

# WHAT WERE THE LESSONS OF THE 1989 LOMA PRIETA?

by

Tsuneo Katayama <sup>I)</sup> and Richard K.Eisner <sup>II)</sup>

## SUMMARY

This paper consists of two parts: the first part is the transcript of the oral presentation made by Katayama at a symposium held in the Tokyo Institute of Technology on November 1-2, 1990. The second part is the letter from Richard K.Eisner, Director of Bay Area Regional Earthquake Preparedness Project, responding to the questions raised in Katayama's presentation. We attempted to clarify some of the problematic points / shortcomings observed during the Loma Prieta disaster, which should be but have not been consistently followed in previous reports.

## KATAYAMA'S PRESENTATION AT TIT SYMPOSIUM\*

I am not going to repeat what has been discussed by previous investigators nor what has been published in reconnaissance reports, because if I do so there is no chance of my winning in front of these US experts. However, I will be using excerpts of published reports for today's presentation. One of the reasons for this is that, by doing so, I do not have to struggle with writing an English manuscript by myself. The purpose of using excerpts is, however, a little more profound.

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I) Professor, Institute of Industrial Science, Univ. of Tokyo.

II) Director, Bay Area Regional Earthquake Preparedness Project, State of California-Governor's Office of Emergency Services.

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While reading reports on the preparedness, response and recovery during and after the Loma Prieta event, I found a number of ambiguous points, which seem to deserve deeper exploration. Therefore, I decided to summarize some of the points I could not well understand and to ask them to the US participants here. I believe this will be of some usefulness even for the US colleagues.

First, let us listen to a tape. This is how it began.

George: This afternoon which until now was just an exciting buildup to World Series Game Three between the Giants and the A's, I tell you right now, these people will have something to tell about in the years to come when their grand-kids say what was it like going to the World Series in Candlestick Park. Mike Woodley, I don't blame you, you started to beeline out of this box badly.

Mike: I did, personally.....

George: There will be probably aftershocks so we shall see a lot of excitement on the field. But up here on the press box a lot of pale faces right now because we had a good jolt here as we get ready just moments away from the World Series.

Stan: Rest assured we will break in on KCBS during our baseball broadcast with any reports on damage or injuries around the Bay Area. This was certainly a solid earthquake. Setting it aside for a moment and we certainly will come back to it, on the field tonight the Giants and the A's are going for Game Three, the A's with the 2 games to none lead. Mike, can the Giants come back realistically?

Mike: I think so if they win tonight. It's important that they get off to a good start tonight, they win it. Keep in mind not only tonight but Games Four and Five, if needed, will be played here at Candlestick Park, so it's important that they get the jump right now. If they are going to get back in the Series, they have to win Game Three tonight. I... that's my feeling and I think the feeling of the players as well.

Stan: All right, you'll be back after the game with Bob Renolly.

Mike: Bob Renolly the Giants catcher and Steve Mckensey the former ace pitcher and if the earthquake is OK, we'll take phone calls till 9:30 tonight.

Stan: All right, fans, this is going to be a wale of a ride on KCBS. We have a World Series Game Three coming up in just a moment, and of course full coverage of what has apparently been a fairly solid earthquake here in the Bay Area, just moments ago. From Candlestick Park along with George Harris and Mike Woodley, I'm Stan Bangard. News 74 KCBS, KCBS Newstime 5:07.

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--Disruption--about 1 minute  
.....

Jan: KCBS Newstime 5:08. We should mention that we have been trying to go to the World Series game. Unfortunately because of the earthquake that we have had in the Bay Area just a few minutes ago, it obviously is an major earthquake, we want to prevent going to the World Series just as long as we possibly can so that we can get you more on this earthquake. We have several people on our Newstime right now. First of all to News 74's Diana Gappis. Diana is a producer here at KCBS. Diana, tell us where you are and what it felt like.

Diana: Well, Jan, I'm here at Albany and it was about 5:03 when the quake hit. It was a rocking kind of quake in Albany lasting about 10 to 15 seconds or so.

Jan: All right. Also on our KCBS Newstime right now is News 74's Chris Cutter. He had been covering a traffic accident at 19th and Judah in San Francisco. Chris, what did you feel, and what's the situation?

