speed/groundspeed system gives him a tool with quantitative information from which real answers are available. Judgment can be developed which is impossible otherwise. Actual training is then possible with skills developed and enhanced.

Most importantly, true safe speeds are used on every approach regardless of headwind loss. By eliminating the need for acceleration, full climb capability is available for downdraft, even during headwind loss. With large headwind loss alone, a power reduction is required for stabilized speed. This is done, quantitatively, by using two minimum speeds. The airspeed is not allowed below normal, and groundspeed is never below the value expected over the threshold. Either speed can be normal or above, but neither below. The pilot then has full quantitative knowledge of what to expect ahead at all times, and he can expect both speeds to be normal at the threshold. If they are not, (groundspeed excessive) he can go-around and approach from the proper direction, which he can discern from his draft on the approach.

There are too many advantages to enumerate now, but no pilot will ever control wind shear without controlling actual speed. Runway overruns or undershoots cannot be controlled without controlling airplane speed relative to the runway.

"LABORATORY MODEL OF FLIGHT THROUGH WIND SHEAR"

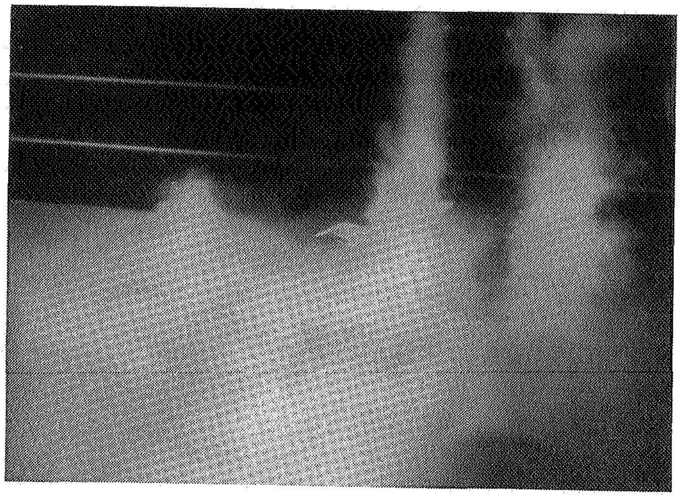
Walter Frost

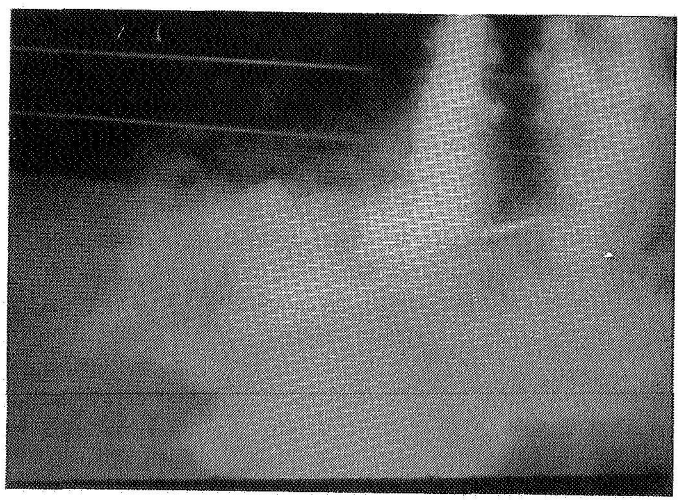
This address deals with the simulation of an airplane flying through a downdraft, or microburst. This project came to pass about this time last year, at the time when the Pan Am accident had just occurred. The television company, Alan Landsburg Productions, which produces the television show, "That's Incredible," decided they would like to do a series on wind shear. They talked to John McCarthy, Bill Melvin, and a few others. Finally, Norm Crabill at NASA Langley Research Center directed them to FWG Associates, Inc. One of the things they were insistent upon was an actual model study of an airplane flying through a microburst, and they would not be satisfied with a computer graphic simulation.

