CONSTRUCTION SPECIFICATION RECOMMENDATIONS AND GUIDELINES
FOR INSTALLATION OF ASPHALT PAVEMENT WITH STONE BASE UNDER LAYER
FOR SYNTHETIC SURFACED RUNNING TRACKS

SECTION 1
GENERAL

1.1 Scope

1.1.1 The following specifications are offered as guideline information only in order to assist the Owner and / or Architect or Engineer in the preparation of asphalt and base for the installation of synthetic running track surface. The specifications are general in nature and may require adaptation in order to suit local climatic conditions, expected loads and soil conditions. The synthetic surfacing contractor shall be informed about any proposed specification alteration.

1.2 Introduction

1.2.1 The extremely strict tolerances for gradients and flatness, which are stipulated by the Sport Federations or Associations for the synthetic surfaces, mean that the construction of adequate asphalt and base is of supreme importance. Tolerances are required to be met not only by the newly completed facility, but also over it's life, which might be two or three times the expected life of the synthetic surface.

1.2.2 The asphalt and base should be designed to meet the following criteria:

- It should be capable of supporting and transmitting to the existing ground the loads of all vehicles, machines and materials to be used in the construction, without causing deformation of the site, or exceeding the ground-bearing capacity;
- It should be capable of supporting and transmitting all the loads on the synthetic surface from athletes and maintenance equipment, without permanent deformation of the asphalt or base;
- It should be sufficiently flexible to provide protection to the synthetic surface from the effects of sub-soil movement and frost heave;
- It should be sufficiently impermeable to provide total protection to the synthetic surface from ground water;
- It should ensure that the above criteria are maintained throughout the life of the installation.

1.2.3 The procedure adopted for the construction of a new asphalt base will normally consist in the following operations:

- A comprehensive Geo-technical investigation should be carried out to accurately determine the sub-soil conditions: it is important to ascertain the strata at depths down to approx. 8 feet (2.5m).
- Excavation to remove vegetable matter, soil, loose or frost susceptible material down to firm, load-bearing sub-soil.
- An adequate sub-drain system shall be provided since adequate surface and subsurface drainage is essential for a stable asphalt base.
- Compaction of the sub-soil, graded to falls within the tolerances specified for accuracy of finished level.
- Laying and compacting of ordinary fill to create the sub-base layer (the minimum thickness of the layer to be determined based on the Geo-technical characteristics of the sub-soil and on the expected loads), graded to falls within the tolerances specified for accuracy of finished level and thickness.
- Laying and compacting of 4" - 8" (10 - 20 cm) thick crushed stone to create the base under layer, graded to falls within the tolerances specified for accuracy of finished level, straightness and thickness. Actual specifications for the thickness and composition of the base under layer should be approved by a registered engineer to ensure suitability to local conditions.
- Laying and compacting of minimum 4" (10 cm) thick hot mix asphalt pavement in two layers.
  The bottom layer, Asphalt Binder Course, shall be a minimum of 2.5" (60 mm) thick, graded to falls and checked for accuracy of finished level, straightness and thickness within the tolerances specified.
  A Tack Coat is applied just prior to placing subsequent pavement layers.
  The top layer, Asphalt Top Coat, shall be a minimum of 1.5" (40mm) thick, graded to falls and checked for accuracy of finished level, straightness and thickness within the tolerances specified.

SECTION 2
PRODUCTS AND MATERIALS

2.1 Ordinary Fill

2.1.1 Ordinary Fill shall be natural soil, well graded and free from all organic or other weak or compressible materials and of any frozen materials. Fill shall contain no stone larger than 4" (10 cm) in any dimensions.

2.1.2 It shall be of such nature and character that it can be dried and compacted in a reasonable length of time which shall not unduly interfere with the progress of construction.

2.1.3 It shall be free of all expansive materials such as highly plastic clays, of all materials subject to decay, decomposition or dissolution and of cinders or other unsuitable material.

2.1.4 It shall have a maximum dry density of not less than 115 pounds per cubic foot as determined by ASTM D1557, Method-D.

2.2 Base Under Layer Material

2.2.1 The base under layer material shall be "crushed stone". The crushed stone shall be washed stone or gravel free of organic materials. Gradation and durability shall conform to ASTM C-33, Size 57, 1' to NO. 4.