Chris: Well, we were just standing there talking to the police officers and all of a sudden the ground beneath me, Jan, just started buckling and I said earthquake, earthquake, and sure enough that's what was happening. We were right next to the 19th and Judah Line here and the overhead wires were just shaking furiously and the sidewalk was just rumbling below me. I have never felt anything like that, and I had been through a few earthquake in San Francisco, having grown up here, but it

was an incredible feeling and I think everybody around me right now is a little bit jittery and I guess...

Jan: Well, we seem to be having some problems with our phone lines. I don't think that's any surprise given the fact that whenever we've had an earthquake here in San Francisco we do tend to have problems with lines. Apparently what happens is a lot of people try to get on the line and make calls just as soon as they can and that causes an overload as far as possibly the phone company is concerned. Right now, we want to go to News 74's Mike Sugarman, he's also with us on the line. Mike, where are you? Tell us what you felt.

Mike Sugarman: Well I'm at home and I'm in the southern part of San Francisco, near City College, not too far from Candlestick Point in fact. And it went on, as everybody that's listening probably knows, it has been going.... well, I can't even guess.....because these things tend to last forever when you are living through them but I say 30 seconds or 45 seconds at least and my entire house was shaking and there was some pictures that fell. I looked outside and saw the street lights in front of our house which is embedded, I don't know how far deep into the ground, it was shaking and.....

Many radio listeners tuned to KCBS-AM, the only all-news station in the Bay Area. The station had dozens of reporters all around the Bay Area. The earthquake knocked out the power and most of telephones at KCBS's offices in downtown San Francisco. But a rooftop emergency generator kicked in almost immediately and the station came back on the air after about a minute [Ref.1, p.312]. With official information slow to arrive, the KCBS staff began to take calls from reporters, both on and off duty, and listeners to assess the damage and to pinpoint the epicenter. Now listen to the tape recorded at around 5:35, about 30 minutes after the earthquake.

Jan: We also noticed some smoke here in downtown San Francisco at the time of this earthquake occurred. Now I don't know whether or not that was dust that was shaken up by the earthquake or what. We don't notice any light now from our vantage point here at No. One Embarcadero Center, the thirty-second floor. We will get back to some of our KCBS listeners. Obviously all of our KCBS reporters are working right now. But first we want to bring you this special announcement.

Announcement: This is a KCBS earthquake emergency safety advisory. If your power is off, use only flash lights for light. If you turn light which is on or off you may ignite leaking gas. Do not use matches, lighters or candles. Additional emergency information is printed in the front of your telephone book. This has been an earthquake safety advisory. Stay tuned for more earthquake coverage on News 74 KCBS.

Jan: KCBS Newstime 5:35. Let's go back now to News 74's John Atkinson who is over the Bay Bridge right now. John what can you tell us from Sky Three?

John: We are right over the Cypress structure and it is just a complete mess. It appears as if it has fallen apart right now. There are cars all over the place. The roadway has completely, well I don't want to say completely collapsed, but it is just a complete mess. It has collapsed in a number of places. There are cars that are overturned and people running around down there, and it does not look like a very pretty sight. Obviously traffic is not getting through there coming off the Bay Bridge. It has nowhere to go. Traffic is just a complete mess in the area. Again the Cypress structure looks like it is just completely, almost completely collapsed in a number of places. And traffic has been stopped in just about every direction and this is just an amazing thing to look at. I do not really know what to tell you. It is like this whole thing is just completely fallen apart.

Jan: John, let me ask you this. How many cars are you seeing right now?

John: On top of the Cypress structure, maybe about a quick estimate would be about twenty to twenty-five cars on top of the Cypress structure. On the lower part of the structure it is impossible to tell, because it looks like the upper part has collapsed on the lower part. There are cars, they have fallen off there. There are cars which are overturned, there are trucks that are overturned and I do not even want to think about what has happened to the cars that are underneath the upper level.

Up to this time, there has not been any information about the size and the location of the earthquake. The emergency announcement you have just heard is the first such announcement, and there has not

been any official reports of the damage. Now I am going to raise some of the problematic points I found in the reports related to the post-earthquake period. I want to confirm what is written in the reports. I want to know why some such situations existed in the Bay Area. And I want to know what has been done within a year since October 17, 1989.

It is reported:

Immediately after the event, the (San Fransisco) police and fire computer-aided dipatch systems failed due to overload and power failure [Ref.1, p.405].

