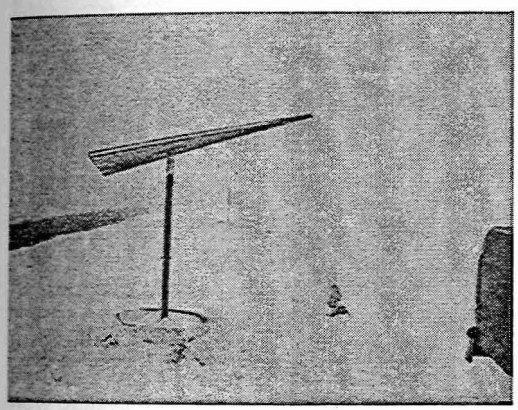
USE OF VORTEX GENERATORS TO ELIMINATE SNOW AND SAND DRIFTING ON WASHINGTON STATE HIGHWAYS

Mike Stanford, Washington State Department of Transportation, Avalanche Control
North Central Region.

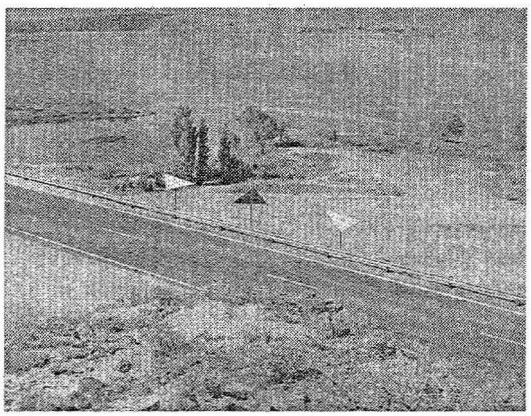
2393 Kinnikinnick DR.
Leavenworth WA 98826
(509) 664-1257

stanford@crcwnet.com

stanfom@wsdot.wa.gov



Site # 1 Mansfield, Washington.



Site # 2 Vantage, Washington

Abstract

Drifting snow and sand on state highways has been a problem for travelers and state workers for as long as there have been roads. This presentation will describe an experiment underway in North Central Washington to see if the Vortex Generators* can passively remove drifting snow and sand from the road. As state funds for maintenance are continually being reduced, more cost effective ways are needed to keep certain sections of highways safe and open during inclement weather periods.

Two eight-foot Generators were placed near a specific section of roadway during the winter of 1999-2000. This area receives snowdrifts that are a continuous problem.

During the summer of 2000, three wings were placed at a location where sand from the dunes along the Columbia River blow sand onto the roadway causing an extreme safety hazard for motorist.

This presentation is intended as an overview of the ongoing project.

Introduction

We were first made aware of the Vortex Generator while attending the ISSW in 1998. Renee Lang (Sigma Technologies Inc.) had done some work in Antarctica moving snow around to keep a runway open. The idea came to us that maybe this would work in spots along several highways in Washington State where we have severe drifting problems. At times, drifting is so bad that a whole community can be shut off from vital services for days at a time. After talking to Renee on several occasions during and after the conference, we became very excited about testing a wing to see if our hypothesis would be correct.
As luck would have it, our desire to test a new product had come at the same time the voters of Washington State passed an initiative that cut our research and development budget down to zero. Money was tight, however the desire to test a wing and the possible savings to the sate if it worked, kept us motivated to make it happen.

