THE AIR FORCE THIRD CONFERENCE ON MATRIX METHODS IN STRUCTURAL MECHANICS

OPENING REMARKS: R. M. Bader
Air Force Flight Dynamics Laboratory

The conference was opened by Mr. R. M. Bader, Chairman of the Conference Technical Committee. Mr. Bader expressed his appreciation to the other members of the technical committee for their efforts in organizing the conference. The Cochairmen of the Conference were introduced: Colonel Charles A. Scolatti, Commander, Air Force Flight Dynamics Laboratory and Dr. J. S. Przemieniecki, Dean, School of Engineering, Air Force Institute of Technology.

WELCOME: Colonel B. S. Bass
Director, Air Force Museum

Colonel B. S. Bass, Director of the Air Force Museum was introduced by Mr. Bader. Colonel Bass welcomed the attendees as being members of the first technical conference to be held in the new Air Force Museum. He described the history of the Air Force Museum, the events leading to the construction of the new facility and the continuing search for items of historical interest to the Air Force. The museum had been recently dedicated in September 1971 with President Nixon as the speaker and honored guest. Colonel Bass then introduced Major General Pinson.

INTRODUCTION OF KEYNOTE SPEAKER: Major General E. A. Pinson
Commandant, Air Force Institute of Technology

The keynote address during the opening ceremony was delivered by Lieutenant General James T. Stewart, Commander of the Aeronautical Systems Division, Air Force Systems Command. This distinguished guest speaker was introduced by Major General E. A. Pinson, now retired, Commandant of the Air Force Institute of Technology. General Pinson was associated with research activities throughout his career and has participated in the three conferences on Matrix Methods in Structural Mechanics, held at Wright-Patterson Air Force Base.

KEYNOTE ADDRESS

Lieutenant General James T. Stewart
Commander, Aeronautical Systems Division
Air Force Systems Command

I am particularly pleased to be here. As Colonel Haviland, Director of Airframe Subsystems Engineering in the Aeronautical Systems Division (ASD), and his people, the SPO's in ASD, and the Air Force Flight Dynamics and Materials Laboratories well know, I am vitally interested in all facets of the structures discipline. My interest is shared by many people in the Air Force. We must follow the developments in this entire area including materials selection, design, analysis, test, manufacturing, fatigue life, and fracture characteristics. To do otherwise is to jeopardize the structural integrity of our future systems. Contrary to what some may think and contrary to some newspaper reports in the over-all, our track record is pretty good.

For example, over the last twenty years, the structural weight fraction of aeronautical systems has stayed fairly constant at about twenty-six percent. Uninformed critics would rush to point out that it should have decreased. That viewpoint is wrong. It is wrong because during the same period, the performance of systems has improved substantially. In effect, a measure of performance increases has been realized through optimization of the structure. How have we done this?

Speaking only to the subject of structural improvements, the last twenty years have brought out the use of higher strength materials. And although some of the lessons have been tough (to wit, the F-111), the pluses have far outweighed the temporary setbacks. And we have been working the materials harder. -- e.g., lower ultimate/working margins due largely to more sophisticated analytical methods. We could do this because our analytical techniques have generally become more precise and dependable. And here again, we have not always been perfect -- to wit, the C-5.

The advent of the large digital computer permitted us to exploit the finite element approach. Fine grid analyses can now be accomplished to a level of structural fidelity which was impossible only a few years ago. And of course you Gentlemen are more well aware than I of the advantages of the finite element approach.

The time required to respond to design changes can be reduced considerably with the use of these automated methods. Applying these methods earlier in the design cycle should not only result in a more efficient structure but, very probably, major design problems can be avoided.

This group generally represents two subsets of the technical community. Some of you are researchers -- from the Laboratory environment; others are engineers -- the users, the system people. I believe these groups must strive even harder to work closely together and build the strongest possible relationship between disciplines. It should be based on a reversible communication process in which the researcher develops more precise analytical techniques, passes them to the user and then the user develops a portfolio of applications experience for the researcher. This sort of dialogue, no one can fault. Everyone wins.

