PROFESSOR TAKUJI KOBORI & HIS INTUITIVE UNDERSTANDING OF SEISMIC RISK MANAGEMENT

Haresh C. Shah[1]

[1] *Obayashi Professor of Engineering Emeritus, Stanford University, Founder and Senior Advisor of RMS, Inc*

ABSTRACT:
Prof.Takuji Kobori's interests for earthquake risk management covered the whole spectrum from structural design, to construction, to operation and to lifetime safety. He was one of those rare engineers who showed great understanding and an ability to implement hard and soft parts of how risk is managed. He provided great leadership in Japan as well as globally by showing that risk can be managed by good design, innovative ideas like active and passive controls, economic and health monitoring strategies and by providing incentives to all by showing the financial advantages of low risk structures over their lifetime. He and Kajima Corporation sponsored a research project in CUREE/Kajima phase IV titled, "Impact of Seismic Risk on Lifetime Property Values". He had this intuitive knowledge that safe structures over their lifetime are also financially more attractive for the owner and for the user. Seismic risk management for individual structures as well as for the whole communities was one of his interests. He sponsored a project titled, "Development of Disaster Prevention Community Models". These and other ideas of Prof. Kobori clearly showed how soft and hard strategies can be combined to achieve a safe and sustainable living environment. This paper will discuss risk management strategies pursued by Prof. Kobori from technical, economic, policy, and social perspectives.

KEYWORDS:
Risk Management, Lifetime Safety, Urban Safety

1. RENAISSANCE ENGINEER

Professor Kobori was both a “hard and soft” engineer. He was interested in designing structures which are optimum from the point of view of behavior, performance (static and dynamic) and also from the point of view of cost, safety, reliability during its lifetime, and functionality. He was one of those rare individuals with fantastic hard and soft skills to be a leader. During the historic evolution of the field of Civil Engineering, Mechanics, and Mathematics over the past centuries, we have heard of great contributors, thinkers, and leaders. Some of them were true renaissance people. They were focused on their discipline, but they also were accomplished poets, painters, artists, writers, and musicians. They were well rounded and not only did they make a mark their chosen profession, they are to this date known for their other talents. In recent decades, these traits are becoming very rare. It is remarkable that we saw those traits in Prof. Kobori. An outstanding teacher, a mentor to many, a business executive, an artist of the best tradition of Japan, he was a true renaissance engineer.

2. TWO DECADES OF CUREE/KAJIMA COLLABORATION

It is quite revealing to see the overall thinking of Prof. Kobori by looking at the themes of various phases of research Kajima, in collaboration with CUREE, and under the leadership of Prof. Kobori had supported. He was specifically the intellectual driver of various phases, until Phase VI of the joint research program. The first Phase was initiated more than two decades ago and this year, phase VII will be initiated. It is revealing to know the breadth and depth of research ‘curiosity’ Prof. Kobori demonstrated during the entire life of this joint effort.

Phase I of the collaboration was mainly related to "hard" part of the earthquake engineering. These included understanding soil-foundation-structure interaction, hysteresis modeling of reinforced concrete members, and design guidelines for ductility and drift limits. Even in this phase, Prof. Kobori introduced one project which had to do with how engineering know how is translated into practice. The title of that project was "The Long Road from Engineering Research to Application". His concern at that time was to make sure that the distance between hard engineering research and development to actual practice should be as short as possible Only through such a transfer of knowhow, one could achieve better reliability of structures and hence reduce risk of life and economic losses.

He was so convinced about that aspect that the Phase II research was mainly focused on evaluating the socio-economic consequences of large earthquakes. The connection between risk reduction and socio-economic consequences of earthquakes is obvious. In this phase, major emphasis was placed on urban risk and urban safety. He urged the researchers from CUREE universities to develop computer tools for optimum design of urban buildings in the presence of risk. Again, this demonstrated his desire to look at the problem of seismic risk reduction as a combination of hard and soft sciences.

Based on the research results of Phase II, Prof. Kobori once again focused his attention in Phase III on the hard part of earthquake engineering where some gaps in understanding design of buildings and their performance was observed. So this phase once again focused on near field ground motions, behavior of structures to the large pulses in the elastic and inelastic domains, demands on the structural capacity imposed by near field ground motions and techniques to improve response of flexible structures to near field ground motions. To balance this hard part of the research agenda, a project on risk management for businesses was also initiated. During this phase, a 3 year project was also initiated to develop Decision Support Tools for earthquake recovery of business. This very innovative project was to manage earthquake risk to property owners and businesses that bear more economic losses due to business interruption than due to loss of 'bricks and mortar'.

In Phase IV, the research collaboration once again turned to softer side of earthquake risk management. Based on the results of Phase III work on decision support tools for earthquake recovery of businesses, a new project was initiated titled, "Impact of Seismic Risk on Lifetime Property Values". In this project, the focus was on the effect of earthquake risk on property values or in real estate investments. Considering the uncertainty of earthquake occurrence during the life time of an investment, the uncertain net income stream and uncertain earthquake losses were evaluated to assess the return on investment and return on equity. Again, it can be seen that Prof. Kobori was continuously aware of the balance between understanding the behavior of structures under earthquake loads as well as the impact on risk of current design processes and its eventual economic and social benefit.

Phase V was further proof of the vision of this renaissance engineer. He wanted to investigate vision based motion tracking for risk assessment during seismic events. This is truly "an out of the box" project. Prof. Kobori wanted to understand, through new technologies, real time monitoring and assessment of facilities with high value nonstructural elements. The intent was to rapidly evaluate and identify potential hazard zones within a structure, exposing rescue workers, society and the environment to unnecessary risks. In the same phase a project on creating a framework for integration and visualization of structural state data. Again, the purpose was to understand how a structure such as a bridge or a building undergoes changes during its life time, thus changing its risk profile.

During the past two decades, there has been increasing concern about progressive collapse, and a risk profile of structures who may exhibit such a behavior. As a result, Phase VI was devoted to investigating all factors leading to progressive collapse of structures.

It is obvious from this 20+ year history of projects which had a strong 'signature' of Prof. Kobori that he wanted to understand the behavior of structures under complex dynamic loads and how they should be designed for optimum performance as well as how the new understanding of designs would alter economic and life loss risk. This parallel

advancement of the hard and the soft earthquake engineering discipline was at the heart of what Prof. Kobori's contribution was in the field of seismic risk management.

3. CONCLUDING REMARKS

Holistic understanding of the whole field of earthquake engineering will convince many that the eventual goal is to reduce risk of damage, collapse, life loss and long term economic impacts. Very few modern engineers in this field tackled this problem with passion, urgency, dedication and elegance as did Prof. Kobori. His most recent work on active and passive controls for earthquake response of structures once again provides a glimpse of how he was tackling the problem. His vision, his low key manner of developing questions and project descriptions and most important, his multi-faceted and multi-disciplinary understanding of the problems set him apart from others. His understanding of the complex field of risk management was almost intuitive. This uniqueness of talents will be sorely missed.