed and Filed in Duplicate)

Filing Fee \$50

Article 3:

Zdenek P. Bazant
707 Roslyn
Evanston, IL 60201

Folker H. Wittman - lives on campus at Institut fur Baustoffe

Hirozo Mihashi - lives on campus at Tohoku University

Article 4. The purpose for which the corporation is organized is:

(a) To organize, coordinate and schedule at regular intervals of several years, international conferences addressing fracture mechanics of concrete and concrete structures and related subjects. The Corporation shall also coordinate the scheduling of other conferences in this or related fields as well as promote, foster, organize and coordinate various research, academic and commercial activities in the general field. The Corporation shall be operated exclusively for scientific, testing for public safety and educational purposes, as defined in Section 501(c)(3) of the Internal Revenue Code of 1986, as amended.

(b) To do each and everything necessary, suitable or proper at any time or place for the accomplishment of any one of the purposes or the attainment of any one or more of the subjects herein enumerated or conducive to or expedient to the interest or benefit of the corporation.

(c) To exercise and possess all powers, rights and privileges necessary to or incidental to the purposes for which the corporation is organized, including any rights, powers and privileges granted by the laws of the State of Illinois to not-for-profit corporations.

Article 5. Other provisions.

(a) No part of the net earnings of the corporation shall inure to the benefit of any member, director or officer of the corporation, or any private individual (except that reasonable compensation may be paid for services rendered to or for the corporation affecting one or more of its purposes), and no member, director or officer of the corporation, or any private individual shall be entitled to share in the distribution of any of the corporate assets on dissolution of the corporation. No substantial part of the activities of the corporation shall be used for the carrying on of propaganda, or otherwise attempting to influence legislation, and the corporation shall not participate in or intervene in (including the publication or distribution of statements) any political campaign on behalf of any candidate for public office.

(b) Upon dissolution of the corporation or the winding up of its affairs, assets of the corporation shall be distributed exclusively to charitable, religious, scientific, testing for public safety, literary, or educational organizations which would then qualify under the provisions of Section 501(c)(3) of the Internal Revenue Code of 1986 and its Regulations as they now exist or as they may hereafter be amended.

N O R T H W E S T E R N
U N I V E R S I T Y



ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Civil Engineering

April 13, 1992

TO: Members of the IA-FraMCoS Steering Committee: B.I.G. Barr, L. Cedolin, M. Elices, Y. Mai, J. Mazars, H. Mihashi, H. Reinhardt, V. Saouma, J.G.M. van Mier, F.H. Wittmann, and Y.Z. Zaitsev.

RE: Proposed By-Laws of the International Association for Fracture Mechanics for Concrete Structures

Dear Friends:

As decided at our first formative meeting in Noordwijk in June 1991, Ben Barr, in collaboration with Folker Wittmann and myself, prepared the enclosed draft of the by-laws of our newly formed Association. Please kindly scrutinize it carefully and send me any comments you may have before May 1, with a copy to Ben Barr and Folker Wittmann. To the necessary extent, these by-laws follow the language and structure of the societies incorporated in the U.S.A. For example, the term "Board of Directors" is required here.

You may notice that the draft lists an alternative possible title of our Association, which was proposed by Folker Wittmann. We will need to discuss it at our meeting in Breckenridge, and have a vote if necessary. However, although I don't regard this alternative as impossible, I really prefer the existing title for reasons briefly explained in the enclosed copy of my recent letter to Dr. Barr.

With best regards,

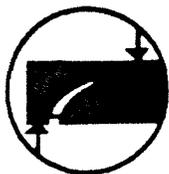
Sincerely yours,

Zdeněk P. Bažant

Walter P. Murphy Professor of Civil Engineering

ZPB:rdf

Enclosure



FraMCoS

COPY

INTERNATIONAL ASSOCIATION OF FRACTURE MECHANICS FOR CONCRETE AND CONCRETE STRUCTURES

FOUNDED IN 1991. INCORPORATED IN THE STATE OF ILLINOIS, USA

Department of Civil Engineering
Northwestern University
Evanston, Illinois 60208, USA
Tel.: 708-491-4025
Fax: 708-467-1078

Board of Directors:

Zdeněk P. Bažant (President)
Folker H. Wittmann (President-Elect)
Ben I. G. Barr (Secretary)
Surendra P. Shah (Treasurer)

June 23, 1992

Dr. Surendra P. Shah
Northwestern University
1800 Ridge Ave.
Evanston, IL 60208

Dear Suru:

As the new Treasurer of IA-FraMCoS, you should be informed of the advice I received from Mr. Clement J. Carroll (Rosenthal and Schonfield, Ltd., Chicago, 312-899-5541), an attorney I hired for our Association. I asked him about the point that Neil Hawkins raised during the general assembly in Breckenridge. He pointed out that an income from a conference accruing to the Association might be taxable.

However, if there are no membership dues and if a portion of the registration fee is set aside as membership dues, or as a fee in lieu of membership dues, then such income of the Association would not be taxable. When we hold the conference next time, we will decide how much of the registration fee of each participant will be given to the society, and it will be important to call it a fee in lieu of membership dues. As for the past conference, we will divide the amount that the Association will receive from the conference account by the number of participants, and this would be the current dues.

It is of course important that anybody who registers at the conference be eligible for membership, which is of course our policy. It will also be necessary to file Form 1023 with the IRS to ensure the tax exempt status, which has not been needed so far since the Association had not had any income prior to the conference. This needs to be done soon.

Furthermore, I received advice on the question of the modification of the Association's name. If we wanted to change the incorporation in Illinois, it would cost the same as incorporating a new society (well over \$1,000). I was however advised this is not necessary at all. It is a customary practice for a corporation to use alternative names, e.g. for trade purposes. We can keep the incorporation as it is, i.e. International Association for Fracture Mechanics of Concrete Structures and go ahead using International Association of Fracture Mechanics for Concrete and Concrete Structures without changing the incorporation in Illinois. The only condition that the alternative name must be close enough so that there is no confusion, and also our name must not cause confusion with any other registered corporation.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:rdf

cc: Ben I.G. Barr
Folker H. Wittmann
Mary Lynn Williams

IA-FraMCoS

Minutes of the First Meeting of the General Assembly of IA-FraMCoS Members held at 3.30 p.m on Thursday, 4th June 1992, in Room Peak 1, Beaver Run Resort, Breckenridge, Colorado, U.S.A.

Attendance: 29 Founding Members
15 Non-Founding Members

1. Welcome

The meeting was called to order at 3.30 p.m. by Zdenek P Bazant, who chaired the meeting. He welcomed all Founding Members and Non-Founding Members to the Inaugural Meeting of the Association.

2. Secretary pro tem

Ben Barr was appointed secretary pro tem.

3. Report on Meeting of Steering Committee (3rd June 1992)

Zdenek Bazant reported on the meeting of the Steering Committee held on 3rd June 1992. The main item of discussion had been the Bylaws and, in particular, the proposed change of name of the Association. The Steering Committee had recommended that the title of the Association should be changed to "International Association of Fracture Mechanics for Concrete and Concrete Structures" and that the abbreviated name should remain as IA-FraMCoS.

4. Bylaws

Zdenek Bazant reported that the Bylaws had been posted at the Conference immediately following the meeting of the Steering Committee and then proceeded to highlight the essential features of the proposed Bylaws. He drew attention to the proposal by the Steering Committee that the INTERVAL between Conferences should be three years.

Neil Hawkins sought clarification on the need for four members of the Advisory Board to be appointed by the Board of Directors and on the role of the Secretary. The four members appointed by the Board of Directors are appointed for one INTERVAL with the role of helping the President arrange the next FraMCoS Conference. The Secretary is primarily responsible for keeping the records and keeping members informed and not with the arrangements of FraMCoS Conferences. Neil Hawkins also drew attention to the need to ensure that the non-profit making activities of the Association be investigated so that problems do not arise in the future in this area. Zdenek Bazant agreed to investigate this fully, including taking legal advice.

Kasper Willam sought assurance that FraMCoS would not be responsible for losses incurred by any future FraMCoS Conference. Zdenek Bazant reported that the Steering Committee had considered this issue and had recommended that **each**

Conference Organiser shall bear all the financial risks involved with running a Conference and will keep all profits that may arise from the Conference.

Stuart Swartz expressed the view that further consideration should be given to the mechanism whereby the Bylaws can be changed. He also wished to know how often the Newsletter would be published. It was reported that the frequency of the Newsletter was yet to be decided. A proposal that the Bylaws be accepted was made by Victor Saouma and seconded by Suru Shah. The proposal was carried nem com.

5. **Transition Period for the introduction of the Bylaws**

Folker Wittmann drew attention to the difficulties in implementing immediately the Bylaws of the Association. He reported that the Steering Committee had recommended that a one-year Transition Period should be introduced in two specific areas:

- (a) **Four elected members of the Advisory Board: The Bylaws allow for two members to be elected for a period of two INTERVALS at each Conference. In order to achieve this two members should presently be elected for only one INTERVAL and two members for two INTERVALS during the Transition Period. This proposal was made by Folker Wittmann and seconded by Jan van Mier. The motion was carried nem con.**
- (b) Office of President and Past President: The Bylaws state that the Board of Directors shall have a President and a Past President. This can not be implemented immediately and there is considerable work still to be carried out by the Acting President. It was recommended by the Steering Committee that the General Assembly should elect a President for one year and a President Elect for the same period and that the President Elect would become President after one year. This proposal was made by Folker Wittmann and seconded by Luigi Cedolin. The motion was carried nem con.