Alameda County's computerized dipatch system failed [Ref.1, p.409].

Communications were disrupted at both Caltrans and the California Highway Patrol when their stations lost power in San Fransisco and Oakland. The lapse in communication left initial post-earthquake decisions on such matters as closure and evaluation to the judgment of low-ranking road crews..... Only a few emergency personnel on the site were aware that a 50-foot section of the deck had collapsed, and this information was not communicated to all personnel directing evacuation. Consequently, for the first 30 minutes after the earthquake, motorists continued to drive toward the collapsed section of the bridge [Ref.1, p.390].

Did all these communications systems fail because of power outage? Were there not emergency generators in any of these organization?

It is also reported:

(In San Fransisco) Initial damage assessment was conducted via police radio by personal observations of patrol officers. There was no damage assessment plan in place before the earthquake [Ref.1, p.405].

It appears that Oakland's EOC (Emergency Operations Center) did not have a prepared damage assessment plan in place. They had to rely on new reports and observations of emergency and rescue workers for damage assessment [Ref.1, p.403].

The City and County of San Francisco's Office of Emergency Services staff works out of the fire dispatch center on an everyday basis..... During an emergency, the EOC is activated in whatever space is available within the dispatch center [Ref.1, p.404].

Neither the (San Francisco) fire department nor the police department have helicopters at their disposal [Ref.1, p.404].

Then, how could it be said that:

The Bay Area is relatively well prepared for earthquakes and is extremely rich in resources that help in dealing with earthquakes [Ref.1, p.397].

It is reported:

The (San Francisco) city departments did not conduct an integrated emergency response..... The police department did interact with the fire department in the Marina District, but there was little coordination with building and safety or public works department personnel [Ref.1, p.404].

The (San Francisco) police officials complained that though they had to control the displaced residents of the Marina District, they were not provided with sufficient information to keep the residents fully informed [Ref.1, p.405].

Why did this kind of lack of coordination and information come about?

With regard to land use and building codes, it is reported:

In the immediate aftermath there was little response by the planning department to the liquefaction hazard in the Marina, and building permits were being expedited. Several weeks after the earthquake, an emergency ordinance to bypass building codes was proposed before the board of supervisors in order to expedite San Francisco's city permit process.... An interagency forum, the Special Earthquake Reconstruction Committee, has been established for the discussion of earthquake-related problems, but no city research effort has been planned for long-term hazard mitigation [Ref.1, p.387].

How true is this? Is there any open criticism against this?

It is also reported:

In response to continuing scientific discussion of the Loma Prieta event, the mayor of San Francisco was quoted as saying, "Geologists talk too much". This reminds one of the repression of scientific information that followed the 1906 San Francisco earthquake [Ref.1, p.426].

Was this the general atmosphere among elected officials or business owners?

I would like to add several more questions on the subjects I am interested in:

The damage caused by soil failure in the Marina District has prompted a coalition of environmental groups to oppose plans for a multimillion-dollar mixed-used development on 142 acres of what is now the Golden Gate Fields racetrack in Albany. The coalition is arguing against the plans on the grounds that the proposed development site is on landfill similar to that in the Marina District [Ref.1, p.387].

What happened to this?

On the federal level, seismic research funds have overwhelmingly gone to pure research, with "crumbs" to engineering..... The research on seismic prediction has gone about as far as it can, and such funds need to be redirected to more practical areas [Ref.2, p.54].

Do you agree?

Originally the San Francisco's Auxiliary Water Supply System network was divided into two independent sections (north and south), served by the separate halves of the Twin Peaks Reservoir. In an emergency, each half could supply the other half. But in 1964, the sections were left permanently interconnected. This decision was costly during last year's earthquake. Breaks in the network's southern section pipes drained the Jones Street Tank within 15 minutes..... Plans are now under way to restore the north/south division [Ref.3, p.59].



Is this true and have the plans been realized?

I have no intention of blaming any persons for what did not go well during the Loma Prieta. I simply want to point out that there are many things which should be more consistently followed. Some of the things may seem to be trivial. However, it is the trivial things that can be remedied and incorporated in practical disaster mitigation program. In this sense, the problematic points/shortcomings I have mentioned here may have to be more seriously investigated.

Thank you.

