# ACHIEVING GOOD RIDE QUALITY

## INTRODUCTION

Ride quality, measured in terms of roughness, is an important road condition indicator for road users in terms of transport costs and driver comfort and for road agencies in terms of its effect on road maintenance costs. To achieve good ride quality consideration must be given to design, environmental, construction, specification and maintenance issues. This technical note provides information on aspects of these activities that are considered to have the most influence on the standard of road pavement ride quality.

## FACTORS THAT INFLUENCE RIDE QUALITY

Factors that influence ride quality extend across most activities associated with a road project however these are considered the most important:

- **Road Environment -**Effects of expansive clays used at or in the vicinity of the subgrade and the effects of trees and roadside plantations on expansive subgrades in close proximity to the edge of the pavement;
- **Design -** Quality and uniformity of the subgrade, and selection of appropriate pavement types, pavement materials, and the number and thickness of pavement layers;
- **Specification -** Inclusion of requirements for random surface level assessment techniques and limits for roughness;
- **Construction and Periodic Maintenance Activities -** Appropriate paving techniques, level control systems, selection of cementitious binders with an appropriate working time; number and location of pavement joints, and use of surface regulation prior to resurfacing;
- **Routine Maintenance Activities -** Methods used for patching and pavement repairs, and for maintaining and/or improvements to drainage systems.

## ENVIRONMENT

### Treatment of Expansive Clays

The presence of insitu expansive clay material at or near the subgrade level can result in severe shape loss over the life of the pavement. Such materials should be removed to a depth of 0.6 to 1m below finished surface level depending on the class of road and replaced with a low swell capping layer material or alternatively, lime stabilised to reduce the swell potential of the insitu material.

### Roadside Planting

The proximity of roadside plantations and existing vegetation to the edge of pavement can cause excessive drying out and shape loss of clay subgrade materials, particularly the more expansive clays. Care needs to be exercised in selection of plant species and location of plantations in such materials.

## DESIGN

### Uniform Subgrade Materials

A uniform subgrade will assist in producing uniform pavement performance (strength, roughness etc) over the design life of the pavement. A non-uniform subgrade can result in premature development of pavement roughness. Use of a minimum 150 mm layer of Type A select filling up to subgrade level can assist in achieving a more uniform subgrade and significantly reduce these effects.

### Number of pavement layers

Generally, the more pavement layers used the better the ride quality because each subsequent layer improves the shape of the preceding layer and so on.

## SPECIFICATION

### Random Level Assessment of the Subgrade and Pavement Courses

For new works a high level of ride quality is usually achieved when random level assessment procedures are specified for the subgrade and each pavement course. The procedure requires level readings to be taken at random locations and compared to the design level determined from geometric design software at each test site. Whilst this procedure is essentially used to verify that minimum requirements for thickness and uniformity of pavement courses have been met, excellent ride quality also usually results.

### Specification of Roughness Limits

VicRoads Standard Specification Section 180 – Ride Quality for Pavements allows specifiers to nominate target roughness performance criteria. The guide notes to Standard Section 180 provide recommended roughness limits for various classes of road.

## CONSTRUCTION AND PERIODIC MAINTENANCE

### Control of Moisture Content of Expansive Materials

The moisture content of the expansive material needs to be maintained at or close to the equilibrium moisture content until covered by the pavement layers. This will assist in avoiding large in-service volume changes as the expansive material returns to its equilibrium moisture content after construction.

### Use of Slow and Medium Setting Cementitious Binders

To achieve good ride quality for cementitiously treated pavement layers, particularly insitu stabilised base layers, it is necessary for the material to remain workable for the time necessary to properly trim and compact the material before the binder sets. The working time required varies considerably with ambient and pavement temperature but less time is available in the "summer" period than in the "winter" period. GP (General Purpose) cement has less working time than GB (General Blended) cement which in turn has less working time than Slow Setting supplementary cementitious binders (e.g. slag/lime blends). It is important to select the appropriate type of cementitious binder with a working time to match the time required to trim to level and fully compact all the material placed.

*Conventional averaging beam*

### Use of Automatic Level Control Systems for Paving

There are numerous automatic level control systems available for spreading and paving equipment where the level of the screed of a paving machine or blade of a grader has an electronic sensor that can follow a moving or fixed level reference. Fixed level references may be a string line or wire set up parallel to the finished surface or a computer controlled laser system capable of referencing the position and design level at any point. Moving references include averaging beams and laser (virtual) averaging beams combined with various slope or grade control systems. These systems are now becoming more wide spread with the introduction of stringent ride quality specifications.

*Final result after use of averaging beam to correct longitudinal shape*

### Transverse Joints

Transverse joints should be minimised by the use of long paving runs however, as some transverse joints are unavoidable, they must be soundly constructed using specified or recommended joint construction procedures for the type of material being placed.

