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SESSION I

DISCUSSION (2nd part)

October 6, 1982 - Afternoon

Chairman: J. BLAAUWENDRAAD (The Netherlands)

J.P. RAMMANT - To Mr. Williamson: concerning the ESTEK package, I have some questions about the applicability of this program in the european industry. Your system is functioning on the work you are doing at McAuto. I ask myself if the european industries are willing to accept people having to pass the cost estimating data through your files, while in Europe people like to handle this kind of things in their own home. Could you comment on that topic?

R.W. WILLIAMSON - I don't mean my presentation to be a sale picture or anything like that; so I didn't mention anything about how we offer ESTEK; obviously we are software house, we are selling software. ESTEK is available on McAuto computers for people who just want to come in and process it, but we also licence the software and, if you have your proper machine, we will licence and install the system on your machine. On other software packages, in various areas in the whole world, we do have our software installed on service bureaus. There is some in Scandinavia,there is some work in France and we have work in England. If somebody wants to get to the system, they will be aware of doing it.

J.P. **RAMMANT** - Can you give some estimate about the necessary hardware?

R.W. WILLIAMSON - Currently ESTEK processes on IBM main frame environment. Machine who are very known are 30/33, the operating system is NVS (and it is compatible with OS VS1 operating system); it is an IBM based system. We are looking at it and evaluating moving ESTEK on to selected microcomputer systems. We have ESTEK as a part of our family of software, scheduling project majoring software. Other systems have just been made available on VAX 11/780/750/730 series machines; so - I suspect our management hasn't approved the convention - I expect next year we will start with the conversion and migrate to the VAX environment also.

D.D. PFAFFINGER - I have a question to Prof. Yao. If I understand your presentation correctly, your main concern is assessing the damage when has already occurred. Is that right? How do you judge the possibilities of assessing the damage from structural analysis, say predicting the probability of a certain damage from the probabilities of the exciting loads?

J.T.P. YAO - As I stated earlier in the presentation, there are two parts in the research program. One part has to do with the present state of structural safety, which I tried to illustrate (was LST or TO) in this paper,and the second part is knowing what the initial condition is, or the present state of the damage is; and can I get the hazard function, which will tell me, from now until twenty years from now what kind of deterioration, or the chance of surviving the loading conditions may occur? Most of my talk here was devoted to the first problem, which is to find the state of damage at the time of inspection.

The second part of the problem: actually the work has been going on since the theory of structural reliability has been introduced. One approach is to use random processes and you assume during this period certain type of earthquakes may occur; there is also an approach called first passage probability or the barrier problem; if you are interested, I can find a list of references to communicate to you. The problem that I have on this regard is that only special cases of those mathematical problems have been solved. For those special cases the structures involved are higherly idealized; they are not really for actual structures. I think the best,the present methods we have can give us,is an estimate. Besides,I am not sure whether we can get the kind of hazard function we need. I guess there are ways of doing it now, but I personally think there are good opportunities for further improvement.

R.W. HOWARD - This is a very general sort of question, an observation; I would like some response if possible from Dr. Yao and from Mr. Steiger and it is about the fact that, over the history of computing in engineering, we tried to define the way we design things in a rather precise way, using digital techniques. I think this question of indeterminacy, which has come up in both the papers, has led us to talk about expert computer systems, where the opinions of experienced engineers can be built into programs. Also I think, talking on the computer aided manufacturing side,perhaps analog inputs where the subtlety of the control of the human hand - for instance - can be built into computer aided manifacturing systems. Have you got any comments on this? Shall we say realizing that the human skills have to be built back into the systems, which attempted to try to mechanize, as you said, human processes in the past.

J.T.P. YAO - This is a very interesting comment to me. I have two ongoing research projects: the one I described is one of them. The other one - in my own mind - is an even longer range project; it has to do with so called structural control, how to apply control theory to reduce or minimize the structural response. There are two objectives: one is for comfort purposes, one is for safety purposes. In fact, there are two tall buildings with passive control devices installed now in the United States that I know of. One is the John Hancock building in Boston, the other one is City Corp Building in New York, where they have a huge block of heavy mass installed on upper floor in both buildings. They they have hydraulic ramps to move it around whenever it is needed and the block would be floating on oil. Now, if you talk to the manifacturers of the system, they say it is working very well. But, if you talk with someone else, they have questions about these devices. Such applications are for comfort control, so even if the device doesn't perform perfectly, there is no real harm then, people just get sick. There are many cases of motion sickness in these flexible top buildings on windy days. So the feedback is already implemented into those systems because when wind blows the motion exceeds certain levels, then the machine starts operating and the oil will pump up the block which is floated and then moved. In 1979, there was an IUTAM Symposium on Structure Control in Waterloo and more then 50 people showed up to exchange ideas on this subject area and we are now thinking about organizing the second one possibly in 1985. I also worked with analog computer and I think it is a useful device that many people overlook.

