

# Meeting of the Bridge Health Monitoring Committee of International Association of Bridge Maintenance and Safety (IABMAS)

## Meeting Minutes

**Meeting Venue:** Kyoto International Conference Hall, Room 510

**Date:** October 21, 2004 10:00 AM-11:45 PM

**Meeting Chairs:** A. Emin Aktan and Hitoshi Furuta

**Recorder:** F. Necati Catbas

**Attendees:** See the attached list.

The workshop was called to order by *Profs. Emin Aktan* and *Prof. Hitoshi Furuta* at 10:15 AM. *Aktan* and *Furuta* welcomed the participants. Attendees introduced themselves (see attached list).

*Prof. Sami Masri* talked about the International Association of Structural Control (IASC), which is a ten years old association, and it will be represented in the IABMAS bridge health monitoring committee. *Masri* also announced that IASC will organize a conference in 2006 in San Diego (more information can be found in [http://cwis.usc.edu/dept/civil\\_eng/structural/welcome.html](http://cwis.usc.edu/dept/civil_eng/structural/welcome.html)).

*Aktan* stated that Bridge Health Monitoring (BHM) Committee is one of the two IABMAS committees. In this committee, there is a strong participation from Far East as well as from Europe. In addition, there are members of ASCE Engineering Mechanics Dynamics Committee, International Association of Structural Control (IASC) and International Society for Structural Health Monitoring of Intelligent Infrastructure (ISHMII). This wide spectrum of participation will provide different perspectives and also help reconcile different approaches. IABMAS is a powerful, well developing organization and the BHM committee of IABMAS has all the needs to be an authority in this area with strong participation of various members such as Prof Ko, who had involved in mega health monitoring projects in Hong Kong.

*Furuta* mentioned that a major objective of the committee is to explore “What works and what does not work in real life.”

*Aktan* mentioned that industry representation is critical for this purpose and this committee includes participation from the SHM industry. With this, *Aktan* proposed that the committee should focus on three areas:

- 1) What kind of effective health monitoring technologies are available today and will be available in the future?
- 2) How can bridge health monitoring and bridge management be developed in a more synergistic manner?
- 3) What are the research needs and what kind of benchmark studies can be developed to address these needs?

*Aktan* requested *Mr. Leo Klatter* who is the Bridge Management Committee Chair to provide the BHM committee with his perspective.

*Klatter* first cleared that bridge management and bridge management systems are not the same. For effective management, we must have a system and the system needs data. Health monitoring is expected to provide the data for this purpose. Currently, we heavily rely on visual inspections, which are well known to be subjective. Therefore, it is very important to have synergy between Bridge Management and Bridge Health Monitoring Committees. Getting more objective data for asset management is also important for intelligent business operations. However, sometimes researchers bring more complexity to the problem. We need the data and the information to be more accessible and usable for Bridge Management. Finally, we have gained experiences from large bridges. Can we downsize those experiences to smaller bridges in rural areas or cities to have safer and more economically managed bridges in general?

*Aktan* agreed that there is a strong connection between health monitoring and asset management. Health monitoring needs to be defined in this context. If we just monitor health, effectiveness will be limited. Bridge management and health monitoring may be very hypothetical if they are detached.

*Paulo Cruz* stated their experiences and work done especially in fiber optics to detect cracks on reinforced concrete structures on highway bridges in Portugal. Portugal will host the next IABMAS.

*Aktan* asked if the three focus areas of the committee are acceptable by the committee. These areas are:

- 1) Today's health monitoring applications that are in place and are working. We should address real problems.
- 2) Investigate synergies and needs between bridge management and health monitoring and assessment programs. We need to define health and performance.
- 3) Research needs in 8-10 years in bridge health monitoring, design and execution of benchmark studies.

BHM committee should organize sessions along these lines at the next IABMAS. Currently, IABMAS sessions are more populated with management related work and just testing or measurement. We need more researchers focused on an integration of BHM and BM to collaborate at IABMAS. There are examples of collaborations in the past such as to study sensors or HM approaches using variety of models. The past studies were useful to an extent. We need to consider and use the existing research know how and add to it. Also, we have to define and include consumer needs.