### Raising of Manhole and Valve Covers

For asphalt overlays, the raising of manhole and valve covers to the new finished surface level is often overlooked. Acute depressions are unnecessarily created in the road surface which have an adverse effect on the ride quality. Consideration should be given to the raising of covers prior to an asphalt overlay.

*Depression where a manhole has not been raised*

Covers so raised require the use of temporary ramping with cold mix or hot mix asphalt placed on sand or paper to aid easy removal.

It is difficult to achieve good quality work if manhole and valve covers are raised after completion of the overlay as at least 200 mm of new material has to broken away from the sides of the covers in order to raise the level. Back filling of this 200 mm is not always well done and inferior to the new asphalt surfacing.

*Filling around manhole after asphalt has been placed rather than before placement*

**Asphalt regulation prior to resurfacing**

If ride quality of an existing surface is poor prior to application of a thin layer of asphalt or sprayed seal treatment, there will be little or no improvement to ride quality unless a regulation or correction course is applied beforehand.

**ROUTINE MAINTENANCE**

**Pavement Repairs**

Larger pavement repairs extending over the full width of the traffic lane, with the use of full scale pavement construction practices, is preferred to a series of small poorly compacted patches. Poorly compacted patches that further compact under traffic have an adverse effect on ride quality. Common sense needs to be applied in each particular case, but it is possible to successfully compact pavement repairs over half the width of a traffic lane if due attention to detail is given to selection of appropriate plant and layer thickness. Patching works must match adjacent pavement levels to avoid unnecessary roughness.

The use of hot mix or bitumen emulsion cold mix in lieu of cutback bitumen cold mix will produce more stable patches that are less likely to deform or shove under traffic.

**Drainage**

An often forgotten part of routine pavement maintenance activity is the regular maintenance or repair of storm water, sub-surface and table drains to prevent the subgrade and pavement layers from becoming over wet. Frequent wetting up of the subgrade or pavement layers results in accelerated deformation and/or pavement failures contributing to a more rapid deterioration in ride quality. Excessive pavement patching without fixing the drainage problem is rarely successful and heavily patched roads generally have substandard ride quality.

**TIPS FOR ACHIEVING GOOD RIDE QUALITY**

Below is a check list of design and construction tips that will aid achievement of good ride quality in addition to specifying limits for roughness.

**New Road Construction Projects**

- Provide as large an unrestricted working area to the contractor as possible by permitting use of traffic detours in preference to part width construction;
- Investigate whether or not the insitu material at or below subgrade level is highly expansive and if so, ensure that this material has a sufficient cover of selected low expansive material meeting the requirements of Chapter 4 of VicRoads Tech. Bulletin No. 37;
- Where insitu materials are comprised of clay, ensure that plant species located in median and verge areas are those requiring minimal moisture from the soil. Plantations should be located well clear of the edge of the pavement (VicRoads Technical Report No. 75). It may be necessary to install root / moisture barriers for existing trees or plantations that need to be retained. (VicRoads Technical Note No. 13 and Technical Bulletin No. 32);
- Use an appropriate cementitious binder for cementitiously treated sub-base layers to provide adequate working time to mix, trim and compact the material.
- Use a full width paver/trimmer and /or laser controlled graders for granular pavement construction;
- Use asphalt pavers fitted with automatic sensors or laser equipment to work from a fixed reference;
- Specify random level assessment procedures for the finished surface of the subgrade and pavement courses for major pavement works where a geometric design is available;
- Use Specification Section 180 – Ride Quality for Pavements where appropriate.

**Pavement Rehabilitation and Periodic Maintenance Projects**

- Divert traffic and permit larger areas to be paved over the full width of the carriageway;
- Use moving level references such as averaging beams or moving laser reference systems for asphalt overlays where no geometric design is available;
- Minimise the number of transverse joints;
- Raise manhole and valve covers to the new finished level prior to asphalt overlay;
- Use slow and medium setting binders for insitu stabilisation of pavements with cementitious binders if the material cannot be mixed, trimmed and compacted within the maximum working time for the binder having regard for the time of year work is being undertaken;
- Provide a design line with geometric design for major overlays, resheets and major insitu stabilisation works in preference to “boning” rods or “by eye” methods.
- Use Specification Section 180 – Ride Quality for Pavements where appropriate;

**Routine Maintenance**

- Use hot mix asphalt or emulsion cold mix in preference to cut back bitumen cold mix;
- Repair pavements in larger or wider areas in preference to several small or narrow areas;

- Maintain or improve drainage in areas where the subgrade or pavement is likely to become over wet.

**REFERENCES**


- VicRoads Standard Specifications for Road and Bridgeworks and Guide Notes
- VicRoads Technical Report No. 75 – The influence of Trees and Shrubs on Pavement Loss of Shape (Barry 1986)
- VicRoads Technical Bulletin No. 37 – VicRoads Pavement Design Guide
- VicRoads Technical Bulletin No. 32 – Drainage of Subsurface Water from Roads.
- VicRoads Technical Note 13 – Vertical Moisture Barriers


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