PART 2

PRESENTATIONS ON PAVEMENT SURFACE MANAGEMENT

APPLICATION OF KNOWLEDGE OF PAVEMENT SURFACE PROPERTIES IN GREAT BRITAIN

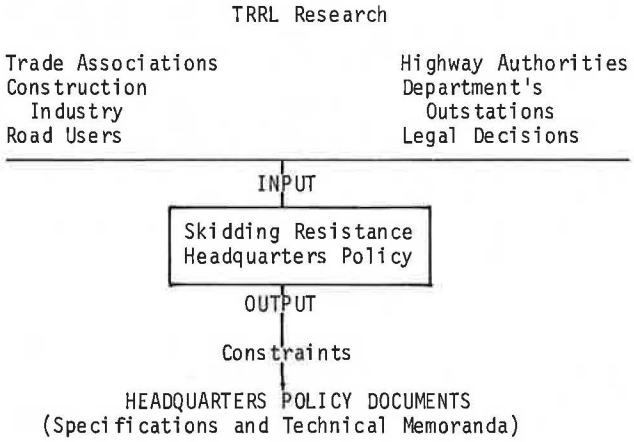
T. J. Carroll, U. K. Department of Transport

Formulating a Skidding Resistance Policy in Britain

Mr. Salt's paper (1) described the research on skidding resistance carried out by the Transport and Road Research Laboratory in Britain over the past 50 years and gave suggestions for translating the results of that research into specification requirements. I would like now to describe briefly how the Central Government in England through its Department of Transport has gone about this translation taking into account the constraints acting on the situation.

First of all, I think it may be of interest to you to see that the shape of the set-up in England for formulating skid resistance policy for the roads under the Department's jurisdiction, namely the trunk roads, which comprise about 7,240 km (4,500 miles) of all-purpose roads and 1,930 km (1,200 miles) of motorway, most of which are inter-urban. This is out of a total road network of about 241, 350 km (150,000 miles).

Schematically the policy is formulated as follows:



Above the line represents the input of experience, pleas for action, warnings and research information coming into the Department's HQ divisions which deal with road safety, traffic engineering, highway economics, highway management, legal aspects and engineering standards. My own work lies in the last-named of these, the engineering standards. Below the line represents the output strained, as it were, through the constraints acting upon the situation to appear as HQ policy in our main Specification for Road and Bridge Works or in supplements to it known as Technical Memoranda.

Extent of Present Policy

The first decision we had to make in considering our policy was whether to publish the skidding resistance standards for new construction and for maintenance works together as one document or as separate documents. We could see that the standards for the two sets of circumstances had to be consistent one with the other but whereas with new construction it is possible to design for the lowest level of risk from the start, with maintenance works the engineer is faced with a preconceived design and with a more complex problem in assessing where each site stands regarding its level of risk and what he should do about it.

In the event the matter was resolved by the decision to publish a new edition of the Specification for Road and Bridge Works at the end of last year, the previous edition gave limited guidance on standards for surface aggregate properties and texture depth for new construction largely based on Giles work at the Transport and Road Research Laboratory (TRRL) in the 1950's. The opportunity was therefore available to completely revise and enlarge this guidance. This has been done and published as a Technical Memorandum at the beginning of this year.

In going for separate documents we saw two advantages: firstly, it enabled us to think right through the specifying processes at the simplest level prior to doing the same with the maintenance difficulties added and secondly, if we ran into difficulties with specifying for the maintenance situation, at least we would have the new roads being constructed to the right standards while we sorted out those difficulties.

One further aspect had to be resolved: should our guidance cover all types of surfacing? Whereas the TRRL has been able to establish reliable correlations between Polished Stone Value (PSV), Sideway Force Coefficient (SFC) and commercial traffic flow for bituminous surfacings, similar research in respect of concrete surfacings is still in progress. We could not, in fact, add anything further to what was covered by the Specifications already.