### REFERENCES

1. Loma Prieta Earthquake Reconnaissance Report, Earthquake Spectra, Supplement to Volume 6, May 1990.
2. Virginia Fairweather, "The Next Earthquake", Civil Engineering, March 1990.
3. Teresa Austin, "Keeping Lifelines Alive", Civil Engineering, March 1990.



### RESPONSE BY EISNER *A Letter Dated December 24, 1990*

Dear Prof. Katayama:

I am just now catching up with the correspondence that has filled my "in box" since October. In reading the materials from the Tokyo Institute of Technology conference, I realized that the questions you posed at the conference were not responded to during the discussions. Since you have posed several important questions, I will try to respond as best as I can and suggest others that may also be able to clarify the questions you have raised.

First, at the time of the earthquake, I believe we were all surprised by the size of the earthquake and the wide spread, seemingly random, pattern of damage. In addition, the recognized vulnerability of

region's power system, had many predictable, but unexpected, impacts. This was particularly the case with telephone communications where many businesses and government bureaus utilize PBX(non-centrex) systems that cannot function without power. In many cases, they had no emergency power. This was the case at the US Geological Survey facility in Menlo Park, the critical facility for accurately determining location and magnitude of earthquakes in this region. In addition to their loss of telephone service, many of their instruments were "off scale" because of their proximity to the epicenter, further delaying identification of the epicenter and magnitude (awaiting information from the USGS in Golden, Colorado).

[I personally think the process was further delayed by the World Series and the number of employees that had left work early to watch game three].

At State OES, we were not notified of the epicentral location and magnitude for more that 30 minutes and because of the telephone problems at USGS, the numbers could not immediately be confirmed, so they were not immediately released to the media.

You note the problems with loss of power and the failure of emergency generators at critical facilities. This was very embarrassing to many governments and businesses. In many cases, emergency generators, their fuel tanks, piping, switching, and conduits were improperly braced. For example, at KCBS Radio, the generator was braced, but the fuel tank was not. The tank shifted during the quake and crimped the fuel line. This was not an immediate problem, but when the "day tank" on the generator ran out of fuel, the generator failed from fuel starvation. It took only a few minutes to repair, but the station went off the air as a result of this problem.

In other cases, such as the Pacific Telephone Emergency Operations Center, the generator was tested monthly, but never tested with a full emergency load. When the load was applied, the generator burned out.

In both San Francisco and Oakland, the "enhanced 911" system failed. This, I believe is what you referred to as the "computer aided dispatch." This system provides dispatchers with the telephone number and address of those calling 911. Both failures resulted from

damage to a single facility that is a part of AT&T's Oakland Central Office. This building suffered limited structural damage resulting in damage to switching gear and computers. Normal telephone service was not disrupted, but the enhanced system didn't function for several days.

It is important to note that the 911 system, which was not designed to handle the load of a major disaster, continued to function in a manual mode, without the computers.

The damage to the telephone system is certainly of great concern to us. Even without damage to the telephone system, service was disrupted from overuse (delayed dial tone). More extensive damage to the Oakland Central Office would have severely impacted "long haul" telephone communication between the Bay Area and the rest of the country. It would have been a very different disaster without the telephones.

The concern you express about the problems with loss of communications within CalTrans and the Highway Patrol is shared. However, our planning has long assumed that central control of response is neither feasible or desirable, so training has promoted decentralized response and decision making. This approach may result in overly conservative decision making on the scene of an incident, but it recognizes that in a major regional disaster, the first responders, local government police and fire fighters, will have to make critical decisions to protect life and property without access to "senior authority." Centralized response to a multi-incident regional disaster or multiple local disasters is alien to and incompatible with American "local home rule" philosophy.

The importance of local home rule dominates both the strengths and weaknesses of the Loma Prieta response. While the state and federal governments set standards and provide training and support, the response is controlled by local jurisdiction--usually the municipality. Even when state and federal resources are dispatched to assist in a disaster, the local government remains in charge, directing state and federal resources.

This results in an uneven approach to disaster preparedness, but also a high degree of political accountability. If the local citizens demand more, the local government will do more. It is the level of government closest to the people and the most responsive to their needs.