F. STEIGER - I think your question can be answered in terms of optimization.

It is a question whether safety and reliability is a constraint, or objective function of designing. I think it should be a constraint, because we have to look to other important things by designing not only in the sense of structural engineering, but also of architecture needings etc. And so, in the decision making process, we have to include these other needings and, from my point of view, it is difficult to value other needings, than costs or prices, because they depend on decision maker interest, or on the interests of his organization. So the paper I present should only be an example that the decisions are done with uncertainties and there are some tools to value these uncertainties. They should not be given into mathematical equations and I think that it is important to know that we cannot make decisions or make design only by computer, but that the decision maker has to select before the important shapes. That depends on this special experience and so these tools may be only helpful for an experienced decision maker.

G. KRUISMAN - I have a little question for Mr. Steiger. We have seen a nice overhead foil saying how you have to meet in an objective way the design criteria and it was indicated that minimum requirements of the client as well as standards and regulations are to be satisfied. What I miss in the statement shown was the satisfaction of the designer. Can you give a method to measure or determine the degree of satisfaction of the designer or is he satisfied if he satisfies others?

F. STEIGER - I think the satisfaction of the designer is a very important thing, but there are borders for him which are very important and the satisfaction of the designer cannot be measured. I think one part of his satisfaction should be that his task is to choose the design-solutions which are possible generally and to choose one, or more provisions, which satisfy all these things you mentioned and his own interests. I think that should be his own satisfaction.

P. LENGYEL - I have a question to Prof. Yao. First of all I think that your primary aim was to make us interested in the question you have presented, and to see what a huge and difficult problem it is. I feel you succeeded in doing so, but the next step would be to get a little closer to it and I do not know which is the best side to be chosen for the approach .' I think your paper might be a good starting point. Here you have written, that you used C language for programming many parts of program SPERIL. For me this choice is very interesting, so it would be nice to hear the specific reasons.

J.T.P. YAO - Well, the language was chosen by my first co-Author, Dr. Mitsuru Ishizuka. He preferred it as the computer language for this particular one: the SPERIL I. As I mentioned before, it is given for the purpose of illustration or demonstration. I have tried with some obvious cases to answer those questions, and - three times out of five - the answer that came out in my own mind was correct. What I am trying to say is that the details right now need a lot of improvement, that is why we are collaborating now with practicing engineering firms. If you are interested, it is much easier if you start writing your own program, rather than you try studying and follow the details of our program. Of course I will send you a copy of the listing in case of need. In fact, I have one copy with me, but please use it with caution, even if you can put it on your computer, because it was written by an electronical engineer even though

I collaborated with him. We just do not have all the details; I don't have all the answers and we are still in the stage of trying with different methods of combining and interpreting the answers. Also, as we all know, there are many different types of civil engineering structures and we do not have in most cases duplicates of a given design. So there is only one Sear Tower, one Golden Gate Bridge and so on. That's why I said it takes at least another ten years before we may have something practical. This is one of the reasons I volunteered to go anywhere I can to tell people about the problem and I really believe this problem is too big for me, or my friends at the university. Let me also say: there are people who are already solving these problems. There have been people doing it all these years, so there are solutions, practical solutions already, but what we are trying to do is to whether we can get it organized in such a way that less experienced people - like myself - can learn this process easier without having to work for specialized consulting firms for thirty or fifty years. At that time, I would be a hundred years old. So I like to encourage anyone interested to work on this problem, and I also believe that the approach we presented is not the only approach. That's why I concluded by showing you different people doing different works,using different approaches. I believe that eventually some combination of these different approaches might make it work better. Therefore, if you are interested, I am most willing to correspond with you and I will give you names and addresses, and I will write letters to my friends to correspond with you also. I really believe that, if more people work together, then there is more chance of solving the problem with more useful results.

S.J. FENVES - You just used a word that requires some explanation; you said you wanted to organize this information. A characteristic of heuristic systems is that they represent the expertise of a particular person or a particular group of people. In SPERIL,do you want to emulate the thinking of a particular person, such as Boris Bresler? Or do you have the expectation of generating a common set of heuristics that is agreed upon by all structural engineers?

J.T.P. YAO - I think it is a very good point, but at the moment we are trying to understand the thinkings of a few experts associated with Wiss Jankey Elstner in Chicago, Illinois. Because we have built up quite a few different methods to combine these simple answers to simple questions, we are going through their files to use them as a calibration - I am not sure if I am using the right word - or to use it as a test to these various methods of combining answers. Once we have a better idea which method works better with these few experts and the government will continue to support these long-range programs, I would like to expand, to include other experts and eventually, I think, your second alternative. We started out with very few experts but we would like to make something which would be aggreable to most structural engineers,or experienced structural engineers. There is a subjectiveness in the selection of experts also.