6. **Election of Board of Directors**

It was reported that the next President of the Association will be responsible for organising FraMCoS2. The Steering Committee had discussed the venue of the next Conference and the next President at their meeting on 3rd June 1992. Four expressions of interest had been received to host the next FraMCoS Conference. The Steering Committee had recommended, after a full discussion of the four proposals, that Folker Wittmann should organise the next Conference and be the next President of the Association. This proposal was made by Pietro Gambarova, seconded by Pere Prat and was carried nem con.

The Steering Committee, at its meeting on 3rd June 1992, agreed to recommend Suru Shah for the post of Treasurer of the Association. This proposal was made by Jan van Mier, seconded by Pere Prat and was carried nem con.

The Steering Committee had also agreed to recommend Ben Barr for the post of Secretary of the Association. This proposal was made by Manuel Elices, seconded by Luigi Cedolin and was carried nem con.

7. **Election of Four Members of the Advisory Board**

Zdenek Bazant drew attention to the transitional arrangements agreed earlier and hence two members should be elected for two INTERVALS and two members for only one INTERVAL.

A secret ballot had been taken by the Steering Committee at its meeting on 3rd June to arrive at the four nominations. Following the ballot result, the Steering Committee had recommended that Manuel Elices and Jan van Mier should serve for two INTERVALS and that Hideyuki Horii and Victor Saouma should serve for one INTERVAL. The proposal for the four elected members of the Advisory Board was made by A.V. Other and seconded by Jaime Planas. Twenty six voted in favour of the motion and there were three abstentions.

During the discussion of this item Zdenek Bazant reported, for information purpose only, that the four names recommended by the Steering Group to the newly elected Board of Directors as members of the Advisory Board were Jacky Mazars, Hirozo Mihashi, Hans Reinhardt and Albert Kobayashi.

8. **Election of Auditors**

Zdenek Bazant reported that the Steering Committee agreed to recommend Kurt Gerstle and Pietro Gambarova for the **posts of Auditors of the Association**. This proposal was made by Victor Saouma and seconded by Luigi Cedolin. Twenty eight voted in favour of the motion and there was one abstention.

9. **Additional Items Discussed by Steering Committee (3rd June 1992)**

Zdenek Bazant reported that the Steering Committee had recommended that the Association should encourage FramCos Research Workshops, focussed on special topics, and also could co-sponsor conferences in related fields.

The Steering Committee had also recommended that the Association should create an Archive of all items related to the work of FramCoS. It had also been agreed that a Newsletter be edited by the Secretary in collaboration with the President.

10. **Any Other Business**

There was no other formal business. Zdenek Bazant thanked all members for attending and expressed his best wishes for the future of the Association.

11. **Adjournment**

The meeting adjourned at 5.20 p.m.

IA-FraMCoS

Minutes of the First Meeting of the Board of Directors of IA-FraMCoS held at 5.20 p.m on Thursday, 4th June 1992, in Room Peak 1, Beaver Run Resort, Breckenridge, Colorado, U.S.A.

Present: Zdenek Bazant, Folker Wittmann, Suru Shah and Ben Barr

1. Welcome

The meeting was called to order at 5.20 p.m. by the Chairman, Zdenek Bazant.

2. Appointment of four members to the Advisory Board

This item had been discussed at the meeting of the Steering Committee held on 3rd June 1992. The Steering Committee had recommended the following names - Jacky Mazars, Hirozo Mihashi, Hans Reinhardt and Albert Kobayashi to serve on the Advisory Board for one INTERVAL. The four names were proposed by Suru Shah, seconded by Ben Barr and the motion was carried nem con.

3. Budget for FraMCoS

It was agreed that the Treasurer, in conjunction with the President, should prepare a Budget for the Association.

4. Acceptance of Members

All applications for membership of the Association, made at the Conference, were accepted by the Board.

5. Newsletter

The first Newsletter requires urgent thought and a list of all members should be circulated with the Newsletter.

6. Removal from the Membership List

It was agreed that all members who did not attend two consecutive FraMCoS Conferences should have their names removed from the list of members.

7. Conference Guidelines

It was agreed that a document of "FraMCoS Conference Guidelines" should be initiated during the next year and produced in its final form by the time of FraMCoS2.

8. **FraMCoS Sponsorship of Workshop**

It was agreed that the Workshop being organised by Folker Wittman in July 1992 on "Numerical Models and Material Parameters for Concrete Cracking" be sponsored by FraMCoS.

9. **Adjournment**

The meeting adjourned at 5.40 p.m.

12/11/92

Dr. Edward Colgate
Department of Mechanical Engineering
Northwestern University
The Technical Institute
2145 Sheridan Road
Evanston, Illinois 60208-3111

Dear Ed,

I received your fax dated 12/9. I basically understand the objects of the project. I think it's worth doing this research for the basic investigation of induction motor and fluid levitation that I was not able to complete in my PhD work. Thank you for the explanation of the project.

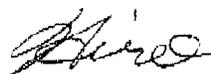
I sometimes contact to Tokyo University. They are very quick and aggressive for the research than you might think. For instance, Mr. Nino has already developed a sinusoidal drive with a closed loop control successfully. He recently present his work in a domestic robotics conference. Besides his paper has been accepted for the coming MEMS in Florida. According to him, a sinusoidal drive has two advantages compared to a square-wave drive. One, the electrical break down is somehow increased. (They are used to use 2000V max. Now, with this drive they are able to use 4000V max.) Two, much more force is generated at the same voltage. And, he also said that regarding the closed loop control by sensors, the electrical noise problem is occurred only at the beginning (first 20 msec), after that the sensing becomes normal. Mr. Egawa developed very small sized film actuator, that is made of Micro FPC, with 40 layer parallel concatenation.

I received the final version of Keith's design today. It looks pretty good to me. I hand it out to our Micro FPC designer, he will finish the review of the drawing probably by next Wednesday. He may request some minor design changes or may not. Anyhow, then we start the fabrication of it. I would like to have the information regarding the quantity and product schedule.

Since I had a lot of business trip and I will, my response may delay sometimes. (As a matter of fact, yesterday I was not to be here.) However, I will try to keep touch with you.

Take care and have a nice holiday season.

Sincerely,



Hiro Matsumoto

IA-FraMCoS

Minutes of the FraMCoS Steering Committee held at 12.15 p.m on Wednesday, 3rd June 1992, in Room Peak 1, Beaver Run Resort, Breckenridge, Colorado, U.S.A.

Present: Ben Barr, Zdenek P. Bazant, Manuel Elices, Hirozo Mihashi, Hans W. Reinhardt, Victor E. Saouma, Suru P. Shah, Jan G.M. van Mier and Folker H. Wittmann.

1. Welcome, Introductions, Appointment of Secretary pro tem

The meeting was called to order at 12.15 p.m. Zdenek Bazant who chaired the meeting welcomed all to the lunch meeting. Ben Barr was appointed secretary pro tem.

2. F. Wittmann's Proposal to Change the Society Name

It was agreed that the title of the Association should be changed to "International Association of Fracture Mechanics for Concrete and Concrete Structures". It was also agreed that the abbreviated name of the Association shall be IA-FraMCoS.

3. Discussion of Bylaws

Correspondence had been received from four members of the Steering Committee regarding the proposed Bylaws. All the points raised in the correspondence were either covered by the Bylaws or by adopting shorter two year terms for half of the elected members of the Advisory Board.

It was agreed that ten copies of the Bylaws should be posted at the Conference so that founding members could read the Bylaws prior to the General Assembly of the IA-FraMCoS Members meeting at 3.30 p.m. on Thursday, 4 June 1992.

4. Discussion of the Next Conference and the Next President

Four expressions of interest had been received to host the next FraMCoS Conference. It was agreed that normally the FraMCoS Conferences should rotate among America, Europe and Asia. Following a brief discussion, it was agreed that the Steering Committee should recommend to the General Assembly that Folker H. Wittmann shall be the next President and organiser (Chairman) of FraMCoS2 Conference.

Folker Wittmann drew attention to the difficulties in implementing immediately the Bylaws of the Association and the need for continuity in the Office of the President during the period when the Association was being formed. He proposed that a one-year Transition Period should be introduced and that Zdenek Bazant, the first president should serve as President for one year after the FraMCoS Conference, that is until 5th June 1993 and that the next president to be elected in Breckenridge should be the President Elect during that time and should become President on 6th June 1993.

It was agreed that a number of recommendations be placed before the General Assembly on Thursday, 4th June and a vote should be taken on each, in turn, as follows:

- (a) Acceptance of proposed Bylaws.
- (b) Acceptance of a one year Transitional Period.
- (c) Recommendation of Zdenek Bazant for President for one year after FraMCoS1.
- (d) Recommendation of Folker Wittmann for President Elect for a one year period and from 6th June 1993 as President of the Association.

The Steering Committee voted on the above recommendations as follows:

- (a) The proposed Bylaws were accepted nem com.
- (b) It was proposed that the General Assembly be asked to allow a one year Transitional Period and to elect a President for one year and a President Elect for the same period (who would then become President for the following two years).
For: 7
Abstentions: Zdenek Bazant and Folker Wittmann.
- (c) It was agreed that the Steering Committee should propose Folker Wittmann to be the organiser of the next Conference and the next President.
For: 8
Abstentions: Folker Wittmann.

It was agreed nem con that the INTERVAL between FraMCoS Conferences should be three years.