Our first step, therefore, has been to limit our new guidance to bituminous surfacings for new roads and to express it in terms of requirements for aggregate properties, PSV and Aggregate Abrasion Values (AAV), and texture depth to match skidding resistance with different categories of highway layout and traffic flow. So far as concrete surfacings are concerned, we are placing reliance for the time being on the aggregate quality and texture depth requirements laid down in the Specifications. The texture depth value of 0.75 mm has been specified for the past few years and is aimed at giving a zero drop-off in skidding resistance, from low to high speed as described in Mr. Salt's paper (1). The present position is

New Roads Only

Bituminous: Aggregates and Texture Depth Based on TRRL Proposals

Concrete: Reliance on Existing Specification

TRRL's Research

Our next task was to examine the input to our skidding resistance policy making, chief among which are the results of the TRRL's research, in the light of the constraints we could identify as governing the shape our policy could take in practice. The results of TRRL's research and the constraints on policy are shown below:

Results	Constraints
Site Categories	Aggregate Availability
Risk Ratings	Surfacing Materials and Construction Techniques
Correlations	Need to Balance Cost with Safety
Risk Rating - Minimum S.F.C.	Legal Implications
Texture Depth - Skidding Resistance - Speed	
P.S.V. & A.A.V.-S.F.C.-Traffic	
Effect of Braking and Turning on S.F.C.	

We saw no difficulty in accepting the idea of site categories; it was a development of something we had used for many years. Nor did the concept of risk ratings within site categories cause too much difficulty. Although our requirements are recommended for general application where possible, they are only mandatory for trunk roads. The great majority of new schemes on the latter are constructed to the Department's geometric design standards and so we have considered it logical to link these generally to the lowest risk ratings in each site category. Where a layout is not to these standards, the engineer is advised to select a PSV appropriate to the situation and based on experience of similar designs in the past. The multiplicity of designs involved precludes giving more precise guidance.

At this point it became apparent to us that the constraints were acting mainly on the levels of PSV, AAV and texture depth which we could apply. Let us now look at what the constraints are and how they affect the level of the standards. In doing this, we took care to look at each factor in the broad context of both new construction and maintenance works.

Constraints

Aggregates

Mr. Salt, in his paper, deals with the commercial availability of aggregates in Britain and I will not enlarge on what he has said except to emphasize that only one or two quarries can supply durable natural aggregate at or just above a PSV of 70. If a higher PSV than that is required, only artificial aggregates can give it and at a much greater cost than natural aggregate. It is therefore imperative to set realistic upper limits to the levels of PSV required in each category from both supply and financial points of view.

Surfacing Materials and Construction Techniques

I have put the next two constraints, our existing surfacing materials and construction techniques, together as jointly they limit the extent to which we can apply the texture depth proposal of 2.0 mm for high speed roads put forward by TRRL. After consultation with the industry and the highway authorities we came to the conclusion that such a level of texture depth is not consistently attainable without great difficulty at the present time, particularly with dense macadams. Rather than wait until it is readily attainable, we have introduced an interim level of 1.5 mm and then only for surfacings with chippings superimposed on the surface, such as our main trunk road surfacing material, hot rolled asphalt. This is a far from satisfactory solution but it has the merit of getting the industry geared to a requirement which had not been specified before for bituminous roads while we carry out trials and surveys to see what can be done to improve matters.

Balancing Cost with Safety

The remaining two constraints, the need to balance cost with safety and the possible legal implications of the levels of standards we set, are also linked together. While the TRRL's proposals will result in aggregates of a generally higher level of PSV being used on our roads at the higher traffic flows, there is also scope within them to reduce PSV levels at the lower traffic flows.

It is not possible to quantify with any certainty the effect the raising of PSV requirements will have on aggregate costs. The better quality aggregates will be channeled to where they are most required and there might be increased haulage costs in addition to an enhancement of price due to market demand. Conversely there could also be an incentive to the quarry industry to open up old workings and new sources of better quality aggregates to meet increased demand and a consequent stabilizing or lowering of costs.

