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Asphalt Concrete – Checks and Key Points

CC-PAV-04015
December 2020

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1. Introduction

The aim of this Technical Document is to provide Employer's Representatives and other interested parties with background information on key attributes for the installation of Asphalt Concrete Base and Binder mixtures used within the structure of the pavement. This document is provided to enhance the understanding of the written requirements of the specifications with photographs and notes are used to emphasise the points being made. The photographs aim to show examples of good practice and poor practice.

The Document is not a specification but should be read in conjunction with contract specific documentation and other TII Publications including the Specification for Road Works. It is not the intention for this Technical Document to replace the requirements of the Specification for Road Works but to help in the interpretation of the requirements. In many instances the specification reference is provided in order for the user to easily locate the actual specification requirement.

It is important to note that this Technical Document does not purport to cover every aspect of Asphalt Concrete nor any legal interpretation of the Specification for Road Works. It is the Contractors responsibility to ensure the end product installed is fit for the intended purpose and durable for its expected life.

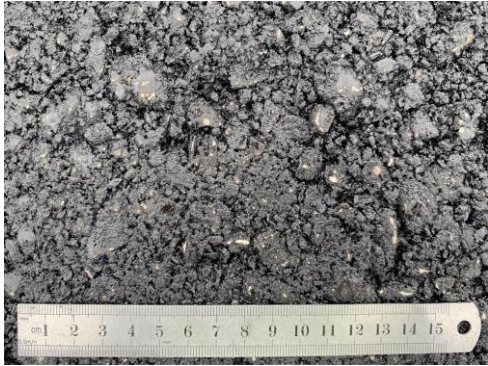


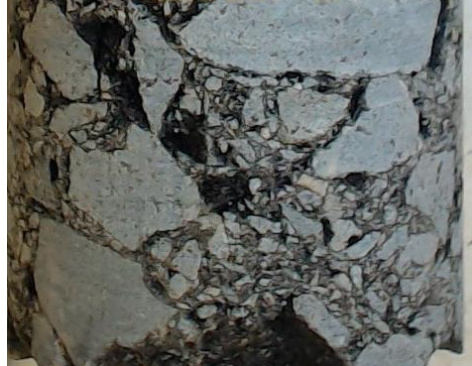
Checklist of items required prior to commencing works:




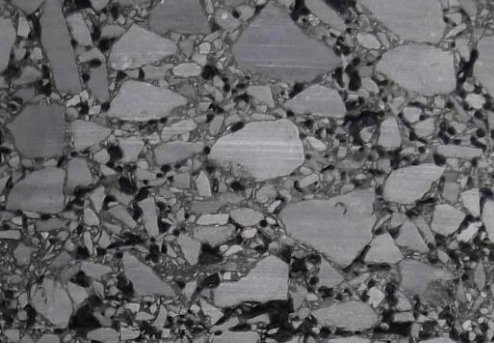


Item	Specification Reference	Task	Done ✓
CE Marking	CC-SPW-00900 Clause 3	Review documentation for compliance with specified AC mixture:	
	CC-SPW-00900 Table 1	Constituents - Type testing, Declaration of Performance, CE Marking - CC-GSW-00900 Table NG1.2a	
	CC-SPW-00900 Table 2	Product Composition - Type testing, Declaration of Performance, CE Marking - CC-GSW-00900 Table NG1.2a	
Works Proposals	CC-SPW-00900 Clause 10.1.2	Contractor to submit works proposals to include:	
		Laying and compaction plant – CC-SPW-00900 Clause 10.1.7 & 10.1.9 & 10.1.9.1	
		Working in different climatic conditions - CC-SPW-00900 Clause 10.1.5 & CC-GSW-00900 NG 10.1.5	
		Formation of joints - CC-SPW-00900 Clause 10.1.8 & CC-GSW-00900 NG 10.1.8	
		Further reading CC-GSW-00900 Clause NGA 10	







Checklist of items required during and after completion of the works:







Item	Specification Reference	Task	Done ✓
Works Requirements	CC-SPW-00900 Table 3 CC-GSW-00900 Table NG10.1 CC-GSW-00900 Table NG10.2	Undertake checks and review for compliance with specified requirements including:	
		Traceability of material in the works – laying records – CC-SPW-00900 Clause 10.1.2	
		Operating Compliance Level of the manufacturing plant – obtain reports - CC-GSW-00900 Clause NG1.5	
		Temperatures - CC-SPW-00900 Clause 10.1.6 & CC-GSW-00900 Clause NG 10.1.6	
		Mixture Properties - CC-SPW-00900 Clause 10.1.10.1	
Monitoring	AM-PAV-06049 Clause 7.2	The Implementation Authority is required to confirm that the data is compliant with the Specification and that the test records are available for review.	