5. Financial Aspects

The following financial aspects were agreed:

- (a) The financial accounts for each FraMCoS Conference must be kept separate from FraMCoS accounts.
- (b) FraMCoS shall receive from the Conference organisers a fixed amount of money per registered participant, agreed upon in advance, after each FraMCoS Conference.
- (c) The fee to be paid to FraMCoS per registered participant will be approved by the Board of Directors.
- (d) Any financial revenue from the publisher of future FraMCoS Conference Proceedings must be paid to the Association.
- (e) Each Conference organiser will bear all the financial risks involved with running the Conference and will keep all the profits that may arise from the Conference.

It was proposed that Suru Shah should be recommended to the General Assembly for the post of Treasurer of the Association.

For: 8
Abstentions: Suru Shah.

It was proposed nem con that Kurt Gerstle and Pietro Gambarova should be recommended to the General Assembly for the posts of Auditors of the Association.

6. **Board of Directors and Advisory Board**

The recommendations of the Steering Committee for the Board of Directors were as follows:

- (a) President - Zdenek Bazant for one year followed by Folker Wittmann.
- (b) Past President - Zdenek Bazant after one year.
- (c) Treasurer - Suru Shah.
- (d) Secretary - Ben Barr

The recommendations of the Steering Committee for the four members of the Advisory Board elected by the General Assembly were as follows:

- Manuel Elices - (two INTERVALS).
- Jan van Mier - two INTERVALS).
- Hideyuki Horii - (one INTERVAL).
- Victor Saouma - (one INTERVAL).

The recommendations of the Steering Committee for the four members of the Advisory Board appointed by the Board of Directors were as follows:

- Jacky Mazars.
- Hirozo Mihashi.
- Hans Reinhardt.
- Albert Kobayashi.

7. **Relation to other Societies, other Conferences**

It was agreed that FraMCoS should develop close links with other societies. In particular, liaison should be established, if possible, with ASCE, ACI, CEB, ICF, ECF, JCI and RILEM.

It was agreed that the President should write to the Presidents of the above societies indicating willingness or desire to establish liaison.

8. **Any Other Business**

It was agreed that the Association will encourage organising FraMCoS Research Workshops, focussed on special topics that are distinctly narrower than the entire field of interest to the Association. The Association might also co-sponsor other workshops, or symposia that do not coincide in scope and field of coverage with the FraMCoS Conferences.

Folker Wittmann proposed that FraMCoS should immediately start collecting information towards creating an Archive. The Archive should contain a brief report

on each Conference with statistical data, Proceedings of each Conference, Photographs, Copies of all Flyers, etc. This proposal was accepted nem con and it was agreed that the Secretary should carry out this task in the initial period.

Finally it was agreed, following a proposal by Folker Wittmann, that the Association should have a Newsletter, circulated to its members once or twice a year. The newsletter will be mailed out by the President and will be prepared by the Secretary in collaboration with the President.

9. **Adjournment**

The meeting adjourned at 2.37 p.m.

REPORT ON THE FIRST INTERNATIONAL CONFERENCE ON FRACTURE MECHANICS OF CONCRETE STRUCTURES (FraMCoS 1)

The first conference of the International Association of Fracture Mechanics for Concrete and Concrete Structures,¹ held at Beaver Run Resort in Breckenridge, Colorado, during June 1-5, 1992. The conference, organized and chaired by Zdeněk P. Bažant of Northwestern University, was financially supported by U.S. National Science Foundation. The conference was organized in collaboration with the NSF Science and Technology Center for Advanced Cement-Based Materials (ACBM) at Northwestern and with ACI Committee 446 on Fracture Mechanics. It was co-sponsored by the American Concrete Institute and the International Association for Bridge and Structural Engineering.

The conference came at a time in which the applications of fracture mechanics to concrete and concrete structures are undergoing an explosive development and are likely to have a major impact on the design of concrete structures and code specifications, as well as the practice of finite element analysis. It appears that this impact will probably be as far reaching as that of the introduction of plastic limit analysis which took place between 1930 and 1970.

The conference program consisted of eight sessions. Each of them started with a general session featuring principal and invited lectures and a one-hour general discussion, and continued with two parallel sections featuring the contributing papers. The conference opened with a principal lecture by Z.P. Bažant which described the state-of-the-art and presented an overview of the freshly completed state-of-art report by ACI Committee 446, Fracture Mechanics, chaired by Bažant. S. Reid presented B. Karihaloo's invited lecture, devoted to material models for concrete fracture and discussing the mathematical formulations for strain-softening, including viscoelastic and stability aspects. The subsequent sections focused on propagation criteria and material models for fracture, smeared-crack concepts, and random process modeling. The problem of size effect theory and of an unambiguous determination of material characteristics were prominent in the discussions.

The second session, dealing with experimental study, material characterization and size effect opened by the principal lecture of F.H. Wittmann, followed by invited lectures by R. Eligehausen, V. Saouma and V.C. Li. Wittmann presented a sophisticated mathematical analysis of the fracture process zone, including not only the effect of its lengths but also its widths, and covering the effect of thickness of the specimen. He used the recutting method to compare the theoretical analysis to experiment. The invited lectures addressed the size effect in the failure of anchors, fracture of concrete dams and problems of ductility in fracture, including fiber-reinforced

¹ This Association which was founded in June 1991 in Noordwijk, Netherlands, with Z.P. Bažant as the first president, is incorporated in Illinois and has its headquarters in Evanston, Illinois.

cementitious composites. The subsequent sections dealt with experimental study and material characterization, X-ray strain measurements, dowel action, aggregate-paste bond, wedge splitting specimens and lateral flexing of direct tension specimens.

Session three, dealing with numerical methods and structural analysis, featured invited lectures by A.R. Ingraffea, A. Carpinteri and J.G. Rots. The pros and cons of the discrete and smeared cracking models were discussed and numerical problems associated with various models (smeared crack model, orthotropic damage model, rotating crack models, etc.) received considerable attention during the discussion.

In session four, on damaged modeling, a principal lecture by H. Mihashi reviewed recent results on tensile strain-softening properties of concrete, and a principal lecture by K. Willam addressed the fundamental aspects of strain-softening description. In a subsequent invited lecture, de Borst presented a gradient continuum model for the treatment of concrete and rock fracture. There were extensive discussions on the problems of mesh-sensitivity and localization and the related size effect, as well as the problems of identification of damage characteristics from experiments, stemming from the impossibility to achieve uniform damage states. The parallel sections dealt with damage modeling and fracture of reinforced concrete. The papers addressed damage modeling by discrete and smeared crack concepts, micromechanics based continuum theory, microplane-type of constitutive models for distributed damage, experimental results on strain-localization in compression fracture, finite element analysis of reinforced concrete panels, crack spacing and width in reinforced concrete, and fiber reinforced concrete, and problems of steel bond modeling.

The fifth session, on mixed-mode fracture and interfaces, opened with the principal lecture by J.G.M. van Mier which was focused on the modeling of shear fracture. J-K. Kim substituted for the invited lecturer Y.-W. Mai to present their joint work on interfacial properties of steel fiber cement mortar composites. There has been a particularly lively discussion interpretation of the various types of shear fracture tests and the existence of shear fracture on the microscale. The parallel sections which followed dealt with mixed-mode fracture, experimental studies, applications to punching failure of waffle flat slabs, analysis of biaxial loading and wedge-splitting tests, torsional damage tests, measurement of fracture energy in early age concrete, and tensile fracture characteristics of high strength concrete.

Session five, devoted to fracture analysis of bond failure, included principal lectures by S.P. Shah and H.W. Reinhardt, and an invited lecture by H.J. Hilsdorf. The lecturers discussed bond properties in fiber reinforced cement and aggregate cement paste interface, role of bond in strain softening at various rates, and applications to concrete repair and protection overlays. The modeling of bond failure its various influencing factors and appropriate experimentation, received considerable interest in the discussions. The subsequent sections dealt with interfaces, mixed mode fracture, and the practical aspects of shear, bond and anchors in reinforced concrete. The practical applications included fracture design of concrete piles, shear strength of longitudinally reinforced beams, fracture of lightly reinforced beams, dynamic behavior of concrete slabs, comparisons of code and fracture mechanics predictions, analysis of headed anchors, and an

evaluation of the results of the recent round-robin testing of anchor bolts.

To avoid conflict with the general assembly of Association members, session seven was shorter and consisted only of parallel sections dealing with the size effect and environmental influences. The presentations addressed the influence of size on the measured fracture energy, the size effect on the nominal strength of short and slender reinforced concrete columns, the size effect on plastic rotational capacity of R.C. beams, crack formation under hygral gradients, thermal fracture, fracture analysis of shrinkage cracks, and fracture in concrete pavements.

The last, eighth session devoted to time-dependence, dynamics and fatigue, opened with a principal lecture by J. Planas and M. Elices, which dealt with fracture caused by drying shrinkage stresses and the consequent structural size effect. In the subsequent invited papers, J. Isenberg presented a review of dynamic fracture of concrete, based on a freshly concluded state-of-art report of ACI Committee 446, Fracture Mechanics, and S.E. Swartz discussed fatigue damage in concrete beams. There have been extensive discussions on the degree of influence of shrinkage cracking on the size effect under applied loads and on the mechanism of the rate effect in dynamic fracture, particularly the difference between fractures under dynamic rates and under slow rates corresponding to loading up to several days duration. The parallel sections that followed dealt with dynamic fracture, fatigue and rate effect. The particular topics discussed were impact analysis, effect of water on dynamic response, torsional impact, blast-loading, experimental results on fatigue loading and cyclic bond slip behavior, generalization of R-curve modeling for rate effect and size effect, effect of cyclic loading on high strength concrete, and probabilistic aspects.

An unfortunate car accident in Colorado just before the conference forced cancellation of the invited lectures by J. Mazars and G. Pijaudier-Cabot. Despite severe injuries, both invited speakers have fortunately recovered by the time of this publication.