2.2.2 Materials used for the base under layer shall be crushed stone meeting the following, or near, gradation:

Sieve	Total % Passing
1”	100
3/4"	90 - 100
3/8"	50 - 95
# 4	35 - 80
# 10	25 - 65
# 40	10 - 35
# 100	3 - 10

2.3 Hot Mix Asphalt

2.3.1 Hot mix asphalt for surface courses shall consist of coarse and fine aggregates and mineral filler plant-mixed with bitumen binder.

2.3.2 All hot mix asphalt shall be in accordance with applicable provisions of State or Provincial Department of Transportation "Standard Specifications for Road and Bridge Construction", except as herein modified.

2.3.3 The hot mix asphalt shall be plant-mixed and the bituminous material for mixture shall be AC-1, 85 - 100 penetration grade or 60 - 70 penetration grade where required in warm climates. The asphaltic cement (AC-1) content shall be 4.0 % - 6.0% (by weight) of the total composite mixture.

2.3.4 Coarse aggregate (material retained on the 4.75mm sieve) shall be sound, angular crushed stone or gravel (shale is not recommended).

2.3.5 Fine aggregate (material passing the 4.75mm sieve and retained on the # 200 (0.075mm) sieve) shall be sand, stone sand and stone screening Class B quality or better and gradation FA -3.

2.3.6 Mineral filler (Material passing the # 200 (0.075mm) sieve) shall be dry limestone or dust.

2.3.7 The aggregate shall have the following maximum limits of detrimental substances:

- Soft fragments, AASHO Ti 89: 2.00%
- Coal and lignite, AASHO Ti 13: 0.25%
- Clay lumps, GHD 1: 0.25%
- Flat or elongated pieces (length greater than five times average thickness): 10.00%
- Sulfur content computed as sulfide sulfur, ASTM E30: 0.01%
- Other local detrimental Substances: 2.00%

2.3.8 The gradation of the composite aggregate for the Asphalt Binder Course shall conform to or near the following:

Sieve	Total % Passing
3/4”	100
1/2”	90 - 100
3/8”	80
# 4	45 - 70
# 8	25 - 55
# 30	(19)
# 50	5 - 20 (12)
# 100	5 – 16 (6.5)
# 200	2 – 9 (3)

Note: The aggregate grain should be as close as possible to the figures in brackets to give maximum density to the asphalt mixture.

2.3.9 The gradation of the composite aggregate for the Asphalt Top Coat shall conform to or near the following:

Sieve	Total % Passing
1/2”	100
3/8”	90 - 100 (100)
# 4	60 - 90 (70)
# 8	35 - 65 (49)
# 30	(22)
# 50	6 - 25 (14)
# 100	(8)
# 200	2 - 10 (3)

Note: The aggregate grain should be as close as possible to the figures in brackets to give maximum density to the asphalt mixture.
A majority of the minus 200 material should consist of mineral filler.
The increase in the amount of mineral filler has, in many instances, increased the toughness of the asphalt. This can be accomplished by using a resultant mineral aggregate having a minus 200 content of about 7% - 8%.

2.3.10 The asphalt "Binder Course" and "Top Coat" mixtures are the type IV mixes recommended by the Asphalt Institute. Asphaltic concrete mixtures may differ from the above provided specifications, meet or exceed the present specifications. The synthetic surfacing contractor must be informed about proposed changes/deviations to the present specifications. Determination of the job mix formula shall be based on attaining a mix having a Marshall Stability (ASTM D1559, 75 blows each Side) of 750 lbs. or greater.

2.3.11 Samples of the job mix from the asphalt plant shall be laboratory tested for Marshall Stability. A compacted specimen shall be retained for density (ASTM D2726) comparison with core samples from the installed pavement.

2.4 Prime Coats and Tack Coats

2.4.1 The primer for application on crushed stone base under layers (prime coat) shall be MC-1.

2.4.2 The primer for application on asphalt surfaces (tack coat) shall be RC-1.

SECTION 3
EXECUTION

3.1 Sub-grade

3.1.1 The excavation levels should be determined to allow paving, pits, etc. to rest on firm, load bearing, undisturbed sub-soil, also capable of properly supporting the paving equipment and haul trucks.

3.1.2 The sub-soil shall be excavated and compacted to a surface parallel to the theoretical finished surface of the pavement and at a depth below it equal to the compacted thickness of the subsequent layers.