We have such a relationship here at Wright-Patterson to a degree, and we are doing everything we can to expand the information exchange. For example, we have physically located system engineers in local Air Force Laboratories, as well as at NASA Ames, and NASA Langley. Our motive is to expose them to the research environment for a period of about one year and then bring them back to the system acquisition world with fresh knowledge of current methods and techniques.

Also, the Laboratory people are assisting us solve aircraft development problems we have been experiencing, as well as actively working with us to apply their work more quickly to new systems.

Equally important is the need within the structures community for cross-talk between the other elements of the discipline. Designers should talk to the static and fatigue test people, the materials people should exchange information on NDI and manufacturing processes with everyone throughout the life cycle of the system. Fatigue failures and corrosion problems should be brought to the attention of all the engineers who worked on that system. That's the way it should work.

However, it doesn't work as well as it should. For example, in the past, some aircraft, or portions of it, have been designed by job shop engineers -- that is, people hired to do a specific task in a given time. They have no company affiliation or loyalty. When the job is over, they go somewhere else. The kind of feedback to the original designers I'm talking about is completely non-existent here.

Take another case, the company with an organic design group. On the average it gets a contract to design an airplane once every five years. After five years, where are the structural design people who worked on Airplane A? Most of the good ones have stayed with the company and moved up or into new projects. Few of them are willing to go back to the boards to work on Airplane B. So the wheel has to be reinvented again. It isn't practical to expect that the design supervisors will catch all the glitches. They can't unless they go into great detail and actually go back to the boards for a while.

So, the need for dedicated design groups working on new ideas all the time, not just every four or five years, has brought us to an appreciation of the experimental prototype concept about which you have heard much. Experimental prototypes can be used to explore promising theories or laboratory findings and their operational utility. They can bridge the gap between theory and application.

We have recently established a Prototype Program Office at ASD. It will establish technical goals, monitor the technical progress of contractors, provide technical assistance, and test and evaluate the end product. Industry, under this "adaptive management" approach will have the responsibility of developing the technical approach and establishing trade-offs, establishing management controls and design standards, and, most importantly, of demonstrating performance in flight.

The Prototype Program Office will have a Project Manager and Project Engineer for each prototype program. They will be supported as needed by designated lead engineers in the AFSC Laboratories and other ASD elements at Wright-Patterson. The key ingredients are small size and solid technical expertise from all appropriate sources.

The Air Force has identified four candidate projects for prototype development initiation in FY72: An advanced medium short take-off and landing (STOL) transport; a very low radar cross section test vehicle; a light-weight fighter aircraft; and a quiet aircraft.

It should be clearly understood that these projects are not aimed at either a pure research vehicle -- a la X-15 -- or an engineering development production prototype. They will be somewhere in between.

Their objective will be to provide options -- to demonstrate advanced technology and probable operational utility before proceeding into full-scale engineering development. The current A–X program is a conservative cut at prototyping.

All in all, we think prototyping is good. It's going to give a much larger degree of technical flexibility in the acquisition of hard data -- including structural performance -- before the big go/no-go decisions.

I think that you can see the dynamics of change in our ideas. For the future, we must avoid the past structural and management problems. One way to do this from the technical side is to increase cross talk between epople in the structural community. That's the name of the game at this conference.

Let me leave you with one thought. In the development of new techniques and exotic solutions to very sophisticated problems, keep in mind that solutions need to be practical (e.g., producible), cost-effective, and most of all, not create bigger problems than they solve..... In this latter regard, I could regale you for hours with almost unbelievable examples of problem solving via violation of structural fundamentals proven sound for at least thirty-five years.

CONFERENCE BANQUET

A conference banquet was held at the Officers Club, Wright-Patterson Air Force Base, on the evening of 19 October 1971. The guest speaker was Martin Goland, President, Southwest Research Institute, San Antonio, Texas, who at that time was the President of the American Institute of Aeronautics and Astronautics. Mr. Goland was a most appropriate speaker for the occasion because of his activity in several scientific advisory groups at the national level and his broad experience in aircraft design, applied mechanics and operations research. His address was entitled "The Engineering Challenge in the Post Industrial Era." He was introduced by the toastmaster for the evening, Dr. J. S. Przemieniecki, Dean, School of Engineering, Air Force Institute of Technology.