HIGHWAYS DEPARTMENT

GUIDANCE NOTES
ON
APPLICATION OF ULTRA-THIN OVERLAY

Research & Development Division

RD/GN/052
Jul 2026

1. Introduction

1.1 This set of Guidance Notes provides information on the application of ultra-thin overlay (UTO) for bituminous and concrete carriageways in Hong Kong. Where reference documents are quoted in this set of guidance notes, practitioners should refer to their latest version for the relevant details.

2. Background

2.1 UTO generally refers to a high-performance, thin layer (some 20mm thick) of specialized dense-graded hot asphalt mixture over existing road surfaces. The bitumen shall possess higher viscosity and elasticity than the highly modified bitumen currently used in Hong Kong and the aggregates shall be stronger and have higher abrasion resistance than our commonly used granite.

2.2 The utilization of UTO has become a proactive and sustainable pavement preservation strategy globally. Originating in Europe and subsequently refined through extensive applications in Chinese Mainland and the US, this technology addresses the functional deterioration of heavily trafficked roads by thin resurfacing or overlaying. The high-performance thin layer aids in restoring surface skid resistance and sealing the pavement against moisture ingress. Because of its application thickness, it is particularly suitable for urban environments where maintaining curb heights and minimizing traffic disruption are paramount.

2.3 In view of its benefits, Highways Department (HyD) introduced UTO from Chinese Mainland, making reference to the Guangdong Province's local standard "Technical specifications for high-toughness ultra-thin friction course in road engineering" (DB44/T 2623-2025) and arranging some local site trials commencing in 2025. The objectives of these trials were to assess the capability of local asphalt suppliers to produce compliant UTO, identify and tackle potential construction problems and constraints, and determine the suitability of UTO in Hong Kong.

2.4 Based on the findings and experiences gained from the site trials, the technical guidelines on the application of UTO are prepared and covered by this set of Guidance Notes.

3. Ultra-thin Overlay Materials

3.1 The mix design for UTO is shown in Table 1 for reference and may be subject to change when required. UTO shall be designed in accordance with DB44/T 2623-2025 with modifications only if agreed by the Engineer. The most recent specifications for these materials should always be referenced in the latest HyD road maintenance term contracts.

Table 1: Mix Design for Ultra-thin Overlay Materials

Properties		Ultra-thin Overlay
Particle size distribution	BS Sieve Size / Sieve Size according to GB/T 6003.1 and 6003.2 (mm)	Percentage by mass passing as percentage of total aggregate (excluding binder)
	9.5 mm	100
	7.2 mm	85 - 100
	4.75 mm	35 - 75
	2.36 mm	15 - 35
	1.18 mm	8 - 25
	0.6 mm	6 - 20
	0.3 mm	5 - 15
	0.15 mm	4 - 12
	0.075 mm	3 - 8
Bitumen Type		Pre-blended type bitumen with Styrene-Butadiene-Styrene (SBS) polymer having performance grade not lower than PG100 of the Performance-Graded Asphalt Binder Specification and viscosity at 60°C not lower than 580,000 Pa.s. For details of the requirement to be satisfied, Table 2 refers.
Bitumen content as percentage of total mass of material		7.2 % min.
Marshall stability		≥ 6 kN
Air voids in mix (VV)		3 % - 6 %
Voids in mineral aggregate (VMA)		≥ 19.0 %
Voids filled with asphalt (VFA)		≥ 70%
Voids in coarse aggregate of mix(VCA_{mix})		≤ VCA_{DRC}
Asphalt Film Thickness (AFT)		≥ 15μm
Draindown percentage		≤ 0.8 %

Table 1: Mix Design for Ultra-thin Overlay Materials (Con't)

Properties	Requirements
Texture Depth	≥ 0.8mm
Dynamic Stability (60°C, 0.7MPa)	≥ 6000 cycles / mm
Dynamic Stability (70°C, 0.7MPa)	≥ 3500 cycles / mm
Four-Point Bending Fatigue (15°C, 1000με)	≥ 500000 cycles
Cantabro Loss	≤ 6 %
Freeze-Thaw Splitting Tensile Strength Ratio (TSR)	≥ 85 %
Retained Marshall Stability	≥ 85 %
Low-Temperature Bending Failure Strain (-10°C)	≥ 5000 με
Permeability	≤ 80 ml/min

Table 2: Property requirements of high-viscosity and high-elasticity modified bitumen

Properties	Requirements
Penetration at 25°C (0.1mm)	30-50
Retained Penetration ratio after TFOT (%)	≥ 70
Softening point (°C)	≥ 95
Solubility (%)	≥99
Flash point (°C)	≥ 260
Elastic Recovery at 25 °C (%)	≥ 98
Viscosity at 60°C (Pa.s)	≥ 580k
Mass change after TFOT (%)	± 1.0
Complex modulus (G*) using DSR at 60 °C without aging (kPa)	≥ 12.0
($G^*/\sin\delta$) using DSR at 100 °C without aging (kPa)	≥ 1.00
($G^*/\sin\delta$) using DSR at 100 °C after RTFO aging (kPa)	≥ 2.20