Key points during and after completion of the works:



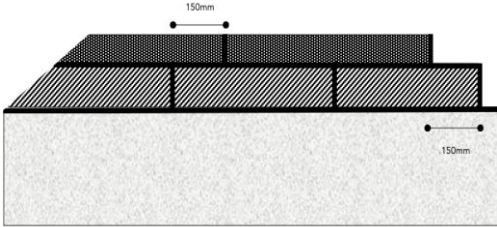



Key point	Level	Example Photographs		Specification References and notes
AC 32 Base Mixture	Good Mixture is dense Rich 'shine' at surface Low air voids Durable	 <p style="text-align: center;">Dense, shiny finish</p>	 <p style="text-align: center;">Good aggregate interlock</p>	Base and Binder course mixtures form the main structural layers of a flexible pavement. Asphalt Concrete (AC) is the primary mixture type used in these layers and requires: <ul style="list-style-type: none"> • Good dynamic stiffness – to spread the load • Resistance to Permanent Deformation – to prevent rutting under traffic • Resistance to fatigue – to prevent cracking • Impermeability – to prevent water entering the pavement
	Poor Mixture is coarse Dull surface High air voids Not durable	 <p style="text-align: center;">Coarse, dull finish</p>	 <p style="text-align: center;">Voided, poor aggregate interlock</p>	To ensure all of the above properties are met, the composition of the AC mixture needs to be designed. The design is influenced by the type and characteristics of each constituent including aggregates, filler, binder and where used, Reclaimed Asphalt (RA). When Reclaimed Asphalt (RA) is used as a constituent, the consistency of the feedstock is very important as RA may be derived from multiple sources.

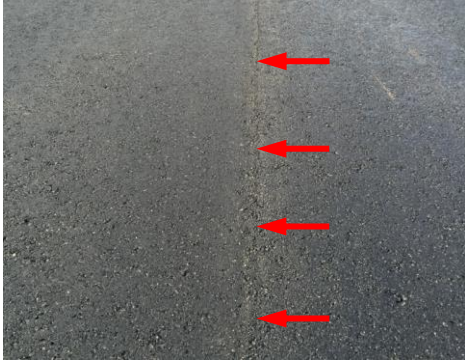
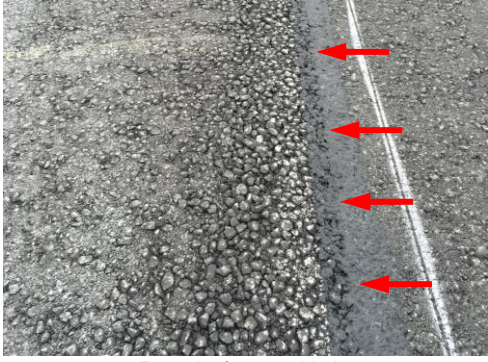

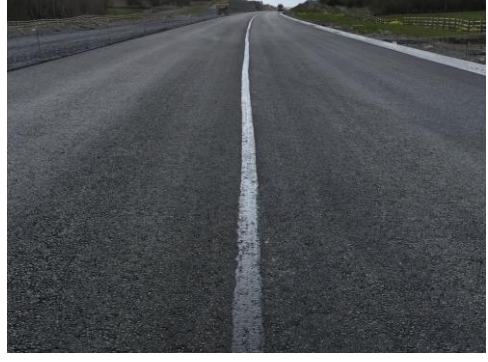


Key point	Level	Example Photographs		Specification References and notes
AC 20 Binder Mixture	<p>Good</p> <p>Mixture is dense</p> <p>Low air voids</p> <p>Durable</p>	 <p>Dense finish</p>	 <p>Good aggregate interlock</p>	<p>The greater the proportion of RA used, the greater the influence on the mechanical properties and effective binder content of the mix.</p> <p>The constituents of mixtures should be traceable, this also applies to RA.</p> <p>AC mixtures should be dense enough to achieve aggregate interlock and rich enough to permit reorientation of the aggregate particles during compaction to reduce air voids.</p> <p>CC-SPW-00900 Clause 10.1.9.1</p> <p>A low level of air voids prevents water ingress, vital for long term durability.</p> <p>The temperature of the AC mixture should be within the limits contained in Tables 2 and 3 of CC-SPW-00900.</p>
	<p>Poor</p> <p>Mixture is partially dense</p> <p>Dull surface</p> <p>High air voids</p> <p>Not durable</p>	 <p>Coarse finish</p>	 <p>Voided</p>	
Transport	Cleanliness & Insulation	 <p>Release agent application</p>	 <p>Well insulated load</p>	<p>CC-SPW-00900 Clause 10.1.3</p> <p>To facilitate the discharge of asphalt, the floor of the vehicle shall be coated with water, a liquid soap solution or proprietary release agent.</p> <p>Insulated transport is essential to minimise heat loss prior to use. CC-SPW-00900 Clause 10.1.3 stipulates the requirements for transport.</p>







