Winter Road Congress dealt with New Challenges for Winter Road Maintenance

Vaisala participated in the XIth Winter Road Congress 28 - 31 January in Sapporo, Japan. Arranged by the World Road Association PIARC under the theme New Challenges for Winter Road Maintenance, the congress attracted a record number of attendees: 2200 people from 62 countries.

In conjunction with the Winter Road Congress, the Standing International Road Weather Commission (SIRWEC) Conference was also held in Sapporo. Organized every 2 years, SIRWEC discusses the latest research and technology concerning roads under a variety of weather conditions. Moreover, this conference also presents meteorological instruments and related technology.

Founded in 1909, the World Road Association (PIARC) deals with road infrastructure planning, design, construction, maintenance and operation. Its membership includes 97 national or federal government members, 2,000 collective or individual members and over 750 experts in 20 standing Technical Committees.

The Standing International Road Weather Commission (SIRWEC) was originally set up in 1985 as SERWEC (Standing European Road Weather Commission), but to reflect changes in the organization's scope, the name was changed in 1992. SIRWEC operates as a forum for the exchange of information relevant to the field of highway meteorology, including, for example, management, maintenance, road safety, meteorology, and environmental protection. ●

that the inputs will better explain the observations.

Figure 3 shows that when the thickness (H) is not included in the inputs, the deviation is clearly greater. The smallest deviations are obtained in the cases when both the thickness (H) and some temperature data (T or D) is included.

Conclusions

In this study the manual analysis of the data showed that the thickness of the ice layer on the road is the main indicator of vehicle grip. The neural network analysis also supported this result. When the thickness of the ice layer was greater than 0.05 mm, we could determine with an accuracy of 97.4 % that the grip would be reduced or poor. On the other hand, when the thickness of the ice layer was below 0.05 mm, it was still possible to assess the grip but in some cases the thickness alone did not yield enough information. Furthermore, the neural network analysis revealed that the second important factor indicating grip was the difference between road temperature and freezing temperature.

Based on this data we can conclude that it is essential for the road weather station to accurately measure the thickness of the ice and water layer in order to detect the likely grip and warn about slippery conditions. However, to detect only the thickness is not sufficient in all situations. The road weather station should also be capable of measuring road surface temperature and freezing temperature which were found to be among the best indicators of vehicle grip in this set of data and observations. ●

Figure 5. Ville Haavisto of Vaisala presented the vehicle grip survey at the SIRWEC conference.

Acknowledgement
The authors wish to thank Mr. Ossi Pilli-Sihvola, Head of the Traffic Information Centre, and also the personnel of the Road District of Southeastern Finland for their help in conducting this trial and arranging the observations.

References

1. *Haavisto, Haavasoja, Turunen, Nylander: Performance of a Road Surface Condition Sensor. Proceedings of the 10th International Road Weather Conference, 2000. Pages 145-152.*
2. *Nicolas, Jean-Peter: Glättebildung durch Überfrieren. Schwellwerte der Oberflächenfeuchte auf Fahrbahnen. Bast Heft V 36, 1996. 26 pages.*

Figure 4. Vaisala showcased road weather products at the PIARC exhibition in Sapporo.

The Road Traffic Authority is the State Government agency responsible for main roads, motor vehicles and motor users in New South Wales, Australia. Focusing on safety concerns, the RTA has developed systems to continually monitor road conditions, using hazard detection devices. The real-time information can be displayed on variable message signs (VMS). For instance, in 1995, a 12-kilometre network of fibre-optic variable message signs was connected to 10 fog detection units and 24 speed detection devices to target individual motorists on the appropriate speed behaviour for the visibility. Changeable message signs have also been provided at several locations which are connected to presence detectors to advise drivers when queues build up at sites with restricted sight distances. These displays revert to a different message when queues are not present. The RTA's Southern Region have now expanded the use of these signs to provide a changeable sign at a sub-standard curve location where wet weather conditions significantly increases the hazard to motorists. In wet weather and when the pavement is wet, the advisory warning provided to motorists changes to reflect the increased risk at the site. This article provides information on the development of this system and the behavioural response of motorists to the changed advice for different conditions as they travel through the curve.

Site selection

The Princes Highway is the major highway running south, following the coast. On the Princes Highway immediately south of Kiama is a 2.3 km section of 4-lane road, which is built on a winding alignment developed in the first half of the last century. The speed limit is 80 km/h. An accident study shows that in the 3-year period from 1996 to 1998, 65 accidents occurred within the section of which 58 (89 %) were in wet weather conditions. This compares to 65 % of accidents

Dr Graham Brisbane
B.Eng. M.I.E. (Aust), Fellow of the Australian Institute of Traffic Planning and Management

Andrew Vasiliou
B.Eng., B.Comp.Sc., M.I.E. (Aust)

Dynamic warning signs act as

Signs of Rain

A number of systems have been introduced in recent years that provide dynamic advice to motorists on the real-time status of the road network. Most commonly, motorists obtain real-time information on congestion, allowing them to take alternate routes for reduced travel time. However, the Roads and Traffic Authority of New South Wales uses road weather systems and variable message signs to improve road safety. These systems allow drivers to modify their speed behaviour on the basis of changes in weather conditions. For instance, information on wet conditions is provided for locations where wet weather increases the hazard to motorists.