A large number of excellent papers, as well as lively and interesting discussions, have made FraMCoS-1 a great success. There have been 139 registered participants at the conference, representing 20 countries. In total, they represented 125 papers.

All the presented papers were published before the conference in a proceedings volume entitled "Fracture Mechanics of Concrete Structures", edited by Z.P. Bažant (Elsevier Applied Science, London and New York, 1992, 1021 pp.) dedicated to the memory of Maurice F. Kaplan, a pioneering researcher in concrete fracture. Aside from the presented papers, the proceedings include the full text of the State-of-Art Report on Fracture Mechanics of Concrete: Concepts, Models and Determination of Materials Properties" by ACI 446, which has just been published as ACI Special Publication and has been reprinted in this volume with ACI permission.

On the social side, there has been a conference luncheon on the first day hosted by MTS Corporation (represented by C. Fairhurst and K. Falkenburg). The banquet, held on Thursday night, was enlivened by a capturing speech on the history of mining in Colorado by Kurt Gerstle, and by presentations of awards for a skiing race and tennis tournament held during the free

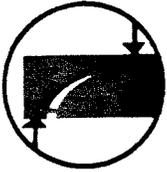
afternoons of the conference. The conference format, with free afternoons and a second session of each day held in the evening after dinner, allowed an extensive program of recreational pursuits during which the participants could come know each other better. The recreational program included a slalom skiing race at Arapaho Basin, a group hike under Mt. Lincoln, white-water rafting on the Arkansas river, and a tennis tourney. The only obstacle to these physically demanding activities, fortunately overcome by most participants, was the altitude of Beaver Run Resort (9700 ft. or 3000 m).

An important event was the General Assembly of the founding members of IA-FraMCoS, held on Thursday afternoon. At that assembly, the by-laws of the new Association, previously prepared by a Steering Committee under the chairmanship of F.H. Wittman and with B.I.G. Barr as secretary, were approved and the officers of the new Association were elected. The General Assembly elected the following Board of Directors: Z.P. Bažant (President), F.H. Wittmann (President-Elect, to become President one year after his election), B.I.G. Barr (Secretary), and S.P. Shah (Treasurer). Also elected was the following advisory board: M. Elices, H. Horri, A.S. Kobayashi, J. Mazars, H. Mihashi, H.W. Reinhardt, V.E. Saouma, and J.G.M. van Mier, and auditors K. Gerstle and P. Gambarova. The Secretary will also serve as newsletter editor and archivist. Membership in the Association is open to any interested person active in the subject.

The FraMCoS conferences will be held at three-year intervals at locations alternating among continents and countries, with no geographic bias, however, favoring the major centers of research. The Association also intends to sponsor or co-sponsor FraMCoS Research Workshops or other symposia on focused subjects.

As decided in Breckenridge, FraMCoS-2 will be held at ETH, Zurich, Switzerland, in 1995, under the chairmanship of F.H. Wittmann who will become the second president of the Association. I have no doubt that this will be an outstanding conference rivaling our first one in Breckenridge in most respects except one—the altitude. I extend to Folker Wittmann my best wishes.

Zdeněk P. Bažant
IA-FraMCoS President



FraMCoS

COPY

INTERNATIONAL ASSOCIATION OF FRACTURE MECHANICS FOR CONCRETE AND CONCRETE STRUCTURES

FOUNDED IN 1991. INCORPORATED IN THE STATE OF ILLINOIS, USA

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August 20, 1992

Mr. Edward O. Pfrang,
Executive Director
American Society of Civil Engineers
345 East 47th Street
New York, NY 10017

*Similar letters to
8 others*

Dear Dr. Pfrang: *Ed:*

It is my pleasure to inform you of the recent establishment of the International Association of Fracture Mechanics for Concrete and Concrete Structures, abbreviated FraMCoS.

Our Association was founded in Noordwijk, Netherlands, in June 1991. It has headquarters in Evanston Illinois, is incorporated in the State of Illinois in the U.S.A., and acquired its definitive form with the approval of the by-laws at the First FraMCoS Conference held in Breckenridge, in June 1992. The general goal of our Association is to foster the applications of fracture mechanics to concrete and concrete structures. The principal activity of our Association is to organize international conferences on the subject. These conferences, the first one of which was held in Breckenridge, Colorado, in June 1992 (organized by Northwestern University), will be held in three-year intervals. The second conference, based on a vote in Breckenridge, will be held in Zurich in 1995, under the chairmanship of the new president, Folker H. Wittmann.

Aside from informing you of these developments, I would also like to mention that it would be our pleasure to have contacts or perhaps even a more formal liaison with a few other established societies active in this field, including yours. We could ensure that the time schedules of our conferences do not conflict. We could share information on various planned activities, especially conferences and workshops which impact on the subject of our common interest. If desired, we could in the future co-sponsor research workshops or other symposia on various focused subjects relevant to our field of interest.

Sincerely yours,

Zdeněk P. Bažant
Walter P. Murphy Professor of Civil Engineering

ZPB:rd

cc: Marie McGuinness, ASCE



AMERICAN SOCIETY OF
CIVIL ENGINEERS

345 East 47th Street
New York, NY 10017
(212) 705-7496

September 10, 1992

Zdenek P. Bazant
Civil Engineering Department
Northwestern University
Evanston, IL 60208

Dear Dr. Bazant:

This letter is in response to your August 20, 1992 letter to Dr. Pfrang regarding suggested liaison activities between ASCE and the International Association of Fracture Mechanics for Concrete and Concrete Structures.

By copy of this letter, I am forwarding your suggestions to the ASCE Engineering Mechanics Division Executive Committee (EMD EXCOM) for discussion at their September 19, 1992 meeting in New York.

Thank you for sharing this information and your ideas with us. I look forward to contacting you after the EMD EXCOM meeting.

Sincerely,

A handwritten signature in black ink, appearing to read 'Marie E. McGuinness'.

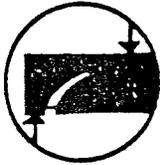
Marie E. McGuinness
Sr. Manager, Technical Services

MEM/kt

cc: EMD EXCOM



*Civil engineers make the difference
They build the quality of life*



INTERNATIONAL ASSOCIATION OF FRACTURE MECHANICS FOR CONCRETE AND CONCRETE STRUCTURES

FOUNDED IN 1991. INCORPORATED IN THE STATE OF ILLINOIS, USA

LETTER FROM THE PRESIDENT

It is my greatest pleasure to initiate the first newsletter of our newly formed International Association of Fracture Mechanics for Concrete and Concrete Structures, in short, FraMCoS. Ours is a rapidly developing new field, which will most likely have profound consequences for the way concrete structures are designed and analyzed.

The research activity in this field surged dramatically during the last decade and may be expected to continue increasing for many years until, hopefully, the subject of concrete fracture mechanics in particular and the design of concrete structures in general will become as clear and rational as, for example, the analysis of elastic frames. That field, close to the heart of civil engineering, had slow beginnings marred by disagreements and was the object of major research efforts for about 100 years until a satisfactory status was reached shortly after the middle of this century. In our field, likewise, we may anticipate a lengthy period of fruition, which needs to be aided by regular convening of conferences to critically appraise the advances and chart the further course. Our new Association, whose main practical objective is the organizing of major periodic international conferences on the subject, is trying to foster this development.

The design of concrete structures to prevent their failure is a complex scientific problem which, at the beginning, had to be addressed purely empirically. As the theoretical knowledge of the behavior of concrete and concrete structures advanced and a wealth of experimental results was being accumulated, drastic changes in the way concrete structures are designed and analyzed took place. There have already been two revolutions in the field. The first one, which in fact made first larger structures possible, was the development of the no-tension design at the beginning of this century. The second revolution, representing a major advance, was the introduction of limit analysis based on the theory of plasticity. That has been an arduous process, which took about 40 years. It began roughly in 1930 and was completed by 1970 (the ACI Code introduced the limit analysis principles in 1971). From the theoretical viewpoint, the case for limit analysis based on the theory of plasticity was essentially clear already about 1935. The reason that the introduction of plastic limit analysis took such a long time was the need to accumulate detailed and systematic experimental evidence, work out the detailed applications to many different types of failure and, last but not least, educate young engineers in the new theoretical principles. At the moment, we are probably standing at the onset of a third revolution in concrete design practice. The process of introducing the principles of fracture mechanics to the analysis and design of concrete structures will not be easy, but let us hope it would take less than 40 years.

The impetus for the recent rapid development of fracture mechanics applications to concrete structures came basically from four directions:

1. The realization that without some type of fracture mechanics or equivalent concepts such as nonlocal damage, the seemingly all-powerful finite element codes cannot correctly describe damage localization phenomena and cannot provide objective, mesh-independent predictions of brittle failures of concrete structures;
2. the recognition that the existing design codes cannot correctly predict the effect of structure size on the maximum load, ductility and energy absorption capability in these types of failures;
3. the realization that fracture phenomena are particularly important for modern high performance concretes and various new cement based materials; and
4. the recognition that development of better cement-based composites is impossible without understanding the micromechanics of fracture.

Realization of these facts led to an explosion of research activity beginning about 1980. A number of committees of various societies were formed with the objective to advance the subject, for example the influential RILEM committee chaired by F.H. Wittmann, which sponsored the first large international conference devoted to the subject in Lausanne in 1985. After that, conferences proliferated, but unfortunately in an uncoordinated fashion. During the last several years the situation became confusing, several conferences conflicting with each other. An active researcher was unable to attend all of them, while at the same time he did not know which would be the principal conference to choose.