In nearly all communities, initial damage assessment ("What happened?" "How big was it?") (in qualitative terms) is performed by local police, fire, public works and other personnel. Initial reports, because of the chaos, were sporadic and incomplete. I believe this is inevitable in such events. Few jurisdictions can afford helicopters or fixed wing aircraft. Even in Mexico City, aerial reconnaissance proved of little value in determining the extent of damage. Reports from that earthquake indicated that from normal flight altitudes, even trained observers could not determine the extent of structural damage unless the structure had pitched over into the street. In several cases it was reported that the "prop wash" and vibration from helicopters flying at lower altitudes for better observations, threatened already damaged buildings, so the flights were canceled. In any case, getting the aircraft airborne to provide assessments, builds delays into the system. Obviously, a combination of ground observations and aerial reconnaissance will provide a better approach, but we are not aware of a case where a lack of aerial reconnaissance delayed response.

Clearly damage assessment remains a serious problem both at the micro and macro scales. The utilization of ATC20 for rapid screening of structures proved very effective. Utilization of more uniform methods for overall assessment need to be developed. Unfortunately, in an event of this magnitude, waiting for accurate damage assessment can only delay response. We are therefore planning for "event triggered response" to events over a certain magnitude and/or epicenter location. That is, when an earthquake greater than, say M6.0 occurs in the San Francisco Bay Region, the state will initiate response with personnel, equipment and communications capability. This will speed response while awaiting a damage report.

You have raised several questions about San Francisco's preparedness and response for the earthquake. As I mentioned at the conference, San Francisco operates as its own country in many ways. It has been particularly hard hit by federal and state budget cuts over the past five years. This has proved particularly devastating to the city as it attempts to provide adequate medical care for the population with AIDS. In the period immediately after Art Agnos became Mayor, budget cuts resulted in the reduction of their Office of Emergency Services from a staff of 6 to a staff of 1 1/2 at the time of the earthquake. Most of the problems of coordination between departments and response resulted from this drastic staff cutback.

We lobbied against these decisions, but in San Francisco, health services for the poor was more immediate and more important than disaster preparedness. I would not like to sit in judgement of decisions such as this.

Interdepartmental coordination has been a serious problem in San Francisco for some time. Like most jurisdictions, disaster preparedness and planning has remained the responsibility of the fire department, with occasional coordination with police and public works. Partly because preparedness became the jealously guarded "territory" of the fire department, and partly because no one else was particularly interested in getting involved (and no directives from the Mayor were issued to do so), other city agencies were not involved in either planning, training, exercises or actual response. You are quite correct that the emergency response was not integrated. This is another problem we have been attempting to address over the past 7 years with only limited successes (Oakland, Hayward, Palo Alto, San Jose are exceptions where integration occurs). The model we are attempting to promote in northern California is that of the City of Los Angeles, where Shirley Mattingly, with the support of Mayor Tom Bradley, has done an outstanding job of planning for response, as well as, recovery and reconstruction.

You raise several questions about the Marina District and its reconstruction. As you are aware, the damage in the Marina District was a result of a very complicated set of circumstances, not completely known even today. These include the poor quality of hydraulically placed fill, flawed architectural design of the buildings, inadequate construction practices, lack of maintenance of the structures over time, and the prior construction on the marina which abandoned foundation piles and debris which may have resulted in differential settlement of some structures. While the damage appeared to be focused in this area, most of the structures in the Marina District were undamaged and remained occupied after the earthquake. The question then became how to respond to the patchwork of damage in an otherwise highly urbanized, undamaged area. The decision was made to permit reconstruction after geotechnical and engineering studies reported that reconstruction could safely occur with cautious and conservative design of foundation and lateral bracing systems. I am aware of the proposal to waive the permit process for reconstruction, but I do not believe it received serious consideration.

I would suggest you contact Laurence Kornfield, Chief Building Inspector with the City Department of Public Works, concerning this question. He is very familiar with the post disaster inspection and review process, and with the reconstruction of the Marina. He also visited Japan for several weeks during the summer of 1990 giving lectures on the earthquake, so you may be familiar with him (I have xeroxed his business card and attached it to this letter).