The lowering of PSV requirements at the lower traffic flows would offset the effects I have just described by bringing more quarries into the markets for the site categories concerned and by relieving pressure on the existing market, lead to more competitive prices.

A reduction in wet skidding accidents will surely follow from the generally higher levels of skidding resistance on the road system and although it is not feasible to assess its extent at this stage, it is certain that the cost to benefit ratio of the new requirements will be more favorable than that of the existing.

Possible Legal Implications

As you will see from the final form of our requirements which I am about to show you, we have proceeded with caution in setting both the higher and lower levels of PSV. We have been conscious of two legal implications in so doing. At the higher end of the scale, requirements must not be so high that highway authorities cannot afford to finance them and run the risk of being sued for not doing their job properly in the event of accidents. And at the lower end, the requirements must not be lowered to the extent that it could be claimed that the roads had been made unexpectedly less safe than road users had become accustomed to

The Present Requirements

In Table 1 the new requirements for PSV are shown against the TRRL's proposals and the previous standards. They are largely self-explanatory and I will therefore confine my remarks to particular features. The risk ratings are from Table 2 of Mr. Salt's paper (1) and the PSV's are derived from those in Table 3 of that paper.

SITES	TRAFFIC (Cv/Lane/Day)	PREVIOUS	TRRL	DEPARTMENT OF TRANSPORT
Category A1	Up to 250		60	60
Risk Rating 6	250 - 1000	62	60-65	65
Minimum P.S.V.'s Very difficult	1000 - 1750		65-70	70
	More than 1750		70-75	75
			Includes +5 units for braking/ turning	
Category A2	Up to 1750		50-60	60
Risk Rating 4	1750 - 2500	62	60-65	65
Minimum P.S.V.'s Difficult	2500 - 3250		65-70	70
	More than 3250		70-75	75
			Includes +5 units for braking/ turning	
Category B	Up to 1750		35-45	55
Risk Rating 2	1750 - 4000	59	45-60	60
Minimum P.S.V.'s Average	More than 4000		More than 60	65
Category C	Up to 250	45	Up to 45	45 (Use higher if economically available)
Risk Rating: Not Used				
Minimum P.S.V.'s Easy				

TABLE 1 Minimum Requirements for Polished Stone Values

1. Category A1 - includes approaches to traffic lights and pedestrian crossing. It accounts for only 0.1% of our road network. Note the additional 5 units of PSV to allow for braking and turning effects.

2. Category A2 - includes approaches to major junctions and roundabouts. It accounts for about 4% of our road network. Note again the 5 additional units for braking and turning. In both categories A1 and A2 we have considered it safe to go slightly below the previous standard for the lowest traffic band.

3. Category B - included generally straight sections and larger radius curves on the motorways and other trunk roads. It accounts for about 15% of our road network. We have used the lowest but one risk rating here, based on an SFC of 0.35 which we consider should be the aim for the trunk road system. Note the PSV reduction at the lowest traffic band. The value of 55 is still 10 units above that in Mr. Salt's paper (1), however. The majority of trunk roads have traffic flows above this level.

4. Category C - includes the remaining 80% of the road network carrying less than 250 commercial vehicles per day. All parts of Britain are within easy reach of suitable aggregates having a PSV of 45 or greater. This has been used as the sole criterion in setting the level.

Conclusions

Those, then, coupled with the texture depth requirement I described earlier, and the AAV's recommended by the TRRL are the new standards now being applied by the Department to the bituminous surfacings of new trunk roads. A surfacing is designed to provide a level of skidding resistance (SFC) above the appropriate minimum throughout its anticipated life by relating its PSV and AAV to the commercial traffic flow expected to be using it at the end of that life.

REFERENCE

1. G. F. Salt. Research on Skid-Resistance at the Transport and Road Research Laboratory (1927-1977). Transportation Research Board. Transportation Research Record 623, 1976, pp. 26-38.