Recognizing this state of affairs firsthand with my initial difficulties at scheduling of what became our Breckenridge conference, I decided to talk about the situation with various leading researchers around the world. In summer 1990 I circulated a letter to the members of the freshly organized International Scientific Advisory Committee of the Breckenridge Conference, suggesting that the disorderly spectrum of conferences could be remedied by founding an international association. The response was overwhelmingly positive. Therefore, I have held detailed discussions with a number of leading researchers, including F.H. Wittmann, S.P. Shah, M. Elices, H. Reinhardt, A. Carpinteri, H. Mihashi, J. van Mier, J. Mazars, L. Cedolin, J. Planas, K. Willam, B.I.G. Barr, V.E. Saouma, and others. We met at several charming locations -- at the International Workshop on concrete dam fracture held in Locarno, Switzerland, September 1990 (organized by Wittmann and Dungar) and at the International Workshop on Concrete Fracture held in Torino in October 1990 (organized by A. Carpinteri).

As a result of these discussions, I called an organizing meeting at Hotel Oranje in Noordwijk, Netherlands, for June 19, 1991, as part of the conference organized by J. van Mier. Our Association was created there by an unanimous consensus of the members of the International Scientific Committee of the Breckenridge Conference who were present in Noordwijk. They became the FraMCoS Founding Members. The first President, secretary and steering committee members were elected on that day. The steering committee, with F.H. Wittmann as chairman and B.I.G. Barr as secretary, has subsequently worked on the by-laws of our new Association which were eventually adopted in Breckenridge. It was decided to incorporate our Association in the state of Illinois and have the headquarters in

Evanston. Mr. Clement J. Carroll, Jr., a Chicago attorney, was hired to take care of the legalities of the incorporation as a non-profit organization, with an initial Board of Directors consisting of F.H. Wittmann, H. Mihashi, and myself, as representatives of three continents. The incorporation was obtained from the State of Illinois on December 16, 1991, which lent our Association legal status. A meeting of the general assembly of FraMCoS, consisting of all the members of the Association, was then called to Breckenridge. It took place on June 4, 1992 in the Beaver Run Resort. With the adoption of by-laws at that assembly, our Association has acquired a definitive form.

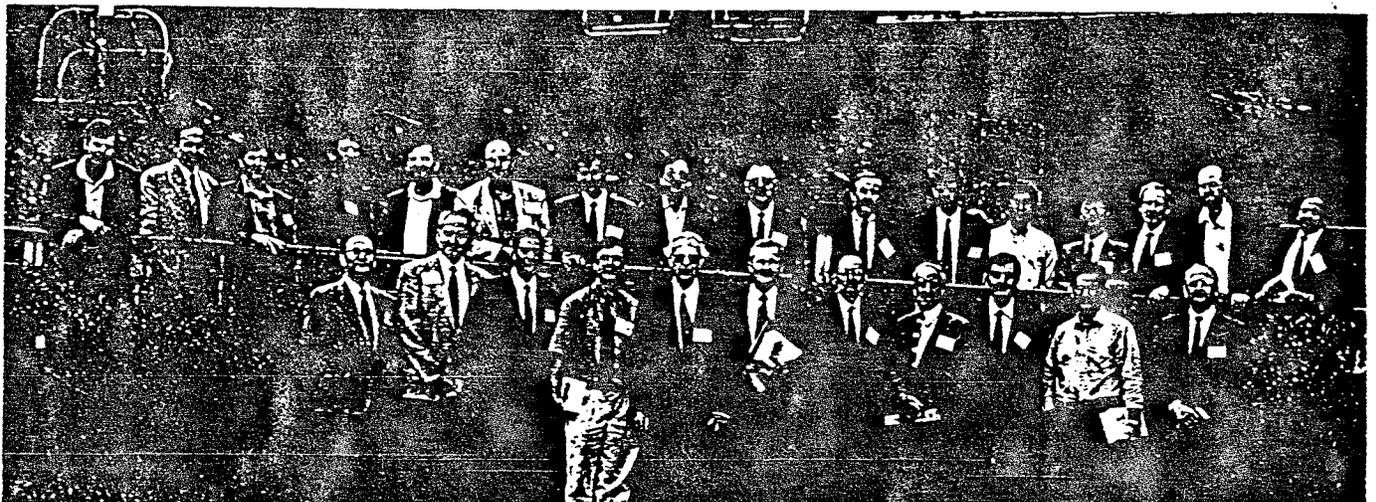
Our Association will be run by its Board of Directors, supported by the Advisory Board. The Board of Directors consists of the president, past-president (however, for the initial one-year transitional period, president-elect), secretary and treasurer. The Advisory Board consists of four elected and four appointed members. The finances will be overseen by two auditors, and the secretary will at the same time serve as the newsletter editor and archivist.

The principal goal of our Association, run democratically by its members, is to organize at regular intervals (three years, as decided in Breckenridge) FraMCoS International Conferences, dealing with all aspects of the application of fracture mechanics to concrete and concrete structures. The sites will alternate among various continents and countries, with no geographic or other bias, however, favouring the leading centers of research. Our Association also desires to sponsor or co-sponsor FraMCoS Research Workshops or other symposia focused on more specialized subjects.

The success of FraMCoS-1, our first conference in Breckenridge, depended on the quality of papers and the quality of discussions. In my opinion, as an overall judgment, they were outstanding. I wish to thank all the authors and participants for their efforts which guaranteed the success of our first conference.

Finally, in this first newsletter, I wish to thank all those leading researchers who lent me support in organizing this Association. In FraMCoS, we have a chance of making a significant contribution to the advancement of an important field of science and engineering.

Zdeněk P. Bažant



FOUNDING MEMBERS OF IA-FraMCoS

FraMCoS 2 - 1995

INITIAL THOUGHTS BY THE PRESIDENT-ELECT

The first International Conference on Fracture Mechanics of Concrete Structures (FraMCoS 1), organised by Professor Zdeněk P. Bažant, took place at Beaver Run Resort, Breckenridge, Colorado, USA, from June 1 to June 5, 1992. FraMCoS 1 was initiated at a preparatory meeting which was held at Hotel Oranje in Noordwijk, The Netherlands, on June 19, 1991, during the Fracture Mechanics Conference (Fracture Processes in Concrete, Rock and Ceramics) organised by Dr. Jan van Mier from Delft University of Technology. At that meeting a steering committee headed by Professor F.H. Wittman and Dr. B.I.G. Barr was charged to prepare statutes for the new International Association of Fracture Mechanics of Concrete Structures (IAFraMCoS). During FraMCoS 1 in Breckenridge, June 1992, the statutes were accepted by the first General Assembly by unanimous vote.

The General Assembly of IA FraMCoS also decided that FraMCoS conferences shall be organised regularly after intervals of three years. In-between, regional conferences and workshops can be held. It is one aim of each FraMCoS conference to document the state-of-the-art reached after three years in a quickly developing branch of science.

At Breckenridge, I had the honour of being elected chairman for FraMCoS 2. The second FraMCoS Conference will be organised in Zurich, Switzerland, in the summer of 1995. The Scientific Advisory Committee and a local organising committee is now being set up. The first announcement will be distributed before the end of this year.

Among other topics, particular attention will be given to the following topics:

- 1) Material models for concrete fracture
- 2) Experimental methods to determine fracture characteristics
- 3) Numerical analysis of concrete fracture
- 4) Significance and experimental/numerical determination of parameters used in numerical models
- 5) Mixed mode and dynamic fracture
- 6) Fracture of unreinforced and reinforced concrete structures
- 7) Environmental effects

Special emphasis will be placed on validation of numerical models and on the application of fracture mechanics in structural engineering. Further details regarding FraMCoS 2 will be provided in Newsletter 2.

Folker H. Wittmann



FOUNDING BOARD OF DIRECTORS AND STEERING COMMITTEE

FIRST BOLOMEY-WORKSHOP/FIRST FraMCoS WORKSHOP

Numerical Models and Material Parameters for Concrete Cracking - July 1992

A two day workshop was organised by the Institute for Building Materials, Swiss Federal Institute of Technology, Zürich in July 1992. The organising committee was chaired by Professor F.H. Wittmann. The workshop was initially planned to be the First Bolomey Workshop commemorating Professor Bolomey (1879 - 1952), a renowned Swiss concrete scientist. However, after IAFraMCoS was officially set up at Breckenridge in June 1992, it was decided to designate this workshop, at the same time, as the First FraMCoS Workshop. All contributions and summary reports of the discussions will be published in a proceedings volume by A.A. Balkema in the Spring of 1993.

The main objective of this workshop was to bring together a small group of invited experts to discuss different numerical models which have been developed recently to describe crack formation and failure of concrete. Special emphasis was placed on the significance of the different parameters used in these models and on the possibility of determining the material parameters experimentally.

The theme of the Workshop was covered in five sessions:

- (i) Fictitious crack model: fracture energy and strain-softening,
- (ii) Smeared crack model,
- (iii) Continuous fracture models,
- (iv) Probabilistic aspects, and
- (v) A special session on Applications.

The fictitious crack model has been developed in parallel with appropriate test methods to determine fracture energy and strain-softening, but further work is needed on this and other models. In some cases it might be difficult to determine all the necessary parameters experimentally. It became evident that a joint effort of scientists specialised in numerical methods on one side and in advanced experimental techniques on the other side will be needed to overcome these difficulties.

FraMCoS SPONSORED WORKSHOP

Sendai, Japan - November 1993

Dr. H. Mihashi is organising an International Workshop on Size Effects in Concrete Structures at Sendai on 1-2 November 1993. The Workshop is co-sponsored by FraMCoS as well as the Japan Concrete Institute, CEB and RILEM. The Workshop will address research areas arising from current developments in concrete structures.