Key point	Level	Example Photographs		Specification References and notes
Preparation	Substrate Cleanliness & condition	 <p style="text-align: center;">Surface deposits</p>  <p style="text-align: center;">Sweeper</p>  <p style="text-align: center;">Close surface finish to granular substrate</p>	 <p style="text-align: center;">Cleaned surface</p>  <p style="text-align: center;">Water bowser & spray bar</p>  <p style="text-align: center;">Loose surface finish to granular substrate</p>	<p>CC-SPW-00900 Clause 10.1.1.1</p> <p>Any packed mud or other deposits on the road surface shall be thoroughly removed and the road surface shall be swept free of all loose and deleterious materials.</p> <p>A good bond will ensure all layers act as one pavement and not individually.</p> <p>Effective removal of detritus can be achieved by:</p> <ul style="list-style-type: none"> • Pressure washing • Spray bars fitted to water tankers • Repeated sweeping <p>CC-SPW-00800 Clause 802.8</p> <p>To enable consistent compaction of the AC material, the surface of any granular layer must uniformly support plant and vehicles.</p> <p>The granular material should have a close surface finish and not move under load.</p> <p>All loose, segregated or otherwise defective areas should be replaced.</p>







Key point	Level	Example Photographs		Specification References and notes
Bond to Substrate	Substrate type	 <p data-bbox="533 596 1025 624">Bond coat on Bituminous bound substrate</p>	 <p data-bbox="1070 596 1585 624">Bond coat on Hydraulically bound substrate</p>	<p>Where the substrate is bituminous or hydraulically bound, the bond to the underlying substrate is essential.</p> <p>A bond coat is applied prior to placing the AC material.</p> <p>For granular substrates, a bond coat is not generally applied.</p>
	Application of bond coat	 <p data-bbox="607 975 958 1002">Good application of bond coat</p>  <p data-bbox="629 1370 936 1398">Bond coat not fully broken</p>	 <p data-bbox="1160 975 1503 1002">Poor application of bond coat</p>  <p data-bbox="1070 1370 1585 1398">Consequences of not allowing to fully break</p>	<p>CC-SPW-00900 Clause 10.1.4</p> <p>Application shall be carried out with a calibrated mechanical binder distributor.</p> <p>After application, an emulsion must be allowed to fully break before the AC is laid.</p> <p>If bond coat is not given sufficient time to break, the emulsion is 'picked up' by plant, delivery vehicles and footwear.</p> <p>Removal of bond coat from the substrate is detrimental to the long term performance of the pavement.</p> <p>The 'pick up' generally occurs in the wheelpaths of the delivery vehicles.</p> <p>These wheelpaths are typically in the same locations as the wheelpaths of the regular traffic. Hence, if 'pick up' occurs, the location with most impact has the least amount of bond.</p>


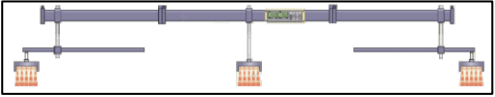



Key point	Level	Example Photographs		Specification References and notes
Transverse joints	Preparation	 <p data-bbox="618 616 954 643">Well treated transverse joint</p>	 <p data-bbox="1155 616 1491 643">Poorly treated transverse joint</p>	<p data-bbox="1621 248 1984 276">CC-SPW-00900 Clause 10.1.8</p> <p data-bbox="1621 312 2119 371">Transverse joints are cut back to a vertical joint.</p> <p data-bbox="1621 408 2130 555">The faces of all upstanding edges shall be treated with hot bitumen binder or cold applied thixotropic bituminous compound – see CC-SPW-00900 Clause 10.1.8 for specific details.</p> <p data-bbox="1621 592 2107 643">The binder must adhere evenly to the full area.</p>
	Formation	 <p data-bbox="551 1015 1014 1042">Raking coarse material away from joint</p>	 <p data-bbox="1223 1015 1447 1042">Resultant neat joint</p>	<p data-bbox="1621 655 2119 715">AC 32 and AC 20 mixtures contain a large range of particle sizes.</p> <p data-bbox="1621 751 2107 866">Segregation can occur when levelling out the material at the joint. This can lead to gathering of coarse particles that are difficult to compact in a confined area.</p> <p data-bbox="1621 903 2130 986">Hand raking the coarse particles away from the joint helps to form a similar finish to the surrounding area.</p>
	Over sealing			<p data-bbox="1621 1046 2130 1098">A sealant is applied to the top surface of all base and binder course joints.</p> <p data-bbox="1621 1134 2141 1217">Not less than 0,50kg/m² of residual bitumen is placed extending to 75mm either side of the joint.</p> <p data-bbox="1621 1254 2074 1313">See CC-SPW-00900 Clause 10.1.8 for permitted types of sealant.</p> <p data-bbox="1621 1350 2007 1409">Joint sealing is required to arrest deterioration from water ingress.</p>