As for benchmark studies, *Aktan* stated that we need to define the desirable attributes of phenomena uncertainty similitude and field models. Then, it is more meaningful to conduct round robin, benchmark studies. *Aktan* stated that the past ASCE EMD Dynamics Committee steel building benchmark model was not fully designed for investigating the fundamental questions. For example, uncertainties that exist in actual

structures were not fully considered. Benchmark studies should include researchers with field experience.

*Prof. Shirley Dyke* stated that she was involved with the steel building study from the beginning. One key issue at the time was to start with a simple study and not to discourage people. Now, the ASCE EMD dynamics committee is interested in more realistic studies such as bridges. The IABMAS BHM committee provides an opportunity to start collaborations for such problems.

*Aktan* stated that those experiences are useful designing better benchmark studies. It is important to consider the similitude laws not only for physical sense but also for incorporating the uncertainties. *Aktan* stated that at Drexel they have developed such a model. This model is flexible in the sense that it can be reconfigured and uncertainties can be increased such as by ill-defined boundary conditions.

*Masri* indicated that there are many issues in developing a benchmark study. In the previous steel building benchmark model, too many complications could have discouraged people and participation could have been much less. As for the future benchmarks, we should not only have one model, we should have several models with increasing complexity.

*Dyke* mentioned that Erik Johnson of University of Southern California is the current chair of the ASCE EMD Dynamics Committee for Structural Health Monitoring benchmark studies. He should be contacted for the coordination of the benchmark studies with ASCE EMD Dynamics Committee.

*Aktan* agreed. He indicated that Dr. Catbas has experience in benchmark studies and requested Dyke and Catbas to work together for one of the three IABMAS BHM committee focus areas: Research needs and benchmark studies. This will also include organizing sessions at the next IABMAS along these lines.

*Aktan* stated that we have to define Health and Performance in relation to Bridge Management and Bridge Health Monitoring. We need sessions on this subject. *Prof. Furuta* will lead these for the next IABMAS.

*Furuta* indicated it is important to understand that what kind of data is needed. For example, accuracy is important, however, sometimes the data is too accurate and too much to be useful.

*Farhad Ansari* commented that it is possible to collect a lot of data with a variety of sensors. We need data at global level and also at local level (e.g. deck, connections). Therefore, a hybrid system is a better approach.

*Aktan* iterated the importance of which sensors work, which don't. Use and selection depend on the circumstances. For example, Prof Ko has major experience and collected a

lot of data from the bridges instrumented in Hong Kong. There are other examples such as the Great Belt Bridge in Europe.

*Ansari* stated that there are a lot of different sensors and knowledge exchange between sensor experts to determine the best ones is important.

*Aktan* asked Profs. Ko and Ansari and Dr. Sorensen to lead the effort and organize sessions on the state of the art of the health monitoring systems, what works-what does not, and the obstructions in real life implementations.

*Ko* indicated the importance of benchmark studies. Also, he pointed out the importance of linking bridge health monitoring and bridge management. How to collect and use data for decision making is a major issue. Collecting data may be for different purposes, and results in different durations (long term-short term). Design for data collection for typhoons and train operations are not the same. In Hong Kong, the data was used for several purposes such as designing new bridges in areas where the designers did not have much wind data. Using the data collected from the monitor systems, the designers feel more confident about their new designs. Still, bridge health monitoring has a lot of problems such as how to deploy sensors in the right manner.

*Aktan* indicated that Hong Kong projects are very important real life experiences and should be presented to demonstrate the available working/not working technologies. He also requested similar examples from Dr Sorenson as the European representative and also Prof. Ansari.

*Dyke* summarized the previous ASCE EMD benchmark studies. Modeling errors, uncertainty in mass, stiffness were evaluated. Initially, numerical problems with noise were solved. These studies were published in a number of papers including an ASCE EM special issue. There is also a web site available for the benchmark study (<http://wusceel.cive.wustl.edu/asce.shm/>). Then, blind tests on laboratory model were conducted. She stated her interest to study what was not covered in the previous studies.