Recently concrete structures have become larger and the strength of members is also increasing. Many concrete structures have been constructed, whose size or strength, or both, exceed the testing capacity of even well-equipped experimental laboratories. Thus there is a need to develop design methods for such large or high strength structures without carrying out tests or testing full scale specimens. Rational analytical techniques need to be developed in order to confirm the safety of structures on the basis of test results from small scale specimens. For this purpose, the fracture mechanics approach may be of potential use.

The aim of this Workshop is to discuss the mechanisms that cause size effects in concrete structures and to encourage exchange of ideas among all the parties involved in this research field, to promote development of rational methods for predicting the size effect in concrete structures, and hence designing such structures safely.

REPORT ON THE FIRST INTERNATIONAL CONFERENCE ON FRACTURE MECHANICS OF CONCRETE STRUCTURES (FraMCoS 1)

The first conference of the International Association of Fracture Mechanics for Concrete and Concrete Structures was held at Beaver Run Resort in Breckenridge, Colorado, during June 1-5, 1992. The conference, organized and chaired by Zdeněk P. Bažant of Northwestern University, was financially supported by the U.S. National Science Foundation. The conference was organized in collaboration with the NSF Science and Technology Center for Advanced Cement-Based Materials (ACBM) at Northwestern and with ACI Committee 446 on Fracture Mechanics. It was co-sponsored by the American Concrete Institute and the International Association for Bridge and Structural Engineering.

The conference came at a time in which the applications of fracture mechanics to concrete and concrete structures are undergoing an explosive development and are likely to have a major impact on the design of concrete structures and code specifications, as well as the practice of finite element analysis. It appears that this impact will probably be as far reaching as that of the introduction of plastic limit analysis which took place between 1930 and 1970.

The conference programme consisted of eight sessions. Each of them except the seventh started with a general session featuring principal and invited lectures and a one-hour general discussion, and continued with two parallel sessions featuring the contributing papers. The conference opened with a principal lecture by Z.P. Bažant which described the state-of-the-art and presented an overview of the freshly completed state-of-art report by ACI Committee 446, Fracture Mechanics, chaired by Bažant. S. Reid presented B. Karihaloo's invited lecture, devoted to material models for concrete fracture and discussing the mathematical formulations for strain-softening, including viscoelastic and stability aspects. The subsequent sections focused on propagation criteria and material models for fracture, smeared-crack concepts, and random process modeling. The problem of size effect theory and of an unambiguous determination of material characteristics were prominent in the discussions.

The second session dealing with experimental study, material characterization and size effect opened by the principal lecture of F.H. Wittmann, followed by invited lectures by R. Eligehausen, V. Saouma and V.C. Li. Wittmann presented a sophisticated mathematical analysis of the fracture process zone, including not only the effect of its length but also its width, and covering the effect of thickness of the specimen. He used the recutting method to compare the theoretical analysis to experiment. The invited lectures addressed the size effect in the failure of anchors, fracture of concrete dams and problems of ductility in fracture, including fibre-reinforced cementitious composites. The subsequent sections dealt with experimental study and material characterization, X-ray strain measurements, dowel action, aggregate-paste bond, wedge splitting specimens and lateral flexing of direct tension specimens.

Session three, dealing with numerical methods and structural analysis, featured invited lectures by A.R. Ingraffea, A. Carpinteri and J.G. Rots. The pros and cons of the discrete and smeared cracking models were discussed and numerical problems associated with various models (smeared crack model, orthotropic damage model, rotating crack models, etc.) received considerable attention during the discussion.

In session four, on damaged modeling, a principal lecture by H. Mihashi reviewed recent results on tensile strain-softening properties of concrete, and a principal lecture by K. Willam addressed the fundamental aspects of strain-softening description. In a subsequent invited lecture, de Borst presented a gradient continuum model for the treatment of concrete and rock fracture. There were extensive discussions on the problems of mesh-sensitivity, localization and the related size effect, as well as the problems of identification of damage characteristics from experiments, stemming from the impossibility to achieve uniform damage states. The parallel sections dealt with damage modeling and fracture of reinforced concrete. The papers addressed damage modeling by discrete and smeared crack concepts, micromechanics based continuum theory, microplane-type constitutive models for distributed damage, experimental results on strain-localization in compression fracture, finite element analysis of reinforced concrete panels, crack spacing and width in reinforced concrete, fibre reinforced concrete, and problems of steel bond modeling.

The fifth session, on mixed-mode fracture and interfaces, opened with the principal lecture by J.G.M. van Mier which was focused on the modeling of shear fracture. J-K. Kim substituted for the invited lecturer Y.-W. Mai to present their joint work on interfacial properties of steel fibre cement mortar composites. There has been a particularly lively discussion on interpretation of the various types of shear fracture tests and the existence of shear fracture on the microscale. The parallel sections which followed dealt with mixed-mode fracture, experimental studies, applications to punching failure of waffle flat slabs, analysis of biaxial loading and wedge-splitting tests, torsional damage tests, measurement of fracture energy in early age concrete, and tensile fracture characteristics of high strength concrete.

Session six, devoted to fracture analysis of bond failure, included principal lectures by S.P. Shah and H.W. Reinhardt, and an invited lecture by H.J. Hilsdorf. The lecturers discussed bond properties in fibre reinforced cement and aggregate-cement paste interfaces, role of bond in strain softening at various rates, and applications to concrete repair and protection overlays. The modeling of bond failure, its various influencing factors and appropriate experimentation, received considerable interest in the discussions. The subsequent sections dealt with interfaces, mixed mode fracture, and the practical aspects of shear, bond and anchors in reinforced concrete. The practical applications included fracture design of concrete piles, shear strength of longitudinally reinforced beams, fracture of lightly reinforced beams, dynamic behavior of concrete slabs, comparisons of code and fracture mechanics predictions, analysis of headed anchors, and an evaluation of the results of the recent round-robin testing of anchor bolts.

To avoid conflict with the general assembly of Association members, session seven was shorter and consisted only of parallel sections dealing with the size effect and environmental influences. The presentations addressed the influence of size on the measured fracture energy, the size effect on the nominal strength of short and slender reinforced concrete columns, the size effect on plastic rotational capacity of R.C. beams, crack formation under hygral gradients, thermal fracture, fracture analysis of shrinkage cracks, and fracture in concrete pavements.

The last, eighth session devoted to time-dependence, dynamics and fatigue, opened with a principal lecture by J. Planas and M. Elices, which dealt with fracture caused by drying shrinkage stresses and the consequent structural size effect. In the subsequent invited papers, J. Isenberg presented a review of dynamic fracture of concrete, based on a freshly concluded state-of-art report of ACI Committee 446, Fracture Mechanics, and S.E. Swartz discussed fatigue damage in concrete beams. There have been extensive discussions on the degree of influence of shrinkage cracking on the size effect under applied loads and on the mechanism of the rate effect in dynamic fracture, particularly the difference between fractures under dynamic rates and under slow rates corresponding to loading up to several days duration. The parallel sections that followed dealt with dynamic fracture, fatigue

and rate effect. The particular topics discussed were impact analysis, effect of water on dynamic response, torsional impact, blast-loading, experimental results on fatigue loading and cyclic bond slip behavior, generalization of R-curve modelling for rate effect and size effect, effect of cyclic loading on high strength concrete, and probabilistic aspects.

An unfortunate car accident in Colorado just before the conference forced cancellation of the invited lectures by J. Mazars and G. Pijaudier-Cabot. Despite severe injuries, both invited speakers have fortunately recovered by the time of this publication.

A large number of excellent papers, as well as lively and interesting discussions, have made FraMCoS-1 a great success. There were 139 registered participants at the conference, representing 20 countries. In total, they presented 125 papers.

All the presented papers were published before the conference in a proceedings volume entitled "Fracture Mechanics of Concrete Structures", edited by Z.P. Bažant (Elsevier Applied Science, London and New York, 1992, 1021 pp.) dedicated to the memory of Maurice F. Kaplan, a pioneering researcher in concrete fracture. Aside from the presented papers, the proceedings include the full text of the State-of-Art Report on Fracture Mechanics of Concrete: Concepts, Models and Determination of Materials Properties" by ACI 446, which has just been published as ACI Special Publication and has been reprinted in this volume with ACI permission.

On the social side, there was a conference luncheon on the first day hosted by MTS Corporation (represented by C. Fairhurst and K. Falkenburg). The banquet, held on Thursday night, was enlivened by a capturing speech on the history of mining in Colorado by Kurt Gerstle, and by presentations of awards for a skiing race and tennis tournament held during the free afternoons of the conference. The conference format, with free afternoons and a second session of each day held in the evening after dinner, allowed an extensive program of recreational pursuits during which the participants could come know each other better. The recreational program included a slalom skiing race at Arapaho Basin, a group hike under Mt. Lincoln, a wild white-water rafting trip on the Arkansas river, and a tennis tourney. The only obstacle to these physically demanding activities, fortunately overcome by most participants, was the altitude of Beaver Run Resort (9700 ft. or 3000 m).