Key point	Level	Example Photographs		Specification References and notes
Longitudinal joints	Preparation	 <p>Offset layers</p>  <p>Joint cut back to vertical face</p>	 <p>Layers offset by minimum of 150mm</p>  <p>Joint formed with edge compressing tool</p>	<p>CC-SPW-00900 Clause 10.1.8</p> <p>All joints shall be offset by at least 150mm from parallel joints in the layer beneath.</p> <p>Longitudinal joints are treated to ensure the void content requirement specified in Clause 10.1.9 is achieved by:</p> <ul style="list-style-type: none"> • Cutting back to a vertical face; • Using an edge compressing tool fitted to the roller to form a 45° or 60° angle; or • Laying adjacent lanes with two or more pavers in echelon.
	Formation	 <p>Sufficiently sealed joint</p>	 <p>Insufficiently sealed joint</p>	<p>CC-SPW-00900 Clause 10.1.8</p> <p>The faces of all upstanding edges shall be treated with hot bitumen binder or cold applied thixotropic bituminous compound – see CC-SPW-00900 Clause 10.1.8 for specific details.</p> <p>The binder must adhere evenly to the full area.</p>

Key point	Level	Example Photographs		Specification References and notes
Longitudinal joints continued	Formation continued	 <p>Well formed joint</p>	 <p>Poorly formed joint</p>	<p>Joints are the weakest part of a pavement.</p> <p>Water ingress from the surface leads to deterioration in the pavement layers below.</p>
	Over sealing			<p>A sealant is applied to the top surface of all base and binder course joints.</p> <p>Not less than 0,50kg/m² of residual bitumen is placed extending to 75mm either side of the joint.</p> <p>See CC-SPW-00900 Clause 10.1.8 for permitted types of sealant.</p> <p>Joint sealing is required to arrest deterioration from water ingress.</p>
Freestanding Edge	Formation	 <p>3 layers of AC at freestanding edge</p>	 <p>Compressing freestanding edge</p>	<p>CC-SPW-00900 Clause 10.1.8</p> <p>The freestanding edge of all layers shall be finished using an edge compressing tool fitted to the roller to form a 45° or 60° angle.</p> <p>The freestanding edge on the high side of the camber is also sealed to prevent water ingress.</p>


Key point	Level	Example Photographs		Specification References and notes
Adjacent Concrete Component	Preparation	 <p data-bbox="680 616 887 639">Sealed kerb face</p>	 <p data-bbox="1205 616 1458 639">Sealed safety barrier</p>	<p data-bbox="1619 248 2143 368">Where AC material is placed in contact with concrete kerb and concrete safety barrier, the upstanding edge of the concrete is also sealed with bitumen.</p> <p data-bbox="1619 403 2067 464">This is to prevent water ingress to the pavement.</p>
Ironwork	Formation	 <p data-bbox="557 999 1010 1023">good level of compaction around gully</p>  <p data-bbox="685 1382 882 1406">Plate compactor</p>	 <p data-bbox="1106 999 1559 1023">Poor level of compaction around gully</p>  <p data-bbox="1211 1382 1453 1406">'Elephants foot' tool</p>	<p data-bbox="1619 647 2143 799">Ironwork such as gullies and manholes may be 'raised' and levelled prior to the AC material being laid or the AC material may be laid over the location of the Ironwork, and the Ironwork 'raised' afterwards.</p> <p data-bbox="1619 834 2143 927">Where ironwork is raised prior to laying AC, the AC material around the ironwork is finished by hand.</p> <p data-bbox="1619 1046 2143 1166">It is imperative that a plate compactor or 'elephants foot' tool is used to quickly tamp the material at the interface to achieve compaction where the roller cannot access.</p>