*Masri* indicated that a lack of well calibrated models is a major issue. Also, relating damage state to signature needs to be researched. Damage detection is an inverse problem and not an easy one. It is important to work with governing agencies to coordinate information exchange and to make data available for future benchmark studies.

*Aktan* indicated that successful benchmark studies require having individuals who have significant bridge testing experience in real life. The previous ASCE EMD dynamics committee study with the steel frame seemed to have researchers who have mainly laboratory experience. The mechanical uncertainties in real life could not be fully incorporated in that study. We have to find and include researchers who have real life experience. There are some and we need their experiences.

*Mufti* indicated that they have tested more than 100 bridges and monitored many in real life. Their approach was first instrumenting and testing the bridges because of the

immediate needs and the size of the problem. Then, they conducted laboratory studies to explain the phenomena observed at the field tests. *Mufti* indicated that researchers from ASCE EMD/IASC, IABMAS, ISHMII should form a joint committee.

*Masri* stated that ASCE EMD/IASC is genuinely open for collaboration. At the same time, the collaboration should be discussed not to create duplicate work.

*Aktan* stated that having Dyke and Masri in the IABMAS committee is an important opportunity for collaboration.

*Ko* indicated that there are so many conferences, collaboration may help the decrease the number of meetings, conferences.

*Mufti* indicated ASCE-ACI joint committee which focuses on finite element analysis of concrete structures. Similar collaboration can be possible. Here, “bridge” is the common focus.

*Ansari* indicated that little time is left for doing the actual work between the conferences. Collaborating on real problems is important.

*Aktan* suggested broadening the collaboration to a joint ASCE EMD/IASC-IABMAS-ISHMII committee and also invite/include ASCE Structures. A broad ASCE SEI (EM-Structures) participation will be even more beneficial.

*Dyke* asked what type of a model should be considered for the lab study, a highway bridge or a long span. These have different characteristics.

*Aktan* indicated that it is very important to include the uncertainties. For example, temperature effects and boundary condition variations are examples that pollute the data not only in just a random manner. These type of uncertainties need to be simulated. *Aktan* mentioned the existing grid model at Drexel. The model is a steel grid with composite deck at the top. It was tested many times and data may be made available. Data from major bridges may also be made available to the joint committee.

*Mufti* mentioned the need for different models and benchmarks for different applications.

*Dyke* asked when and where the next meeting would take place.

*Aktan* suggested SPIE Nondestructive Evaluation for Health Monitoring and Diagnostics conference in San Diego (March 2005). Many of the IABMAS members attend SPIE.

*Ko* indicated that the meeting should focus on specific areas, such as IASC on modeling, IABMAS on bridges, applications and maintenance.

*Aktan* agreed and added ISHMII should focus on issues in field deployment and state-of-the-practice.

*Furuta* stated that each committee should exist to fill a gap and they should focus on their specific areas. Small duplication to an extent is necessary.

*Aktan* summarized the meeting: Three focus areas for the IABMAS bridge health monitoring committee are determined. Groups are assigned to lead each focus area; the groups will also organize sessions during the next IABMAS meeting.

*Aktan* adjourned the meeting at 11:45 pm, and thanked the participants.

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**Attendees of the IABMAS Meeting:**

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**Date:** October 21, 2004 10:00 AM-11:45 PM

**Meeting Chairs:** A. Emin Aktan and Hitoshi Furuta

**Recorder:** F. Necati Catbas

	<u>Name</u>	<u>Affiliation</u>
1	Aftab Mufti	ISIS Canada/ University of Manitoba
2	Emin Aktan	Drexel University
3	Farhad Ansari	University of Illinois at Chicago
4	Hitoshi Furuta	Kansai University
5	Jan-ming Ko	The Hong Kong Polytechnic University
6	Leo Klatter	Ministry of Transportation
7	Mazen Wahbeh	Mactec Engineering
8	Necati Catbas	University of Central Florida
9	Paulo Cruz	University of Minho, Guimaraes, Portugal
10	Ruth Sorensen	COWI, Denmark
11	Sami Masri	University of Southern California
12	Shirley Dyke	Washington University
13	Walter Saltzberg	ISIS Canada/ University of Manitoba