HIGHWAYS DEPARTMENT

GUIDANCE NOTES
ON
ROAD SURFACE REQUIREMENTS FOR EXPRESSWAYS AND HIGH SPEED ROADS

Research & Development Division

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Contents

1. Introduction

1.1 This set of Guidance Notes provides the technical guidelines stipulating the road surface requirements for expressways and high speed roads. This revision, which supersedes the previous version issued in February 2023, mainly reflects the full transition of the use of 10mm nominal maximum aggregate size highly modified friction course (HMFC) from polymer modified friction course (PMFC).

2. Background

2.1 Guidance Notes No. RD/GN/032 was issued in June 2007 (which superseded Road Note 5 issued in 1983) stipulating the road surface requirements for expressways and high speed roads and recommended the use of friction course (FC) for enhancing road safety on all expressways trunk roads and primary distributors when vehicle speeds exceeding 80 km/hr were anticipated.

2.2 Since the issue of Road Note 5 in 1983, FC, which is also known as porous asphalt, has been used in Hong Kong as the standard surfacing material on expressways and high speed roads to provide fast drainage of surface water and high skid resistance. The Transport Planning and Design Manual recommends the use of FC material as the standard surfacing material in expressways.

2.3 An asphalt binder of penetration grade 60-70 was recommended in Road Note 5 for FC, which has been widely used in expressways or high speed roads since then. As FC is porous in nature, its oxidation rate and deterioration rate are faster than conventional continuous or gap graded bituminous materials and therefore it is relatively less durable than these materials. Overseas experience and practice indicates that the use of suitable polymer modified binders should enhance the durability of the porous asphalt.

2.4 In 2004, the Research and Development (R&D) Division of HyD began a research study "Testing on Polymer Modified Binders and Friction Course (Porous Asphalt)" (the Study) in collaboration with the Hong Kong Polytechnic University (PolyU). The Study aims at reviewing the use of the porous asphalt in overseas countries, studying the performance of three types of asphalt binders and their porous asphalt mixes, and conducting a cost-effectiveness analysis. The study report recommends the use of a new type of FC material with a pre-blended polymer modified binder, i.e. PMFC, which is found to be more cost-effective. In this regard, Guidance Notes No. RD/GN/011B issued in 2001 recommended the use of PMFC as a low noise road surfacing (LNRS) material in local roads, because slow moving traffic imposes greater damage on the material than fast moving traffic.

2.5 In 2014, R&D Division collaborated with the PolyU carried out another study on the application of highly modified asphalt in Hong Kong to further improve the durability of PMFC (the Further Study). With the use of a higher amount of Styrene-Butadiene-Styrene (SBS) polymer, highly modified bitumen with performance grade not lower than PG82 and viscosity at 60°C greater than 70,000 Pa.s, HMFC with a thickness of 25- 30 mm was introduced under the Further Study. The Further Study report recommends the use of HMFC which performs better than PMFC as revealed in the laboratory environment.

2.6 Since 2017, HyD commenced site trials to explore the potentials of HMFC for public roads, especially on its application on expressways and high speed roads. 24 trial road sections have been laid with HMFC under the trial programme with promising findings. Afterwards, Guidance Notes No, RN/GN/032A was issued in February 2023 promulgating the use of HMFC, apart from updating other technical guidelines.

3. Road Surface Requirements

3.1 Road safety on high speed roads is of prime concern and is affected by a number of factors or their combinations, including the vehicle and tyre condition, driver's behaviour, traffic condition, weather condition, road geometry and road surface condition. The skid resistance of the road surface is part of the road surface condition that contributes to safety. As skid resistance increases, the likelihood of skidding on the road surface will be reduced.

3.2 The skid resistance of a road surface is a complex matter. At low traffic speed, this is predominantly controlled by the "microtexture" of the aggregate used, and its resistance to polishing. The skid resistance tester in use in Hong Kong simulates the effect of a braking tyre travelling at 50 km/h, and thus provides a guide to the skid resistance of the road surface for a vehicle travelling at that speed. However, as speed increases beyond 50 km/h, the effect of the "macrotexture" of the road surface (i.e. the surface texture of the pavement) becomes increasingly important, particularly in permitting the escape of the water film between the tyre and a wet pavement. Surface texture is thus an important requirement for expressways and high speed roads in enhancing the road safety. The texture depth is an important factor influencing skidding in wet conditions on high speed roads.

3.3 A minimum average texture depth of 0.7 mm is recommended for concrete carriageway surfaces in the General Specification for Civil Engineering Works. However, research has shown that the texture depth required for no reduction in skid resistance at high speeds on bituminous surfacings is almost double the texture depth required for concrete roads. As the typical texture depth of bituminous wearing course material is only between 0.3 mm to 0.5 mm, it is necessary to adopt the porous friction course material which provides a texture depth of about 1.5 mm measured by the sand patch method at the time of new construction.