3.1.3 The excavation shall proceed in such a manner that disturbance of soils below the excavation level by equipment is avoided.

3.1.4 Surface shape of the sub-grade shall be such that water cannot accumulate at any point. If this is not possible, it is important to provide all necessary equipment, including automatically operated pumps and piping to run-off facilities, to maintain the excavations, pits, depressions free from accumulated water during the entire period of construction.

3.1.5 Excavation may encounter soft, non-bearing soils below the excavation level over some of the area. When the nature at the soil is such that appropriate load bearing cannot be achieved at the excavation levels originally designed, additional excavation to good bearing is necessary. The non-bearing material will be replaced with suitable ordinary fill as will permit rough grades to be as specified.

3.1.6 When encountered in the work and indicated on the drawings, all existing active sewer, water, gas, electric, steam, irrigation and other utility services and structures shall be protected at all times and, if required for the proper execution of the work, shall be relocated.

3.1.7 The sub-soil shall be rolled and compacted by a roller to a minimum density at ninety-five percent (95%) as determined by the Modified Proctor Test (AASHO T99).

3.1.8 Should a section of the work be not acceptable on the basis of inadequate compaction, further compaction effort shall be applied until the specified standard is achieved.

3.1.9 If the moisture content varies outside the specified limits, add water or allow drying as necessary; before commencing rolling mix mechanically for a minimum depth of mm 300 to ensure uniform distribution of moisture.

3.1.10 Surface shape of the sub-grade shall comply with the tolerances itemized in the following table:

Item	Characteristic	Tolerance
Sub-grade	Level	+20mm/-20mm
	Thickness	Unspecified

3.1.11 Should a section of the work be not acceptable on the basis of level, high areas shall be graded off, low areas shall be corrected by adding and compacting material similar to that already in place.

3.1.12 If the sub-grade has dried and becomes loose and dusty due to construction traffic, it should be watered, lightly bladed and rolled prior to placement of the sub-base layer.

3.1.13 The placement of the sub-base layer shall not be commenced until the sub-grade has been approved following inspection and/or testing.

3.2 Sub-base and base under layer

3.2.1 Each layer of the pavement shall be completed to a surface parallel to the theoretical finished surface of the pavement and at a depth below it equal to the compacted thickness of the subsequent layers.

3.2.2 Surface shape of each layer shall be such that water cannot accumulate at any point. If this is not possible, it is important to provide all necessary equipment, including automatically operated pumps and piping to run-off facilities, to maintain the excavations, pits, depressions free from accumulated water during the entire period of construction.

3.2.3 All fill material and crushed stone shall be spread evenly by direct tipping from suitable vehicles or by the use of a mechanical spreader above the approved sub-grade. Care should be taken to avoid segregation of granular material during tipping and spreading.

3.2.4 Layers of pavement material shall be not less than 4” (10 cm) in compacted thickness. Maximum layer thickness shall be limited to that which will allow compaction to specified densities by the equipment in use.

3.2.5 Ordinary fills material and crushed stone, when delivered, shall have a moisture content within +/- 2% of the modified optimum moisture content. During compaction moisture content shall be maintained in the correct range. If the fill material or crushed stone does not contain the proper moisture content for compaction, it shall be wetted or dried as required before rolling. Water spraying equipment used for this purpose shall be capable of uniformly distributing water in controlled quantities over uniform lane widths.

3.2.6 Each layer of the ordinary fill material shall be disked whenever necessary to break down clods, thoroughly mix the different materials, secure a uniform moisture content and ensure uniform density and proper compaction.

3.2.7 When the moisture content and condition of each spread layer is satisfactory, the area shall be rolled by an approved type roller to a minimum density of ninety-five (95%) as determined by the Modified Proctor Test (AASHO). The final rolling shall be accomplished with a tandem steel roller. Rollers of variable mass shall receive ballast to the greatest mass that can be supported without distress to the pavement or sub-grade.

3.2.8 Surfaces of fine crushed rock shall be constructed slightly higher than the specified levels and cut to profile by power grader towards the end of the compaction process. Rolling shall then continue to specified density to produce a tight, even surface without loose stones or slurry of fines.