4. Areas of Application

4.1 Compared with the highly modified stone mastic asphalt (such as HMSMA10), the capital cost of UTO is significantly higher due to the use of higher quality raw materials, in particular bitumen and aggregates, with more stringent technical requirements. Considering its better performance, environmental benefit of lesser resource consumption and the need to balance cost-effectiveness, UTO should be considered as surfacing material for converting existing concrete surfaces to bituminous surfaces (i.e. the "White-to-Black" overlaying or resurfacing works) to enhance driving comfort and road surface conditions. If a project proponent intends to use UTO on bituminous carriageways, prior agreement of the Research and Development Division of HyD shall be sought.

4.2 When considering the application of UTO on an existing concrete surface, the information on existing road surface conditions shall be comprehensively gathered and assessed. Defects in the concrete pavement shall be clearly identified and documented in accordance with the HyD Guidance Notes No. RD/GN/015 on Catalogue of Road Defects (CORD), complemented by ground penetration radar survey (GPR) to support decision making. UTO shall only be considered where the underlying materials are structurally sound. Local maintenance experiences and other relevant considerations shall be taken into account when selecting the most suitable surfacing material.

5. Special Attention

5.1 To ensure the high-quality production and construction of UTO, practitioners shall strictly follow the technical requirements for its design, mixing, handling and storage, laying and compaction, and testing. Specifically, the following areas require special attention.

5.2 It is important to note that the bitumen used possesses a very high viscosity at 60 ^{o}C (i.e. $\geq$ 580,000 Pa.s). The exceptionally high viscosity presents significant technical challenges on material handling. Practitioners shall strictly implement the stringent temperature control on UTO as shown in Table 3 and UTO shall not be laid when the ambient temperature is below 10^{o}C.

Table 3: Temperature Requirements

Operations	Requirements (ºC)
Aggregate at mixing	190-220
Pre-blend bitumen	180-190
UTO after mixing	185-200
Pre-heated Tack Coat	80-85
UTO at laying	Not less than 165
UTO at start of compaction	Min. 160
UTO at completion of compaction	Min. 120

5.3 The use of UTO aims to provide a high-performance, thin layer of asphalt over existing road surfaces. Therefore, the soundness of underlying materials is critical to the success of the entire pavement structure. As stated in Section 4.2, defects in concrete pavement shall be clearly identified to determine if UTO is suitable to be laid. Defects such as joint stepping and rocking indicate a high potential for loss of support from unbound materials and the structural soundness shall be verified by a GPR survey. For defects such as block cracks, corner cracks and spalling, the extent of the affected area shall be identified for removal and repair in accordance with the HyD Guidance Notes No. RD/GN/037 on Preservation of Concrete Carriageway. For joints and cracks less than 3mm in width, no special pre-treatment is required. For joints and cracks equal to or greater than 3mm in width, all infilled materials such as debris, sealants and fillers shall be entirely removed and the gaps shall be filled with the recommended materials summarized in Table 4 for the pre-treatment of joints and cracks, subject to the Engineer's approval.

Table 4: Recommended Materials for Pre-treatment of Joints and Cracks

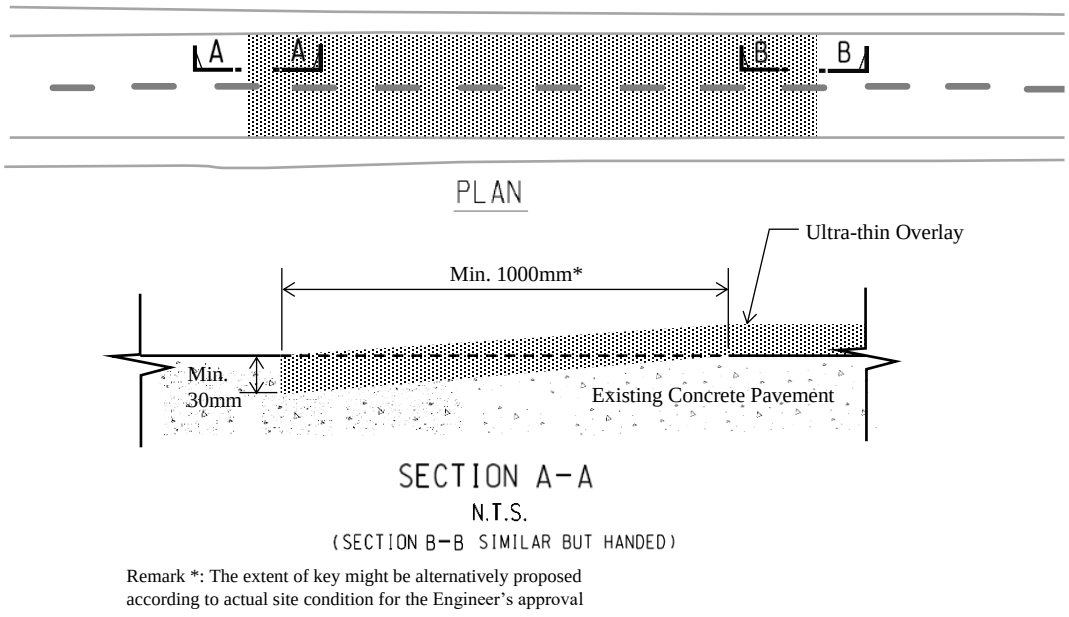
Width of Joints and Cracks	Recommended Materials
< 3 mm	N/A
≥ 3mm and < 5mm	- Bitumen complying with the requirements in Table 2; - Hot applied elastomer modified bitumen binder; or - High tensile strength epoxy polymer
≥ 5mm	- Mixture of bitumen complying with the requirements in Table 2 and fine aggregates (passing 2.36mm sieve); - Hot applied elastomer modified bitumen binder; or - High tensile strength epoxy polymer