And now to the question of the Mayor of San Francisco. First of all, he is a politician. Maybe that says it all. During the aftermath of the earthquake, he was extremely successful in being "visible" in the media, presenting the "official story" of San Francisco's miraculous survival of the disaster. It is to his credit that the earthquake is now known popularly as the San Francisco earthquake! He is also a primary promoter of tourism in the region and has, therefore, attempted to put the best "spin" on the disaster that he could. His comment about geologists was a result of the recently released report by the USGS that the probabilities for additional earthquakes of the magnitude of Loma Prieta in the region are greater than 67% within the next 30 years. He was reacting to this long term forecast when he said that "geologists don't know what they are talking about and should keep their mouths shut until they can predict an earthquake within days." Having participated in several discussions with the scientists concerning the methodology and conclusions about the probabilities for future earthquakes, I am not unsympathetic to Mayor Agnos's statements. However, his outbursts create difficulties for us in convincing the public to continue to prepare.

I have also read "Denial of Disaster" with interest. While I do not deny that "boosters" of development in the region may have played down the earthquake threat, I find the conclusions of collusion and conspiracy a little hard to accept. First, it is extremely difficult to research an event eighty years after it occurred. Many of the author's conclusions are based on rumor, letters, and journals that cannot be validated or confirmed but are generally viewed as exaggerated accounts of the earthquake. In addition, there was certainly no lack of information in the scientific communities about the seismology, geology, and engineering impacts of 1906. Unfortunately, as it is today, politicians and developers argue that the earthquake was a rare event that will not likely reoccur for decades or perhaps, centuries. While they may be right, I fear that they are wrong and detrimental to our efforts. But, rather than being a covert conspiracy,

as suggested by Hansen and Condon, it is a very overt, publicly acknowledged, promotion of the region's economy.

Several recent surveys of business and government officials suggest that the Loma Prieta earthquake did result in additional investments in preparedness and response planning and mitigation of potentially hazardous structures. While it is difficult to evaluate quantitatively the value of this investment, there appears to be a positive pattern that was not affected by Mayor Agnos's comments. Dennis Mileti, from Colorado State University, and Patricia Bolton from Battelle in Seattle are investigating the various aspects of post Loma Prieta social response and preparedness. Their research findings should be of particular interest to planners and should be available for presentation at the 3rd US Japan Workshop in 1991.

Other development proposals around the Bay Region have been impacted by the lessons of Loma Prieta. In the Santa Cruz mountains, repair, reconstruction and new development have come to a virtual standstill awaiting geologic study of the entire area. In the east Bay, the development of Bay front lands owned by Southern Pacific Railroad, including the Golden Gate Fields lands, are being reviewed with great care. There is a dilemma here that we must all address. The engineers can assure us that they now know how to build structures on poor soils, including those susceptible to liquefaction. In most cases, the costs for construction of offices, apartments, and commercial facilities can be absorbed. Unfortunately, the costs of making lifelines, including communication, water, power, emergency services and access, survivable are prohibitively expensive. So we may be building safe structures that will be isolated and inaccessible, after the next quake.

Earthquake research continues to be a frustrating problem. Under the National Earthquake Hazards Reduction Program, more than 80% of the research funds are allocated to basic research through the US Geological Survey and the National Science Foundation. Applied research by NSF in engineering, planning and architecture, or the social sciences, is extremely limited. Indeed, funding of application of research findings for mitigation or for preparedness at the local level makes up less than 10% of the total hazard reduction program. I have long suggested that the "R" in NEHRP should signify research, and we should end the pretense that the US has a hazard reduction program. This is very frustrating, and it appears that the strongest lobby with the US Congress in this area is the Geological

Survey, and not the engineering or preparedness communities, so it is unlikely that the ratio of funds committed will change.

You raise several questions about the water system in San Francisco which should be addressed by Charles Scawthorn and/or Frank Blackburn of the San Francisco Fire Department. As I understand what occurred on October, damage occurred in the distribution system of piping in the City were ground failure ruptured both the domestic and high pressure systems. As in 1906, there was no lack of water available to fight fires, but they could not get the water from the reservoirs to the fires. I do not believe the failure of the Jones Street tank impacted the fire fighting in the Marina, but, Charlie will be able to answer your questions definitively.

Your questions were very direct and helpful in focusing on the lessons of Loma Prieta. It was unfortunate that the limited time available at the Symposium did not permit discussion of your questions and a complete exploration of the issues you have raised. I hope my response is a small beginning to a better understanding and communications about these issues that can be more fully explored during the 1991 US Japan workshop in Hawaii.

Thank you again for your questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Rich.", written in a cursive style.

Richard K. Eisner, AIA, AICP  
Director