3.2.9 Should a section of the work be not acceptable on the basis of inadequate compaction, further compaction shall be applied until the specified standard is achieved. If the moisture content varies outside the specified limits, add water or allow drying as necessary. Before commencing rolling mix mechanically for the full depth of the layer to ensure uniform distribution of moisture.

3.2.10 Pavement base under layer courses shall comply with the tolerances itemized in the following table:

Item	Characteristic	Tolerance
Base under layer	Level	+5mm / -5mm
	Straightness	6mm maximum deviation from 4 meter straight-edge in all directions
	Thickness	+15mm / -15mm
Sub-base	Level	+10mm / -10mm
	Thickness	+30mm / -30mm

3.2.11 Should a section of the work be not acceptable on the basis of elevation, flatness or depth, high areas shall be graded off, low areas shall be scarified to the full layer depth, built up as necessary and re-compacted as specified.

3.2.12 Each successive layer shall not be commenced until the underlying layer has been approved following inspection and/or

testing.

3.2.13 The base under layer must be firm, non-yielding and not pumping under the travel of haul trucks and other construction equipment at the time of the laying of the hot mix asphalt. Base under layers that show movement under trucks or construction equipment will need additional compaction work or other remedial work to repair the substandard installation.

3.3 Hot Mix Asphalt Pavement.

3.3.1 Mixing of hot mix asphalt should be undertaken in a mixing plant capable of effectively drying and heating the aggregate to the specified temperature, accurately proportioning and uniformly mixing coarse and fine aggregate, filler and binder to meet the specified requirements at all times.
In general, batch-mixing plants are preferable to drum mixing plants, because of their greater capability to fine-tune the aggregate gradation.
For all types of mixing facilities:

- Cold aggregates must be handled and stored in a manner that avoids contamination and minimizes degradation and segregation.
- Filler shall be stored and handled in a separate system from that which handles aggregate
- The bitumen storage and handling shall be arranged so that contamination of the bitumen by flushing liquids or other materials cannot occur.
- The bitumen storage tanks shall be capable of holding at least sufficient bitumen for one day's production.
- Heating of bitumen shall be accomplished by steam coils, electricity or other means that will allow no direct flame to come into contact with the heating tank.
- Discharge from the plant shall be so arranged as to minimize segregation.
- Asphalt, which has been stored for more than twenty-four hours or produced at temperatures not in accordance with those specified, shall not be used.
- The mix shall leave the mixing facility at a temperature between 285°F (140°C) and 325°F (163°C).

3.3.2 The hot mix asphalt must be kept clean during hauling and covered if necessary during transit with canvas or other material that will retain the desired pavement temperatures. The mixtures must not be hauled in such a manner that segregation of the ingredients takes place or that a crust is formed on the surface, or that mixture will crumble or flatten out when dumped. Trucks that transport the mixture must have metal beds, and the beds must be clean, smooth and free of holes. Before loading, the truck bed is coated with a thin film of a release agent (oil or soap solution) that assists in preventing fresh hot mix asphalt from sticking to the surface of the bed. After the bed is coated, any excess release agent must be drained from the bed.

3.3.3 The hot mix asphalt shall be spread with a self-propelled machine spreader having a floating screed assembly controlling the elevation of the strike-oft. The use of road graders or towed spreaders will not be allowed. Means shall be provided to heat the screed uniformly over its full width. The screed shall be equipped with automatic screed controls to adjust automatically to place a uniform mat of desired thickness, grade and shape.

3.3.4 Typical members of the paving crew should be: paving superintendent, paver operator, dump person, two screed people, and two people to lute and take care of joints and mat repairs. Co-ordination of the entire crew with the paving superintendent and screed people is essential to achieve all the desired goals.

3.3.5 Self-propelled rollers are required as compaction equipment. Towed-type rollers should not be used.
Hand-held or vibrating plate compactors can be used in small, inaccessible areas.
Steel-wheeled non-vibrating rollers shall have a mass of 10 tons (9 metric tons).
Steel wheeled vibrating rollers shall have a mass of 5 tons (4.5 metric tons).
Pneumatic tired multi-wheeled rollers shall not be used.

3.3.6 The hot mix asphalt shall be placed with a minimum delay after delivery. On no account shall hot mix asphalt be reheated.