Figure 1. Selected site.

occurring in wet weather in the next homogeneous section of the Princes Highway immediately to the south.

The 55 accidents are all loss of control accidents suggesting excessive speed on the bends despite the provision of advisory speed warning signs throughout the section and the selective provision of skid-resistant pavements at the most frequent accident locations. In 2000, New Jersey kerb treatment, together with central median drainage, was provided where practical in an attempt to reduce both accident frequency and severity.

Within the Kiama bends section, 17 of the accidents occurred at the location selected, with 10 of those occurring in the northbound direction.

Site details

The selected site contains a right hand curve on a 4-lane section of the Princes Highway separated by a New Jersey kerb. Annual rainfall is in the order of 120 cm, and there is an Annual Average Daily Traffic (AADT) in excess of 13000 vehicles per day. A curve warning sign is currently located in the approach to the curve with an advisory speed of 65 km/hr.

In establishing the trial site, the sign has been converted to a three way sign with displays shown as shown in fig. 2.

The different displays are activated by a moisture detection device, which is able to detect weather conditions and the amount of precipitation when raining as well as the pavement conditions in terms of dry/moist/wet. The equipment is also capable of detecting other conditions such as frost and snow which, however, are not relevant at this site. Details of the display triggers are shown in table 2. Flashing Lights are attached to the sign for use in the third mode, which is assessed as the most dangerous situation.

In order to assess the effectiveness of the system, speed detection loops were placed in both lanes as shown in fig. 3. This allowed speeds to be measured during different conditions. For each vehicle, speeds were measured together with records of lane (fast or slow), time of day (to assess day and night effects), rainfall and pavement conditions. Vehicle lengths were also recorded in order to provide data for heavy vehicles and motor cycles. No changes are proposed to signposting for southbound traffic.

Effects of signposting assessed

The site was commissioned on 30th May and speed measurements were taken for a period before the sign was activated to assess the effects of traditional signposting. These measurements are to be continued until a behaviour pattern had been established in wet as well as dry conditions. At the time of writing the site remains in this condition as insufficient rain periods have occurred to allow an adequate comparison of variable conditions to be made. When such data has been obtained, the sign is to be commissioned and further data recorded using the displays triggered by the logic shown in Table 2. ➤

Figure 2. Variable sign arrangement

Normal (Condition1) | Raining (Condition2) | Wet Road - No Rain (Condition3)

Table 2. Display logic

Condition1		Condition2		Condition3	
Weather	Surface	Weather	Surface	Weather	Surface
Clear	Dry	Rain	Dry	Clear	Moist
Cloudy			Moist	Cloudy	Wet
				Wet	

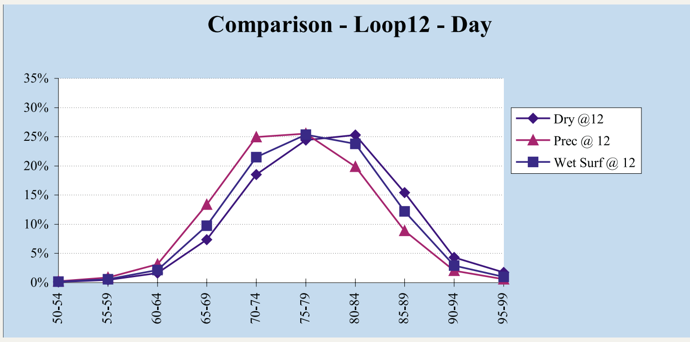

Figure 4a. Speed variation during daytime before sign

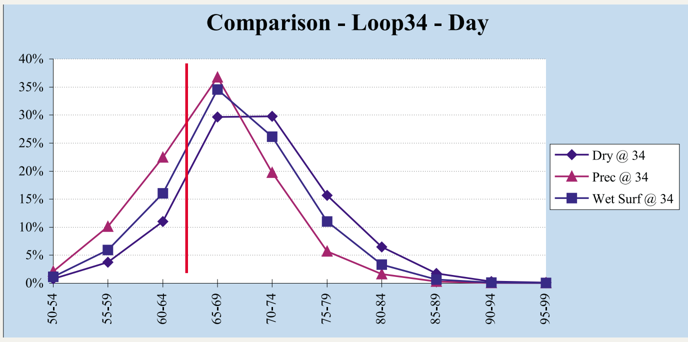

Figure 4b. Speed variation during daytime after sign

Results

Detailed results have been obtained for all conditions. For "Condition1" (clear and dry), a full week's data has been obtained providing over 50,000 data sets. This data has been obtained on days when no rainfall has occurred. For "Condition2" and "Condition3", only 3573 and 8289 samples respectively have been obtained which is considered insufficient to enable a full statistical comparison of a before-situation. In the case of "Condition2", a range of samples is also required for differing precipitation rates to allow a study of the sign's effectiveness in varying rainfall conditions. This would allow further studies to be undertaken at a later date to determine if additional features would be effective in heavy rain conditions when aquaplaning is more likely to occur (e.g. use of flashing lights when the rain exceeds a certain intensity.)