5.4 In general, pre-treating the existing concrete pavement surface by milling is considered not necessary and UTO can be directly laid on the surface after the completion of pre-treatment works as required in Section 5.3 and cleaning. However, if surface texture deficiencies, such as ravelling and loss of surface texture including polishing, are noted on the existing concrete surface, the deficient surface shall be suitably milled or roughened. Prior to the laying of UTO, the surface shall be properly and thoroughly cleaned and entirely free of deleterious elements to ensure proper application of the tack coat and sufficient bonding with UTO. Appropriate cleaning methods and equipment, which may include, but are not limited to road sweepers, bucket sweepers, high-pressure water jet, industrial vacuum cleaners, or a combination of the above, shall be proposed for the Engineer's approval. The proposed cleaning methodology shall demonstrate that it can achieve the required surface cleanliness to ensure sufficient bonding of the UTO, while taking into account site-specific conditions and operational time constraints.

5.5 To ensure UTO is firmly adhered to existing concrete pavement surface, tack coat shall be a high-viscosity modified bituminous emulsion complying with the requirements shown in Table 5 and shall not be diluted with water or solvent before use. Tack coat shall be pre-heated to a temperature between 80 °C and 85 °C and be applied by a spray paver which shall be capable of applying tack coat material uniformly to the surface to be overlaid at a rate of 0.8 to 1.2 kg/sq. m immediately before laying of UTO material. At the start of each shift, after stoppages, or during batch changes, the tack coat temperature, condition, and spray pattern shall be verified, with any degraded or non-uniform tack coat immediately rejected. In addition to the above tack coat requirements, transition tapers or commonly known as keys shall be prepared at both ends of overlay area to reinforce bonding and provide a smooth transition with existing concrete surface. The construction details of keys on concrete pavement are illustrated in Figure 1. For UTO paving works to be carried out by stages over a short period of time to tally with the temporary traffic arrangement scheme, preparation of keys at the transverse joints between consecutive stages may be waived, subject to the Engineer's approval, provided that a temporary ramp is formed to create a smooth transition to the existing concrete surface. The temporary ramp shall be completely removed and the exposed surface thoroughly cleaned prior to the application of tack coat and subsequent laying of UTO material.

Table 5: Property requirements of tack coat

Properties	Requirements
Bituminous Emulsion Properties	
Efflux time 3mm at 25°C (s)	12-60
Residue on sieving 1.18mm (%)	≤0.1
Particle Charge	Cation
Setting Classification	RS or MS
Properties of Residue by Evaporation	
Residue content (%)	≥ 55
Penetration at 25°C (0.1mm)	40-80
Softening point (°C)	≥ 82
Ductility at 5°C (cm)	≥ 20
Viscosity at 60°C (Pa.s)	≥ 50k
Solubility (%)	≥ 97.5
Elastic Recovery at 25 °C (%)	≥ 92
($G^*/\sin\delta$) using DSR at 82 °C (kPa)	≥ 2.20



Remark *: The extent of key might be alternatively proposed according to actual site condition for the Engineer's approval

Figure 1: Typical Construction Details of Key for UTO on Concrete Pavement

5.6 If UTO is planned to be directly laid on existing concrete pavement surface, road safety check shall be performed to identify potential roadside hazard due to the change of ground profile condition. The corresponding improvement measures shall be formulated and implemented, making reference to the prevailing traffic and highway engineering standards and taking into account actual site conditions. In addition, road pavement drainage design shall be reviewed due to the change of ground profile condition. The serviceability state and ultimate state design shall be checked in accordance with the HyD Guidance Notes No. RD/GN/035 on Road Pavement Drainage Design and practicable improvement measures at suitable locations shall be provided as necessary. The decision to raise utility covers either prior to or after the laying of UTO shall be carefully planned, taking into account road safety, time constraints, and the total number of covers on site. Temporary ramps may be provided around the raised covers and between the traffic lanes with level difference until the works are fully completed.