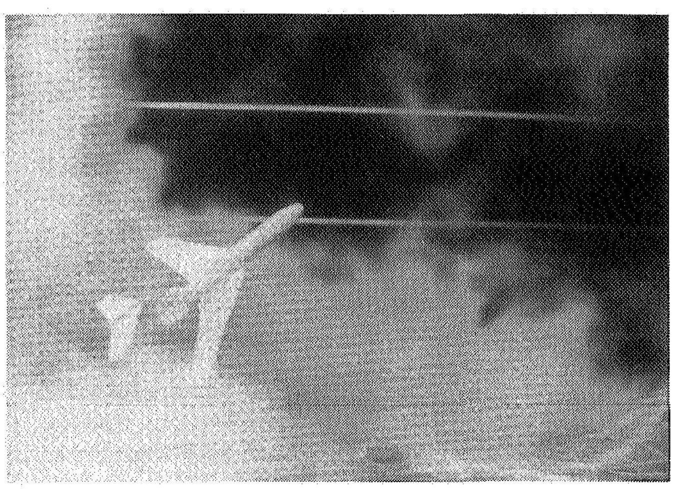
We had, roughly, two weeks to design, construct, and carry out the simulation. We decided to use a large building next door to FWG Associates, Inc., the small research and development company located in the UTSI Research Park. This building is approximately 50 feet wide, and we had to do some quick scaling laws to determine the best method of handling the project. We decided to show the takeoff because it is the easiest to do. We needed to simulate a constant take-off thrust; subsequently, we used, roughly, 100 feet of surgical tubing stretched through the door of the laboratory. This gave us an essentially constant thrust of about 2-1/2 pounds, which is what we calculated as being needed for the size of aircraft being modeled. We hung a large fan in the ceiling which had about 16,000 cubic feet, and scaled the velocity coming out of that fan relative to the velocity of the aircraft as it passed through the microburst.

Our tail was on the line because we had an agreement with Landsburg that if it indeed worked, they would pay us a relatively adequate sum of money. However, if it did not work, we were going to eat it! So, we were trying very hard and getting very anxious near the end. Nevertheless, it did work very well. We actually put a control into one of the aircraft models and learned a little about the dynamics of the aircraft. We found that if you pitched up, as Bill Melvin and others at that time were saying, when you passed through the wind shear, often times the model would come out of the wind shear and not crash. However, if you tried to put the nose down and pick up speed at all, which was the other option, the aircraft invariably crashed.

A lot of people have asked whatever became of the video results. It was supposed to go on national television; but it didn't sell, because it was competing against 60 Minutes, and the second sequel of the series which we were supposed to be in was never released. I have, however, brought a short clip that I have put together on my 1/2-inch video tape and I would like to show it to you. Incidentally, one of the airplanes which had a controlled system in it flew right into a television camera. Another of the models was glued back together so many times it was amazing that it still flew. The first part of the video was transcribed from high-speed film onto television tape, and it shows the aircraft coming out of the microburst, made visible by CO_2 fog. A series of pictures, Figure 1, show the aircraft as it flies into the wind shear, lifts, loses lift, pitches up, and hits the ground.







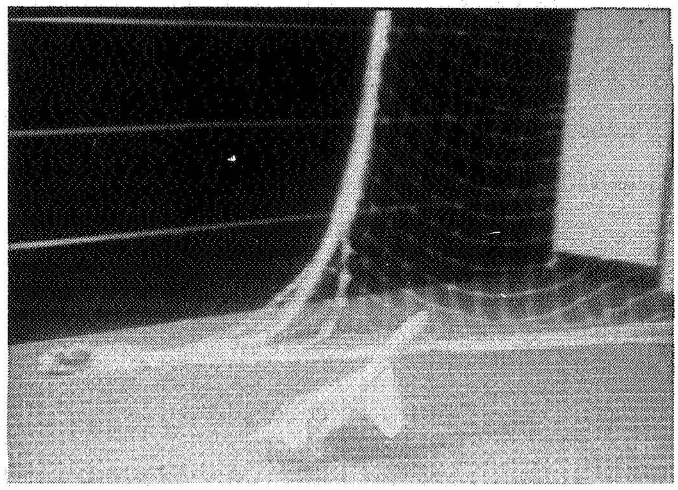


Figure 1. Sequence of aircraft trajectory through simulated microburst

When you study the downdraft phenomena, Figure 2, which has been illustrated, it shows a similarity to things we have measured with radar, suggesting that a microburst is a cold outflow moving down towards the ground and spreading out in all directions. The markers on the wall indicate a scaling of about 100 to 200 feet, respectively. If you will notice, the air jet comes out and spreads out all over the ground. It is not, however, perfectly symmetric; because we have discovered that microbursts are not perfectly symmetric.

You can see from Figure 2 how relatively shallow the outflow is once you get out of the downdraft.