The data has also been separated into four different time of day periods (dawn, daytime, dusk and night) when differing ambient light conditions might be expected to result in differing driving behaviour. Table 3 shows the average speeds that occur at the two speed-detection sites before and after the sign.

	Dawn		Day		Dusk		Night	
	Loops1/2	Loops3/4	Loops1/2	Loops3/4	Loops1/2	Loops3/4	Loops1/2	Loops3/4
Condition1	75	68	75	67	75	67	75	67
Condition2	74	65	71*	62	72	62	69**	60
Condition3	73	64	74	65	71	62	71	63

Table 3. Average speeds by time of day

Speed profiles were also obtained for each of these conditions. Figures 4 and 5 are an example showing the speed profiles for all three conditions during the day and night times.

Not unexpectedly the early results show that in more adverse conditions vehicles slow down to a greater extent in the approach to the curve (Loops 1/2). This speed reduction varies by time of day with reductions during wet conditions of around 4* km/hr during the day and 6** km/h at night.

Further reductions of around 8 - 9 km/h occur as the vehicles enter into the curve. However, the early indications (Fig. 4a & 4b) are that during the day when the pavement is wet but rain is not falling ("Condition3") the speed profile of vehicles is similar to that for dry conditions.

This result is also very apparent at dawn and dusk periods (these results are not shown due to the low sample numbers for adverse conditions).

At night vehicles appear much more likely to maintain the speed reduction which occurs when rain is falling (Fig. 5a & 5b).

A visual examination of the data also shows that the pavement sometimes remains wet or moist in some cases for several hours after the rain has ceased. There is also evidence that dew is responsible for considerable periods of a moist pavement. It is noticeable that the sample numbers obtained to date for "Condition3" are around double those of "Condition2".

Comments

The results achieved to date clearly raise concerns as to the behaviour of motorists in conditions of wet pavements when rain is not falling. The structure of the site arrangements will provide important information to allow further analysis to occur.

The provision of the enhanced signposting is intended to further reduce the speed of vehicles travelling through the curve with particular emphasis on maintaining speed reductions when the pavement is wet or moist but no rain is actually falling. Success in this area will provide a further option for those sites where significant wet weather problems exist and other treatments have not been fully successful in reducing the wet weather accident problem. ●

References

Brisbane, G.J.B., (1996): Driving In Fog - Putting Research Into Practice. Proceedings 18th ARRB Conference. Part 5. (Australian Road Research Board. Christchurch, New Zealand.)

Brisbane, G.J.B., (1999): ITS - Not Just For Cities Proceedings ITSA '99 (Intelligent Transport Systems Australia, Adelaide)

This article was printed with the kind permission of ITS Australia. For further information please refer to the ITS Australia web site at www.ITS-Australia.com.au.

Acknowledgement

Whilst the views and conclusions in the paper are those of the authors, the assistance and support of the Roads and Traffic Authority in using work examples is greatly acknowledged.

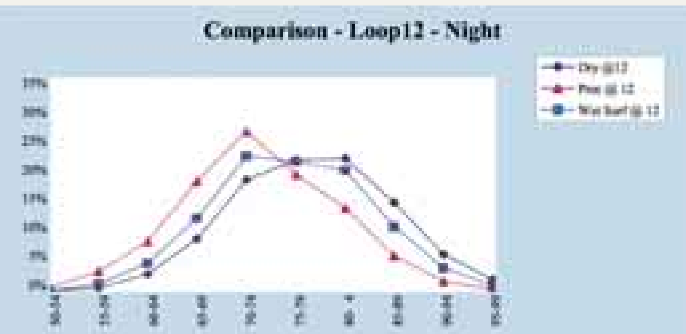

Figure 5a. Speed variations at night before sign

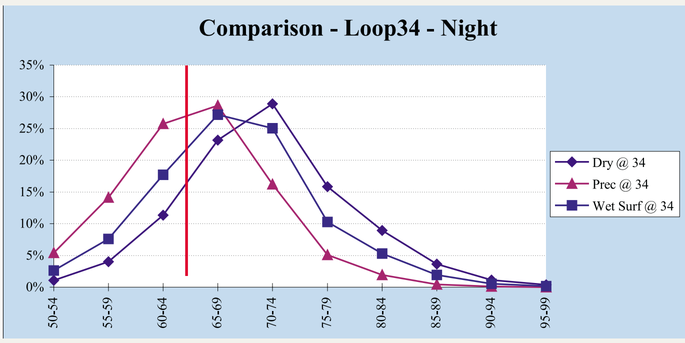

Figure 5b. Speed variations at night after sign