3.3.7 The day's work shall be organized so that each layer spread covers the full width of the pavement.

3.3.8 Hot mix asphalt shall be spread to a depth consistent with the specified compacted thickness. Each layer shall be completed to a surface parallel to the finished surface of the pavement and at a depth below it equal to the compacted thickness of the subsequent layer or layers specified.

3.3.9 Hot mix asphalt shall not be placed during rain, or when the air temperature in the shade and away from artificial heat is 40°F (5°C) or less, or while the surface is wet or when the pavement temperature does not comply with the Table below.

Pavement surface temperature in shade	Minimum Laying Temperatures Binder Course	Minimum Laying Temperature Top Coat
40°F - 50°F (5°C - 10°C)	302°F (150°C)	293°F (145°C)
50°F - 60°F (10°C - 15°C)	293°F (145°C)	284°F (140°C)
60°F - 77°F (15°C - 25°C)	284°F (140°C)	275°F (135°C)
Over 77°F (Over 25°C)	275°F (135°C)	266°F (130°C)

3.3.10 Maximum laying temperature of the mixture shall be 325°F (163°C)

3.3.11 The temperature of the mix shall be measured in the truck just prior to discharging into the paver hopper. A suitable stem type thermometer shall be used. The stem shall be inserted into the mix to a depth of approximately 8" (200mm) at a location at least 12" (300mm) from the side of the truck body. An average of at least two readings shall be adopted as the temperature of the mix.

3.3.12 There are three acceptable types of sensing devices used with the automatic screed control system:

- The Wand Sensor
- The Ultra Sonic Sensor
- The Laser Sensor

3.3.13 The grade reference used with the above listed sensing devices can be either a fixed string-line tied between graded iron pins or on an existing surface, a previously placed surface, a curb line, etc.
A string-line can be erected that will include roll down factors for true grade. The roll down is estimated to be about 25% of the un-compacted mat thickness. To calculate the exact position of the string-line, a survey crew is used to determine the existing grade at approximate intervals of 9 meters (30 feet). The existing grade is subtracted from the theoretical grade for calculation of lift thickness. A roll down factor of 25% of this thickness is added for the string-line grade. Once the string-line is erected, intermediate points of support may be placed under the string-line, especially on curves or in sudden changes of grade.
Graded iron pins and intermediate supports should be placed so that they will not interfere with the travel of the machine spreader, but close enough to each other and to the path of the machine spreader that they can hold the string in a convenient position to be reached by the electronic sensors and by a short straight edge placed on the newly laid pavement to visual check on its level.

3.3.14 The reference system that is best for the job depends on the existing pavement surface on which the mat is to be placed.
If the surface on which the mat is to he placed has an appropriate longitudinal grade, so that the finished pavement is expected to have a constant thickness, then the surface on which the mat has to be placed, an adjoining existing surface, a previously placed surface, a curb line, etc. can be used as the reference system, since a constant roll down is expected.
If the longitudinal grade is erratic, so that the finished pavement is expected to have a variable thickness, a string-line should be used as the reference system, to take in account the variable roll down.

3.3.15 To maintain proper transverse grade, automatic screed controls use:

- A dual sensing systems on both sides of the paver, using two grade references, one on each side of the paver or
- A single sensing system on a single side of the paver, using a single grade reference on a single side of the paver, in association with an automatic slope control system: in using the transverse slope control, no specific roll down factors can be applied to grade calculations for slope transfer.

The Control System that is best for the job depends on the existing pavement surface on which the mat is to be placed.
Dual Grade Control System is preferable if the surface on which the mat has to be placed has an unsatisfactory transverse grade.
Single Grade Control System transfers the roll-down factors of the grade control side to the opposite side as equal factors, which may or may not be equal. Single Grade Control System is acceptable in situations where the surface on which the mat is to be placed has an appropriate transverse grade.

3.3.16 The area to be surfaced with hot mix asphalt shall be cleared of all foreign or loose material with power blowers, power brooms or hand brooms.