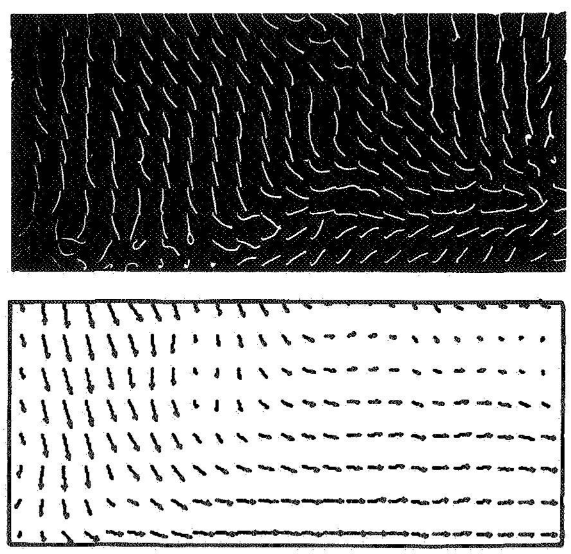


Figure 2. Comparison of laboratory microburst flow field with measured flow field from JAWS project

It took only about two seconds for the model to fly the entire length of the building, so to control it we had to be quick. However, interestingly enough, you could control it if you were on your toes. We simply had an elevator to give us pitch control.

If you are interested, there was article written about the simulation in Aviation Week and Space Technology. We have a few of the reprints of that article here if you would like to have one.

"AVIATION WEATHER OF THE 1980'S"

Sepp Froeschl

I would like to thank Walt and Dennis for giving me the opportunity to talk to you for a few minutes, because I think it is a rare, if not unique, occasion to have such a wide range of expertise to talk to. To give you a few ideas of my background which may be the reason for some rather controversial things I will say later, I am a meteorologist, and I work for the Canadian Government. I am called a Chief Analyst and Prognostician of the Quebec Weather Center. I have been a pilot for over 40 years, with a wide range of experience from military to airline flying. Over and above this, I am an enthusiast in meteorology and, particularly, aviation meteorology. As the title of my impromptu speech indicates, we are in a transition period. Our problem is that there is still a wide credibility gap between the user and the provider which is what I call the weather services. As for users, I am referring to the various components of the aviation community.

I think we have tried for too long to do everything for everybody, and I am afraid that if we carry on this trend, we might end up doing nothing for anybody. We are, due to budgetary constraints, having to cut down on personnel, and having to use more and more automation. Please do not get me wrong; I am not anti-modelling or non-automation, because my initial ideas and education are in mathematics. However, I am a realist. Since I am a user as well as a producer, I think we need a different approach. This is, I think, the weather services. They should get into measurable, quantitative configuration and move away from qualitative information. In my opinion, this is our biggest handicap. Originally, when we moved into qualitative terminology, it was a way out of the situation; but, in the last 30 years, we have not moved too far ahead. I once wrote a thesis on aircraft icing; and after hearing at the last six workshops how much is going on in icing, I went back and read the thesis. I thought to myself how new it all sounds to me; but remembered that thesis was 30 years old. In other words, we have not made good use of the new technology because it is primarily an advance in technology, not so much in real science. We should, however, make better use of this technology, especially in aviation meteorology. With the new high-speed computers we should make use of them instead of being used by them. If we make full use of them, we can really go into a quantitative description of the atmospheric conditions. By doing that, we are avoiding controversy and ambiguity. For example, I hate the term "VFR conditions", because VFR includes many things besides meteorological parameters. Over and above that, we cannot measure VFR. We can define it as something, but it cannot really be defined in quantitative parameters. We might say three miles, 1,000 feet, or whatever; but it doesn't mean anything because you can't measure or forecast that in terms of atmospheric conditions. What we should do, by going to quantitative expressions or terminology, is forecast a ceiling of 500 feet and a visibility of one-half mile and then the user can call it, or do with it, whatever he wants.

One of my theoretical specialities was icing, as I mentioned before. If we continue to talk about light to moderate rime icing in clouds with a risk of heavy mixed conditions in build-ups, we are wasting time. Every pilot knows that if he is in build-ups, convective clouds, etc., there is a danger of icing existing there. What is light to moderate? We have from a Cessna 150 up to the Space Shuttle. In the old days, there was about 150 kts speed ± 30 %, and that was everything we had. So, we could be rather generous in using those terms for everybody; but now it is completely out of range. What I would like to say, and what I would like to implant into you, is the idea that we should:

a) Aim for quantitative information; i.e., forecasts, observations, etc., and move away from qualitative.