An important event was the General Assembly of the founding members of IA-FraMCoS, held on Thursday afternoon. At that assembly, the by-laws of the new Association, previously prepared by the Steering Committee under the chairmanship of F.H. Wittman and with B.I.G. Barr as secretary, were approved and the officers of the new Association were elected. The General Assembly elected the following Board of Directors: Z.P. Bažant (President), F.H. Wittmann (President-Elect, to become President one year after his election), B.I.G. Barr (Secretary), and S.P. Shah (Treasurer). Also elected was the following advisory board: M. Elices, H. Horri, A.S. Kobayashi, J. Mazars, H. Mihashi, H.W. Reinhardt, V.E. Saouma, and J.G.M. van Mier, and auditors K. Gerstle and P. Gambarova. The Secretary will also serve as newsletter editor and archivist. Membership in the Association is open to any interested person active in the subject.

As decided in Breckenridge, FraMCoS-2 will be held at ETH, Zürich, Switzerland, in 1995, under the chairmanship of F.H. Wittmann who will become the second president of the Association. I have no doubt that this will be an outstanding conference rivaling our first one in Breckenridge in most respects except one—the altitude. I extend to Folker Wittmann my best wishes.

Zdeněk P. Bažant
Chairman, FraMCoS 1

FraMCoS 1

NONTECHNICAL ACTIVITIES

A good research conference or workshop is remembered as much for its social and nontechnical events as for its scientific contributions. It is the social events which allow personal acquaintances to be developed and provide the basis for friendship among participants. Indeed, one of the objectives of the by-laws of FraMCoS is to arrange social functions to promote contact amongst the members. In this respect FraMCoS 1 was a resounding success since considerable attention had been given by the organisers to ensure that participants could meet socially in one of the most attractive conference locations. Those fortunate enough to attend FraMCoS 1 will remember the conference setting and activities long after the finer points made during the discussions are forgotten.

The first social event was the ski outing and slalom race on the morning of 1 June, prior to the start of the conference in the afternoon. Ignacio Carol, the winner of the slalom ski race at an earlier conference held at Zell-Man-Zee, Austria (1990), organised the ski outing, in an excellent manner. Twenty-two participants travelled to the nearby Arahapoe ski resort, the highest elevation resort in the US. The mountains, under rapidly moving clouds and occasional glimpses of sun, offered a dramatic view. Thanks to stormy weather which deposited a few inches of powder snow on a hard base, the skiing conditions in the upper part were good.



LINE UP OF SKI PARTICIPANTS

A giant slalom race (a short course of ten gates, run twice) was organised by the professionals from the local ski resort. Eighteen conference participants entered the race. Ignacio Carol was the overall winner, but history does not record the other names nor the names of the four who did not take part! The race, which featured some impressive performances as well as hilarious events, was recorded on a video and shown after the conference banquet amid further hilarity. The slalom was taken more seriously by some since prizes were at stake for the best performance.

Another organised event - a conference hike - was held during the Tuesday afternoon. About sixty conference participants went by cars over Hoosier Pass and hiked the valley under Mt. Lincoln from Montgomery Reservoir towards Wheeler Lake. After earlier rains, thunderstorms and even snowstorms prior to the start of the conference, the weather cleared for the Tuesday afternoon hike. The valley was placid and the views spectacular which encouraged every hiker to make it past the abandoned old mine. Many reached the upper portions of the valley and a few even reached the high altitude lake (3700m), despite having to cross many snow fields and swollen creeks.



CONFERENCE HIKE PARTICIPANTS

The second free afternoon, on Wednesday, featured a white-water rafting trip through the nearby canyon of the Arkansas River. Kurt Gerstle who organised this event managed to entice some 25 participants to take part. A bus was chartered to carry the volunteers to the river where they boarded the rafts provided by the local white-water outfitters. The event may also be described as the white-knuckle event and there were no free hands to provide the publisher of this newsletter with a photographic record of the rafting trip.

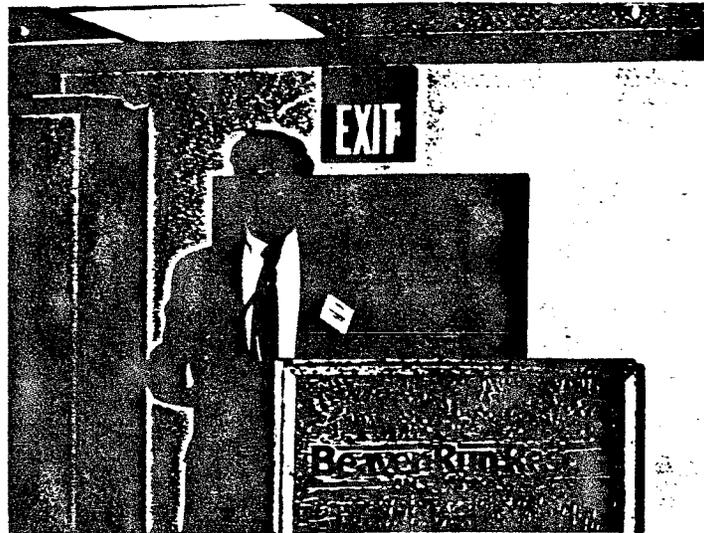
Wednesday afternoon was also set aside for the round-robin tennis tournament. There were nine participants and they did manage to record their efforts for posterity (see below).



TENNIS PARTICIPANTS

The tennis tournament was well organised - it was decided to play in three groups of three. The winners of each group ascended to the final group of three, in which the winner was Jeremy Isenberg, second was Zdeněk P. Bažant and third was Alberto Castro-Montero. Although everybody suffered in various degrees by exhaustion from altitude, it was a memorable meet. We discovered that our professional colleagues are more than just engineers and researchers.

Another highlight of the Breckenridge conference was the banquet held on the Thursday night. A most appropriate and interesting after-dinner speech was made by Kurt Gerstle who enthralled us with a fascinating account of the history of mining in Colorado. His speech was followed by the presentations of awards for the skiing race and tennis tournament.



**KURT GERSTLE SPEAKING
AT CONFERENCE BANQUET**

A number of FraMCoS business meetings were also held during the conference. A meeting of the FraMCoS Steering Committee was held on Wednesday afternoon, 3 June 1992. The Inaugural Meeting of the General Assembly of IA-FraMCoS Members was held on Thursday, 4th June - this meeting was attended by 29 Founding Members and 13 Non-Founding Members. The first meeting of the General Assembly was followed immediately by the first meeting of the Board of Directors of IA-FraMCoS. One of the items discussed by the Board was the need for a document giving "FraMCoS Conference Guidelines". This is an activity being pursued by the Board and the comments or suggestions of members are most welcome.

MEMBERSHIP

The bylaws state that membership of FraMCoS is open to all who are active in the field of the application of fracture mechanics to concrete and concrete structure.

This Newsletter has been circulated to all current members. Members who are aware of others who are eligible for membership of FraMCoS should encourage them to join by returning the Reply Slip below.

ITEMS FOR NEWSLETTER 2

Any member who wishes to make a contribution or to bring some appropriate activity to the notice of colleagues in Newsletter 2 should contact the Secretary at the address given below.

Newsletter 2 will be issued in the summer of 1993.

REPLY SLIP

Herewith I apply for membership of FraMCoS.

NAME: _____

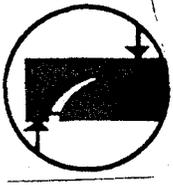
ORGANISATION: _____

TELE. NO: _____ FAX NO: _____

SIGNATURE: _____

Please return to the Secretary at the address below:

Dr. Ben Barr
Division of Civil Engineering
School of Engineering
PO Box 925, Newport Road
CARDIFF
CF2 1YF U.K.



FraMCoS

INTERNATIONAL ASSOCIATION OF FRACTURE MECHANICS FOR CONCRETE AND CONCRETE STRUCTURES

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Folker H. Wittmann (President-Elect)
Ben I. G. Barr (Secretary)
Surendra P. Shah (Treasurer)

June 4, 1993

To: IA-FraMCoS Officers (Wittmann, Barr, and Shah)

Dear Friends:

As my last act as the President, I have decided to approve FraMCoS Co-sponsorship of the "Europe-U.S. Workshop on Damage and Fracture in Quasibrittle Materials: Experiment, Modeling, and Computational Aspects", which Prof. Z. Bittnar and I will organize in Prague during September 21-23, 1994.

I would like to check your opinion on this point. If you have any comments, please let me know. All of you received my invitation to this Workshop, which listed only the financial co-sponsors. The name of FraMCoS as a scientific co-sponsor would be used in future formal announcements. My letter which you received contains detailed information on this Workshop.

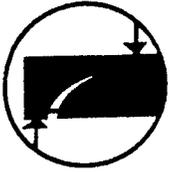
With best regards,

Sincerely yours,

Zdeněk P. Bažant

Walter P. Murphy Professor of Civil Engineering

ZPB:rdf



FraMCoS

INTERNATIONAL ASSOCIATION OF FRACTURE MECHANICS FOR CONCRETE AND CONCRETE STRUCTURES

FOUNDED IN 1991. INCORPORATED IN THE STATE OF ILLINOIS, USA

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Northwestern University
Evanston, Illinois 60208, USA
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Board of Directors:

Zdeněk P. Bažant (President)
Folker H. Wittmann (President-Elect)
Ben I. G. Barr (Secretary)
Surendra P. Shah (Treasurer)

June 15, 1993

Prof. Dr. Folker H. Wittmann
Institut für Baustoffe
Werkstoffchemie und Korrosion
ETH-Hönggerberg
CH-8093 Zürich, Switzerland

Dear Folker:

At the first anniversary of the Breckenridge Conference, according to the decision taken there, I am transferring to you with greatest pleasure the presidential chair of FraMCoS. It was my great privilege to be able to provide the stimulus for the creation of our society, of course with the crucial help of several others including yourself. Now the solidification of our society in the world-wide community of researchers, establishment of our influence in that community, and attainment of tangible goals such as improvement of the concrete design codes, will depend primarily on you. I wish you good luck and I will be glad to collaborate with you.