3.3.17 Crushed stone or asphalt surfaces shall be primed prior to the installation of the binder course and topcoat.
Prime crushed stone surfaces at the rate of 0.3 gallons per square yard.
Prime asphalt surfaces at the rate of 0.05 gallons per square yard.
Sprayers shall be capable of spraying the tack coat uniformly through jets in a spray bar at the desired rate of application.
Each sprayer shall be fitted with a hand lance.
Tack Coat shall be applied, not less than thirty (30) minutes nor more than two (2) hours before asphaltic concrete is placed.
When spraying the tack coat, shields shall be used and all necessary precautions taken to protect curbs, gutters, channels, adjoining structures, surfaces and grassed areas.
Any pools of tack coat, which may form in small depressions or surface irregularities, shall be brushed out over the adjacent area with brooms or rubber squeegees before the emulsion breaks.
In dusty conditions, every precaution shall be taken to prevent freshly coated surfaces from being contaminated by dust or other foreign material.

3.3.18 Uniformity of operations is essential in hot mix asphalt paving. Uniform, continuous operation of the paver produces the highest quality pavement.
Paving too fast can result in the paver stopping frequently to wait for trucks to bring more mix. The smoothness of the pavement will suffer when the paver stops and starts up again. The paver speed should he matched to the quantity of HMA being delivered to the project to provide a uniform paver speed.
The paver must be continuously supplied with enough mix, and at the same time, trucks should not have to wait a long time to discharge their loads into the paver hopper.

3.3.19 Starting blocks equal to 1.25 times the thickness of the un-compacted mat are required to set the thickness and to null the screed. By using starting blocks the grade can be very close at the beginning of the operation.

3.3.20 Blocks equal to 25% of the un-compacted thickness are used to start from a joint. The 25% additional thickness allows for proper roll-down or compaction while maintaining proper grade.
Extended screeds will require multiple shims for each extension area.

3.3.21 The screed must be initially heated at the start of each new paving operation. If not, the mix will tear and the texture will look open and coarse, as if the mix were too cold.

3.3.22 If the mat being placed is uniform and satisfactory in texture, and the thickness is correct, no screed adjustments are required. But when adjustments are required, they should be made in small increments. Time should he allowed between the adjustments to permit the paver screed to complete reaction to the adjustments sequentially.

3.3.23 The minimum un-compacted thickness of a hot mix asphalt course is equal to 1.25 times its minimum compacted thickness, which is equal to three times the nominal maximum size aggregate. When the mat falls below this thickness, it pulls, tears, cools rapidly and generally will not be able to achieve the proper density and pavement smoothness.

3.3.24 There are places on many projects where spreading with a paver is either impractical or impossible. In these cases, hand spreading may he required. Placing and spreading by hand should be done very carefully and the material distributed uniformly so there will be no segregation of the mix. When the HMA is dumped in piles, it should be placed upon arrival on steel dump sheets outside the area in which it is to be spread and shall then be immediately laid to the required depth.
The material should be deposited from the shovels into small piles and spread with lutes. In the spreading process, all material should be thoroughly loosened and evenly distributed. Any part of the mix that has formed into lumps and does not break down easily should be discarded. After the material has been placed and before rolling starts, the surface should be checked with templates or straightedges and all irregularities corrected.

3.3.25 Asphaltic concrete shall be spread in such a manner as to minimize the number of transverse and longitudinal joints in the pavement.

3.3.26 Transverse joints shall be constructed where the spreading operation is stopped for longer than 20 minutes. Transverse joints in adjoining spreader runs shall be offset by not less than 8 feet (2.44m). Transverse joints shall be offset from layer to layer by not less than 8 feet (2.44m). Transverse joints shall be constructed at right angles to the direction of spreading and be cut to a straight vertical face for the full depth of the layer.

3.3.27 When the construction is ready to stop for the end of the day or for a period longer than 20 minutes, the following procedure is used to form a suitable transverse joint:

1. When the paver is placing the last load, it is shifted into low gear as it approaches the location of the proposed joint.
2. As the hopper empties and the amount of material in the screed chamber decreases below normal operating level, the paver is stopped.
3. The screed is raised and the paver moved out of the way.
4. The mix is then removed from the end of the mat to form a clean, vertical edge.
5. Heavy wrapping paper is placed on the existing surface along the edge of the joint.
6. New material is finally placed on top of the paper and used to form a ramp, from the new surface to the existing surface.