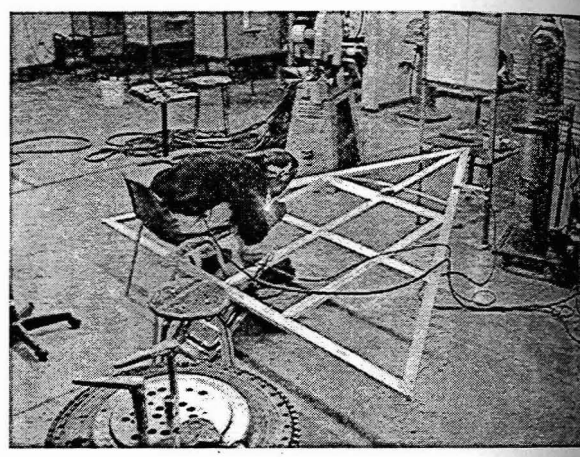
Questions Questions Questions

The ball was set into motion. Our brain storming sessions on the project left us with headaches and more questions. We were sure of one thing, we would find a way around any obstacle and we would test this wing during the winter of 1999-2000.
One of the first questions was: if one wing gets the type of results that we saw with Renee's work, what would the results be if we put two or three wings together? We wanted to know this because on the highway we have long sections of road that would need to be kept clear. Also, as a continuation of Renee's work, it seemed logical for the next step.

The Lab that Renee had worked with in Antarctica, had built a proto type wing. After several calls and e-mails, CRREL (Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers) agreed to lone us the wing they had built for our test. We in turn would build an additional wing and mount them side-by-side.

The next question was where do we test? This proved harder then we had first thought. We needed a place that had a history of drifting. It also had to be a place where the state either owned the right of way or where the landowner was willing to allow us to perform our test. There was also the concern of safety to the traveling public. Any time you place an object along a road it has to be engineered to break away if someone hits it or it has to be placed at a location where there is minimal chance of it getting hit.

How do we pay for the additional wings? With the passage of Initiative-695, any extra money for research and development was gone. We solved this problem by enlisting the help of the Cascade High School Industrial Arts class. We supplied the material, told them what we wanted and they produced the wings. This worked very well, except that our time frame for completion did not always coincide with the schedule of the high school. The students were very enthusiastic and the quality of work was very good.



Cascade High School student welds our wing.

Weather or not

As we all know, the weather is the weather. Just when you think you have it all figured out, you find out you don't. This was the case during our first winter of testing with the two Vortex Generators* in Mansfield Washington. One of the biggest problems with using the generators on a highway is that you are committed to the wind direction depending on which side of the road you place them. In our situation, the wings were placed on the north side of the highway where historically the biggest drifting occurred. As luck would have it we were only able to record one significant storm that came from this direction. Most of the winter storms during the 1999-2000 winter came from the opposite direction.

During that one storm however, it was observed that the wings did just what we had hoped. The surface area affected by the wings was being scoured, while the other road areas on either side did see some drifting.
A small weather station was placed at the site to record wind speed and direction. The data colleted from this station only confirmed what we visually observed, wrong direction.

Drifting sand on roadway causes severe traffic hazard.

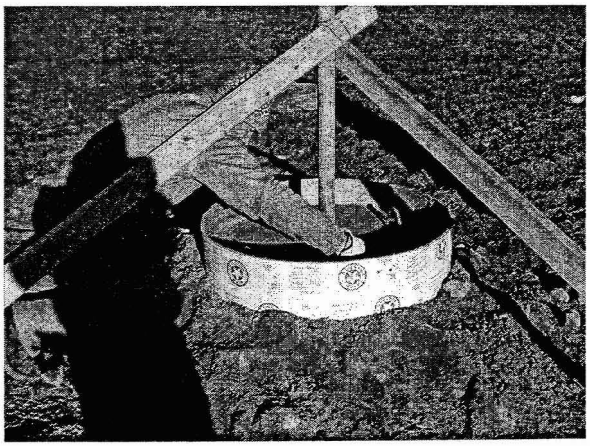
Sand Sand Sand

In the North Central Region we have a Snow and Ice Team made up of DOT employees. There job is to help other employees in the region do there job better, safer and more efficiently. One of the ways they do this is to investigate and try new developments in technology, processes and equipment. From the start, the Snow and Ice Team have been and still is, the oil which allows this experiment to run.
During the winter of 1999-2000, one of the members of the team asked if the wings would work, or had they ever been tried on sand. Our first reaction was "Oh boy, another question". It was however, a good question, and it was passed on to Renee Lang who informed us that one of her students had been doing some testing with sand and had some promising results.