3.4 FC material is a very permeable asphalt layer with continuous voids. Water can percolate through the material to the pavement edges and discharge into appropriate drainage systems. The material has the following properties compared with continuously graded materials:

(i) improved skid resistance at high speeds;

(ii) reduced water spray from the rear of vehicles during wet weather;

(iii) greatly increased texture depth;

(iv) reduced possibility of aquaplaning;

(v) reduced tyre/road noise; and

(vi) enhanced resistance to wheel path rutting.

3.5 It is worth noting that FC was originally designed to improve skid resistance by virtue of its open texture. Because of the acoustic absorption and rapid drainage properties of the material, it has been revealed by overseas researches that porous friction course can also reduce traffic noise induced by the interaction between road surfaces and vehicles tyres of high speed traffic. With the findings of the recent trials, it is reasonably expected that the noise reduction performance of HMFC is comparable to PMFC; therefore, HMFC could serve as low noise road surfacing material on expressways and high speed roads. Together with the findings from the previous trial of FC, it is ascertained that the noise reduction effect will deteriorate gradually as clogging up of the voids and secondary compression of the surfacing occur over the service life. Furthermore, the interconnected voids allow access to air, so ageing and embrittlement is potentially exacerbated.

3.6 In view of the high texture depth and high porosity of porous asphalt, FC materials are recommended to be used on expressways and high speed roads connecting to these expressways where a major portion of vehicles are expected to travel at speeds exceeding 80 km/hr and HMFC should be used as the standard surfacing material in the above roads.

3.7 The mix design for HMFC is shown in Table 1 for reference. The mix design and specification for HMFC may be subject to change when required. The up-to-date specification for HMFC in the most recently awarded Highways Department road maintenance term contract should always be referred to.

Table 1: Mix Design for HMFC

Properties		
Nominal maximum aggregate size		10 mm
Particle size distribution	BS test sieve	Percentage by mass passing
	14 mm	100
	10 mm	85 – 100
	5 mm	20 – 40
	2.36 mm	5 – 15
	75 μm	2 – 6
Bitumen type		Pre-blended type polymer modified bitumen having performance grade not lower than PG82 of the Performance-Graded Asphalt Binder Specification and viscosity at 60°C not lower than 70,000 Pa.s
Highly modified bitumen content as % of total mass of material	min.	5.5 %
	max.	7.0 %
Air voids in mix (VIM) as a percentage of total bulk volume		20.0 % min.

4. Technical Aspects

4.1 Structural Layer

4.1.1 PMFC was previously considered as a non-structural layer. On the contrary, HMFC can be treated as a structural layer with better durability and material properties as compared with PMFC. In other words, while carrying out structural design for a pavement section, the thickness of HMFC can contribute to the required thickness of the bituminous layers. However, when replacing PMFC already laid as a surfacing material of existing expressways or high speed roads with HMFC, the existing pavement composition of the underlying bituminous layers should remain the same.

4.2 Laying and Compaction

4.2.1 Pneumatic-tyred roller shall not be used for compacting FC materials to ensure continuity of voids in the mix.

4.3 Road Pavement Drainage

4.3.1 Gully gratings wholly or partly lying inside the expressways and high speed roads should follow the details shown in HyD Standard Drawing No. H3106.

4.3.2 For retrofitting of FC materials on existing roads, the flood height should be checked in accordance with the latest version of Guidance Notes No. RD/GN/035 to ensure the flow height will not exceed the kerb height under the ultimate limit state.

4.3.3 Existing/raised bridge joints may obstruct surface water draining through the FC materials. Provision of gullies should be considered where ponding may occur at the bridge joint if there is no gully to collect the surface water draining along the joint.

4.3.4 It should be noted that surface water drains through FC materials and flows along the surface of the underlying layer according to the road gradient. The ramp at the end of the FC layer will stop the flow at the underlying layer. It is therefore advisable to stop the downstream end of the FC layer at the location of a gully and/or install sufficient gullies at the downstream end of the FC layer to avoid the accumulation of surface water, which may affect the long-term performance of FC materials. For road sections connecting tunnel, a similar drainage issue also happens at the transition between FC materials (for high speed road approaching tunnel tube) and the impermeable dense-graded wearing course material (inside tunnel tube). Meanwhile, it is common that tunnel cut-off drain(s) will be provided to avoid the accumulation of surface water. To the best of both worlds, the transition between the bituminous materials is recommended to be set at the tunnel cut-off drain.

4.4 Bridge Joints

4.4.1 Overlaying of bituminous materials on the concrete surface of bridge structure with buried joints would be vulnerable to reflective cracking and is therefore not recommended.

4.5 End Details

4.5.1 At the transition between HMFC and other pavement materials, details shown in HyD Standard Drawing No. H1135 should be adopted.