3.3.28 When construction is ready to resume, the following procedure is used to form a suitable transverse joint:

1. The ramp of material is removed along with the board or paper.
2. A straightedge is used to check the longitudinal grade of the mat. Because the paver was running out of material as it laid the last few feet of mat, it is possible that those last few feet taper slightly from the specified level of the mat. If this is the case, a new transverse edge must be cut behind the point where the taper begins.
3. The vertical face of the mat is tack-coated.
4. The paver is backed up to the edge of the mat and the screed rested on the mat surface.
5. The screed is heated while it rests on the mat. This provides some heat to the material at the edge of the mat.
6. The heated screed is raised and shims as thick as the difference between the compacted and the un-compacted mat (approximately 25% of the compacted thickness) are positioned under its ends.
7. The truck with the first load of HMA is backed carefully to the hopper. During discharge of the mix from the truck bed to the paver, it is essential that the truck not bump the paver and cause it to move.
8. The paver starts forward in a low gear.
9. Once the paver has moved away, excess asphalt is cleaned off the surface of the mat and the smoothness of the joint is checked with a straightedge.
10. If the joint is satisfactory, a 6" (150mm) width of the fresh mix is rolled transversely and the joint checked for smoothness. If the joint is satisfactory, transverse rolling is continued in 6" to 12" (150 to 300mm.) increments until the entire width of the roller is on the new HMA. If straight edging shows an uneven joint, the surface of the new mat must he scarified while still warm and workable. Scarification is done with the fine side of the lute. Excess material can then be removed or additional material added, and the joint rolled. During rolling, timbers should he placed along the edges of the mat to prevent the roller from driving off the longitudinal edge and distorting it.

3.3.29 Longitudinal joints shall be offset from layer to layer by not less than 6" (150mm). Longitudinal joints shall be parallel to the centerline of the pavement. Alignment of the mat is dependent on the accuracy of the guideline provided for the paver operator and his alertness in following it. Attention to this detail is vital to the construction of a satisfactory longitudinal joint, since only a straight edge can be properly matched to make the joint

3.3.30 Hot joints are formed by two payers operating in echelon. The screed of the rear paver is set to match the grade or thickness of the unrolled edge of the first mat placed. The advantages of a hot joint are that the two mats are automatically matched in thickness; the density on both sides of the joint is uniform because both sides are compacted together, and the hot mats form a solid bond. The disadvantage is that traffic cannot move in one of the lanes while the other is being paved. Both lanes are blocked simultaneously.

3.3.31 In building a cold joint, one lane is placed and compacted. At a later time, after the HMA in the first lane has cooled, the companion lane is placed against it and compacted. Special precautions must be followed to ensure a joint of good quality.

3.3.32 The following procedure is used to form a suitable longitudinal joint:

1. The exposed edge of the first lane shall be formed while hot to a straight line with a dense face, which shall lie between vertical and 45° to the vertical for the full depth of the layer.
2. The unsupported longitudinal edges of spread material should be side tamped to raise the level of the asphaltic concrete slightly to secure maximum edge compaction from subsequent rolling.
3. While placing the companion lane, the paver screed should be set to overlap the first mat by 1" to 2" (25 to 50 mm).
4. The elevation of the screed above the surface of the first mat should he equal to the amount of roll-down expected during compaction of the new mat.
5. The coarse aggregate in the material overlapping the cold joint should be carefully removed and wasted. This leaves only the finer portion of the mixture to be pressed into the compacted lane at the time the joint is rolled.

3.3.33 The placing of hot mix asphalt against abutting structures such as curbs, gutter manhole or adjoining pavement shall be carried out in the same manner as for longitudinal and transverse joints. Any spaces left unfilled between the spreader run and abutting edges shall be filled with sufficient material to the proper height prior to compaction.

3.3.34 After the paving mixture has been property spread; it shall be thoroughly and uniformly compressed by rolling with power rollers.

3.3.35 Hot mix asphalt shall be compacted uniformly to the standard specified as soon as it will support rollers without undue displacement. All rolling shall be completed while the mix is at a temperature above 185°F (85°C)

3.3.36 The pavement shall be compacted to 97% or more of the density (ASTM F2726) obtained on a retained job mix specimen by the seventy-five blow Marshall procedure (ASTM D1559), Marshall stability (ASTM D1559) shall be 750 lbs. or greater.

3.3.37 The exact number of passes of a roller that will be required to obtain adequate density will be determined on a test strip using a nuclear density gauge to measure the density of the mat after each pass, until maximum achievable density is indicated by the test results. The rolling pattern used on the test strip should be the same that will be used on the remainder of the job. The number of rollers and/or the rate of production will be adjusted accordingly.