From the limited, but encouraging results we had gotten from our snow site, we now turned our efforts to the other end of the region to a place adjacent the Columbia River where sand from dunes along the river blows up a steep hill onto the highway. At times, this sand can build to depth of four to six inches. A car or semi traveling at 55-65 mph and hitting this sand can be thrown into an extremely dangerous situation. One of most exciting aspects of this site was that we did not have to wait for the sand to fall from the sky so it could be blown onto the road. The wind, because of the topography of the land, was already there and we were guaranteed it would blow.

A third wing was constructed because of the distance of roadway we wanted to test. The area of erosion is in direct relationship to the size of the wing. We made our wings 8 x 8 x 8. This was done in consideration of both cost and size. The bigger they are the harder they are to handle. Unlike the Mansfield site, we had limited space along the roadway to plant the bases, and so were forced to place the wings closer to one another then we had hoped. The total length of roadway for this test was 180 feet. This was with three wings. At the Mansfield site, this distance was tested with two wings simply because we were able to place them further off of the roadway.

In our discussions with Renee, she had told us that the upward force on the wing created by the wind was insignificant. Because we were dealing with a public highway, and winds at times in excess of 70 mph, we were not about to take any chances.
All of the bases at both sites were constructed of 36" sauna tube 3' deep, filled with ¾ of a yard of concrete. Each base weighed in at around 1500 lbs. Needless to say, they were not going to blow over. The bases were equipped with lifting rods so they can be removed and placed at other locations if desired.



Bases were poured on site, but are removable

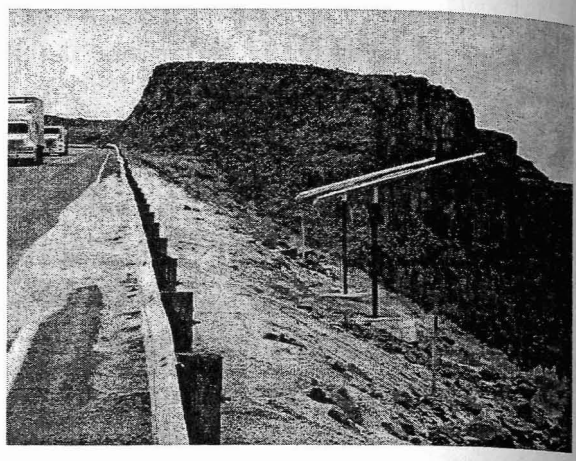
Immediate results

As luck would have it, the day after we installed the wings, the wind blew and we were able to get our first real conclusive visual data that the wings worked. The only real problem we encountered was that the guardrail running along the side of the road seemed to interfere with the wind flow over the wing. Several options were looked at to deal with this. The option of removing the rail was shot down by the legal office. Moving the rail out, so it was below the plain of the wing was shot down because of legal specifications for state highways. As time went on, the small strip of sand was found not to interfere with traffic. Dealing with this problem is still in the working stages. From conception of the idea of the wing to this point has been seven months. Everyone who had been involved with the project was very pleased.

What now?

As we stated in the abstract, this is an on going project. We are currently gearing up to place the three wings from the sand site along the Columbia River, to the Mansfield snow site. There are two main reasons for this. One is that for us to conclusively prove that the wings did their job on the sand, we must now remove them and see if the original problem returns. If it does, then permanent wings will be installed at this site.

The second reason is that we would like to obtain some good snow data. Now that El Nino and La Nina have apparently gone away for now, we are causally optimistic that a "normal" winter will be forth coming and we will be able to obtain good results. We are also working on placing several smoke bombs at the site during a wind event and video taping the actual wind patterns. This may help us in placement of the wings. This will also allow us to obtain data about the exact source location of the sand. Knowing this may help us in the elimination at the source.



Strip of sand left by guardrail interfering with wind flow.

If you would like more information on this project you may contact us at the phone number or e-mails listed at the beginning of this paper. If you would like additional information on the Vortex Generator* you can contact Renee Lang, Sigma Technologies, (253) 265-3075 or e-mail her at www.harbornet.com/sigma

* Patent Number # 6053479