Key point	Level	Example Photographs		Specification References and notes
Temperature	Mixture cohesion	 <p data-bbox="533 579 1032 639">Thick layer – slow rate of cooling & ample time for compaction</p>	 <p data-bbox="1093 579 1570 639">Thin layer – fast rate of cooling, not fully compacted</p>	<p data-bbox="1619 248 2074 280">CC-SPW-00900 Clause 10.1.5 Laying</p> <p data-bbox="1619 312 2136 432">The ambient conditions at the time of installation should be monitored and recorded. Compaction control is critical with variable weather conditions.</p> <p data-bbox="1619 464 2130 584">Rate of cooling is very dependent upon layer thickness. As a guide a 25% increase in thickness = a 50% increase in time available for compaction.</p>
	Transverse cracking			<p data-bbox="1619 624 2107 775">If the mixture temperature is too low, reduced cohesion occurs at the interface between the binder film and aggregate leading to excessive voids in the finished surface and subsequent loss of material.</p> <p data-bbox="1619 807 2123 983">Cracks can develop when the mixture is unable to initially support the roller at high temperature. Cracks can also develop at a mid-range temperature circa 100°C to 115°C. Momentarily pausing compaction will avert further crack development.</p>
	Longitudinal cracking			<p data-bbox="1619 1023 2123 1110">Cracks can also be due to a tender or dry mix. If cracking continues then the mixture should be reviewed.</p> <p data-bbox="1619 1142 2112 1326">Localised cracking of the AC mixture can also occur as a result of 'soft spots' in the substrate. A waterlogged or plastic substrate does not provide adequate support and the AC mixture becomes overstressed.</p>

Key point	Level	Example Photographs	Specification References and notes	
Regularity	Pins & Sensors	 <p data-bbox="568 692 1003 746">Pin set in concrete. Hanger and wire attached</p>	<p data-bbox="1615 245 2154 405">For new construction, site availability usually permits time to place pins at chainage points. The pins are set in concrete and tapes are placed on the pins to indicate the finished road level.</p> <p data-bbox="1615 437 2154 533">Hangers can be placed on the pins at the correct level for paving and a wire attached between successive pins.</p> <p data-bbox="1615 564 2154 660">Ultrasonic sensors on the paver use the wire as a datum to automatically adjust the paving level.</p>	
	Averaging beam	 <p data-bbox="568 943 1003 970">Ultrasonic sensors attached to beam</p>	 <p data-bbox="1106 692 1563 719">Ultrasonic sensor using wire as datum</p>  <p data-bbox="1227 1059 1442 1086">Ultrasonic sensor</p>	<p data-bbox="1615 767 2154 991">Where pins cannot be placed, an averaging beam can be used in conjunction with ultrasonic sensors can be combined for use on an averaging beam, data collected from the three ultrasonic sensors is averaged out to create a virtual reference. The resultant level cuts through rather than follows irregularities in the underlying layer.</p>
	Laser Total Station	 <p data-bbox="533 1374 1039 1401">Prism on paver. Reference level on ground</p>	<p data-bbox="1615 1059 2154 1362">The total station technique uses a non-contact system to control levels. The 3D design model is contained in a control box mounted on the paver. A prism also mounted on the paver is connected to the control box. Level stations placed along the carriageway communicate with the prism on the paver. The system controls the height and slope of the screed in reference to 3D design model.</p>	

Key point	Level	Example Photographs		Specification References and notes
Specific issues	Segregation of mixture	 <p data-bbox="618 608 949 635">Segregation in vehicle body</p>	 <p data-bbox="1095 608 1565 635">Cluster of coarse aggregate on laid mat</p>	<p data-bbox="1621 248 2141 400">Segregation should be identified at the point of loading. If laid, the clusters of coarse aggregate particles can lead to difficulties with achieving a dense surface with low air voids.</p> <p data-bbox="1621 432 2114 496">Segregation is most prevalent with AC 32 mixtures and may be caused by the:</p> <ul data-bbox="1621 528 2040 624" style="list-style-type: none"> • Proportioning of the constituents • Hot storage of the material • Load out of the material
	Dry mixture	 <p data-bbox="607 999 960 1026">Uncoated aggregate particles</p>  <p data-bbox="685 1390 882 1417">Crumbling edge</p>	 <p data-bbox="1077 999 1588 1026">Dull appearance (compared to adjacent rip)</p>  <p data-bbox="1274 1390 1391 1417">Ravelling</p>	<p data-bbox="1621 639 2141 727">A dry mixture is evident by a variable finish, often exhibiting one or more of the following:</p> <ul data-bbox="1621 759 2007 887" style="list-style-type: none"> • Uncoated aggregate particles • Dull appearance • Crumbling joint / edge • Ravelling <p data-bbox="1621 919 2141 983">A mixture exhibiting these features will not be durable for its expected life</p>



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