With best regards,

Sincerely yours,

Zdeněk P. Bažant

Walter P. Murphy Professor of Civil Engineering

ZPB:rdf
Enclosure

P.S. My secretary will be transferring to you some documents that you, as President, might wish to have on file (including the LaTeX code for our stationery).

Institute for Building Materials
Prof. Dr. F.H. Wittmann

0313

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Prof. Zdeněk P. Bažant
Northwestern University
The Technological Institute
Dept. of Civil Eng.
Evanston, Illinois 60208
USA

July 16, 1993

Dear Zdeněk

I received the material which is meant to transfer chairmanship of FRAMCOS from you to myself. Thank you. I will try to work on it in the next few weeks and send out a draft for the first circular letter to the members of the Organizing Committee. I also received your letter of June 4th, and I would like to tell you that I fully agree with your last act as President i.e. to approve co-sponsorship of the Europe-US-Workshop. I will contact you later on my prospective contribution on this workshop.

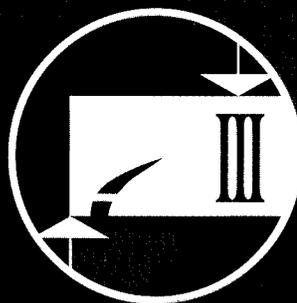
Sincerely yours,



Prof. F. H. Wittmann

**Third International Conference
on Fracture Mechanics of
Concrete and Concrete Structures**

PROGRAM



**October 12 - 16, 1998
Nagaragawa Convention Center
Gifu, Japan**

FRAMCOS-3

Third International Conference
on Fracture Mechanics of
Concrete and Concrete Structures

PROGRAM

October 12 - 16, 1998

Nagaragawa Convention Center
Gifu, Japan

Main Hall	Room A	Room B
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Oct. 13
Tuesday

9:00	Registration
9:15	Opening
10:00	Plenary Session : Principal Lectures (Part I) <i>Reinhardt, H.W. & Mihashi, H.</i>
10:45	Coffee Break
11:05	Plenary Session : Principal Lectures (Part II) <i>Willam, K. & Horii, H.</i>
12:00	photograph & Lunch
14:00	Invited Lectures <i>Rokugo, K.</i>
15:00	Coffee Break
16:00	Invited Lectures
17:00	

Chairmen

Oct. 14
Wednesday

9:00		Session 1A: Detection of Microcracking and Fracture Process Zone <i>Bascoul, A. & Ohtsu, M.</i>	Session 1B : Influence Factors on Fracture Properties (I) <i>Planas, J. & Nomura, N.</i>
10:00	10:40	Coffee Break	Coffee Break
11:00		Session 2A : Mode II and Mixed Mode Fracture <i>Alfaate, J. & Niwa, J.</i>	Session 2B : Influence Factors on Fracture Properties (II) <i>Hawkins, N. & Otsuka, K.</i>
12:00	12:40	Lunch	Lunch
14:00		Session 3A : Dam and Thermal Cracking <i>Slowik, V. & Umehara, H.</i>	Session 3B : Computational Modelling (I) <i>Bicanic, N. & Shirai, N.</i>
15:00	15:40	Tea Break	Tea Break
16:00		Session 4A : Rate of Loading <i>Oh, B.H. & Kinugasa, H.</i>	Session 4B: Computational Modelling (II) <i>Mazars, J. & Mizuno, E.</i>
17:00	17:20		

Oct. 15
Thursday

9:00		Session 5A : Fracture Parameter(I) <i>Guinea, G.V. & Kitutaka, Y.</i>	Session 5B : Numerical Analysis of Concrete Structures (I) <i>Reid, S. & Sato, R.</i>
10:00	10:40	Coffee Break	Coffee Break
11:00		Session 6A : Fracture Parameter(II) <i>Ingraffea, A.R. & Hashida, T.</i>	Session 6B : Numerical Analysis of Concrete Structures (II) <i>Rots, J.G. & Maekawa, K.</i>
12:00	12:40	Lunch	Lunch
14:00		Session 7A : Fatigue <i>Mueller, H.S. & Suzuki, M.</i>	Session 7B : Microstructure and Material Properties <i>Hu, X. & Igarashi, S.</i>
15:00	15:40	Tea Break	Tea Break
16:00		Session 8A : Damage under Cyclic Loading <i>Valente, S. & Maruyama, K.</i>	Session 8B : Numerical Models (I) <i>Pijaudier-Cabot, G. & Hasegawa, T.</i>
17:00	17:40		

Oct. 16
Friday

9:00		Session 9A : Compressive Failure & Size Effect (IV) <i>Wang, M.L. & Hatanaka, S.</i>	Session 9B: Numerical Models (II) <i>Cervenka, V. & Matsushima, M.</i>
10:00	10:40	Coffee Break	Coffee Break
11:00			
12:00			

Registration & Ice
Breaking Party

Room C

Room D

Social Program



18:00

Welcome Party by JCI

Oct. 14
Wednesday

9:00
10:00
10:40
11:00
12:00
12:40
14:00
15:00
15:40
16:00
17:00
17:20

Session 1C : Material Property. & Structural Performance <i>Schwesinger, P. & Ueda, T.</i>
Coffee Break
Session 2C : Fiber Reinforced Cementitious Composites (I) <i>Stang, H. & Kanda, T.</i>
Lunch
Session 3C : Fiber Reinforced Cementitious Composites (II) <i>Karilaloo, B.L. & Tsubaki, T.</i>
Tea Break
Session 4C : Deterioration <i>Leung, C.K.Y. & Shinmura, R.</i>

Workshop-I <i>De Borst, R.</i>
Coffee Break
Workshop-I
Lunch
Session 3D : Size Effect (I) <i>Wittmann, F.H. & Akita, H.</i>
Tea Break
Session 4D : Size Effect (II) <i>Kim, J.K. & Tanabe, S.</i>

18:00

Cormorant Fishing Party

Oct. 15
Thursday

9:00
10:00
10:40
11:00
12:00
12:40
14:00
15:00
15:40
16:00
17:00
17:40

Session 5C : Repair and Retrofit(I) <i>Reinhardt, H.W. & Nobuta, Y.</i>
Coffee Break
Session 6C : Repair and Retrofit(II) <i>Karbhari, V. & Kono, S.</i>
Lunch
Session 7C : Size Effect (III) <i>Bazant, Z.P. & Yoshikawa, H.</i>
Tea Break
Session 8C : Detailing and Structural Performance <i>Ozbolt, J. & Mikame, A.</i>

Workshop-II <i>Van Mier, J.G.M.</i>
Coffee Break
Workshop-II
Lunch
Workshop-III <i>Li, V.C. & Horii, H.</i>
Tea Break
Workshop-III

18:15

Music Concert

19:00

Conference Banquet

Oct. 16
Friday

9:00
10:00
10:40
11:00
12:00

Session 9C : From Micro to Macro <i>Gettu, R. & Niiseki, S.</i>
Coffee Break

Session 9D : Anchor Bolts & Tension Stiffening of Rebars <i>Bolander, Jr.J. & Mishima, T.</i>
Coffee Break
General Assembly of IA-FraMCoS & Closing

12:30

TECHNICAL PROGRAM



	13	14	15	16
morning				
coffee				
lunch				
coffee				
evening				

Tuesday, October 13 / Main Hall

Opening Session

9:00 - 9:15 *Mihashi, H.*,
Opening address

Plenary Session 1: Principal Lectures (Part I)

9:15 - 9:45 *Otsuka, K., Date, K. and Kurita, T.*,
Fracture Process Zone in Concrete Tension Specimens by X-Ray and AE
Techniques ...3

9:45 - 10:15 *Cervenka, V.*,
Applied Brittle Analysis of Concrete Structures ...a separated handout

10:15 - 10:45 *Maekawa, K. and An, X.*,
Post-Yield Shear Failure of RC Column and Its Ductility Simulation ...1463

10:45 - 11:05 Coffee Break



	13	14	15	16
morning				
coffee	■			
lunch				
coffee				
evening				

Tuesday, October 13 / Main Hall

Plenary Session 2: Principal Lectures (Part II)

- 11:05 - 11:35 *de Borst, R.*,
 A Class of Gradient-Dependent Damage Models for Concrete Cracking ...827
- 11:35 - 12:05 *van Mier J.G.M.*,
 Failure of Concrete under Uniaxial Compression: an Overview ...1169
- 12:05 - 12:35 *Li, V.C.*,
 Repair and Retrofit with Engineered Cementitious Composites ...1715
- 12:35 -12:45 Photographing** of participants on the roof (or inside the hall in case of rain)
- 12:45 -14:00 Lunch**



	13	14	15	16
morning				
coffee				
lunch				
coffee				
evening				

Tuesday, October 13 / Main Hall

Plenary Session 3: Invited Lectures

- 14:00 - 14:05 *Rokugo, K.*,
Introduction
- 14:05 - 14:45 *Bazant, Z.P.*,
Size Effect in Tensile and Compression Fracture of Concrete Structures:
Computational Modeling and Design ...1905
- 14:45 - 15:25 *Okamura, H. and Kim, I.H.*,
Size Effect and Failure of RC Structures under Earthquake ...1263
- 15:25 - 15:40 Break**
- 15:40 - 16:20 *Wittmann, F.H.*,
Application of Fracture Mechanics to Optimize Repair Systems and Protective
Coatings for Reinforced Concrete Structures ...1707
- 16:20 - 17:00 *Koyanagi, W.*,
Fracture Process and Maintenance of Concrete Structures ...1579