3.3.38 The speed of rollers at all times shall be slow enough to avoid displacement of the mix and shall not be greater than 3 mph (5 km/h).

3.3.39 Steel wheel rollers shall be operated with minimum wetting of rollers.

3.3.40 The driving roll shall be nearer the spreader.

3.3.41 Vibratory mechanisms shall be disengaged before stopping or reversing direction.

3.3.42 Rollers shall not remain stationary on asphaltic concrete while it is still warm. Roller wheels shall be kept free from any buildup.

3.3.43 The roller shall pass over the unprotected end of the freshly laid mixture only when a transverse joint has to be made.

3.3.44 Initial (breakdown) rolling shall be performed with a static steel-wheeled roller. Transverse joints shall be rolled first, then the longitudinal joint and the outside edge. Breakdown rolling shall continue longitudinally, commencing on the lower side and proceeding to the higher side of the spreader run. The roller shall overhang the unsupported edges of the run by about 4-inch (100mm). Each longitudinal pass shall overlap the previous pass by about 4-inch (100mm) and adjacent passes of the roller shall be of different lengths.

3.3.45 Secondary rolling to obtain required density before the mixture cools to 185^{0}F (85^{0}C) shall be performed as soon as possible after initial rolling and shall be performed with a static or a vibratory steel wheeled roller. Rolling shall be carried out longitudinally commencing on the lower side and proceeding to the higher side of the spreader run. Each roller pass shall overlap the previous pass and adjacent passes shall be of different lengths.

3.3.46 Final rolling for the improvement of the surface while the mixture is still warm enough to permit removal of any roller marks
shall be performed with static steel wheeled roller.
3.3.47 When paving in echelon, the edge of the run common to adjacent spreaders shall be left unrolled for a width of 8 inch (200mm) until the longitudinal joint has been constructed. This strip shall be rolled together with the edge of the adjacent spreader run. Rolling shall commence before the temperature of the material along the edge of the first spreader run has fallen below 95 ^{0}C (203 ^{0}F)

3.4 Acceptance of paving work - remedy work.

3.4.1 Each successive layer shall not be commenced until the underlying layer has been approved following inspection and/or testing.

3.4.2 Acceptance of paving work as far as compaction and Marshall Stability specifications is concerned will be based on tests to be performed on core samples taken from each layer shortly after application. Test results shall be submitted to synthetic surfacing contractor.

3.4.3 Should a section of the work be not acceptable on the basis of inadequate compaction and/or the mixture became loose and broken, mixed with dirt or in any way defective, it shall be removed and replaced with fresh mixture which shall be immediately compacted to conform with the surrounding area.

3.4.4 Areas of one (1) square inch or more showing excess of bitumen shall be removed and replaced.

3.4.5 On completion of placement and compaction, pavement courses shall comply with the tolerances itemized in the following table.

Item	Characteristic	Tolerance
Top Coat	Level	+2mm / -2mm from design levels
	Thickness	+5mm / -0mm from design levels
	Flatness	3mm maximum departure from a 3m straight-edge in all directions
Binder Course	Level	+4mm / -4mm from design levels
	Thickness	+5mm / -0mm from design levels
	Flatness	4mm maximum departure from a 3m straight-edge in all directions

3.4.6 Surface shape of each layer of pavement shall be such that water cannot accumulate at any point and the surface shall free drain to drainage channels.

3.4.7 The whole surface of each layer of pavement should be checked for levels by a local surveyor, and for flatness with a 10 foot straightedge in all directions; the surface shall also be flooded and inspected for ponding, "bird baths", ridges, etc. After testing, all high and low areas shall be marked on the leveling course surface.

3.4.8 Low areas shall be remedied by cutting out the course to full depth (or to a minimum depth of 3/4" – 1" (20 - 25 mm)) and replacing with the correct hot mixture. The repaired area shall be thoroughly compacted to the specified tolerance. First the area must be fully tack coated. No filling by using sand mix shall be allowed. Sand asphalt lacks sufficient internal strength. No tar emulsions such as 'jet shield" or similar products shall be applied to the surface. Nor shall any other type at asphalt or tar leveling or sealing product (hot or cold) be coated on the surface,
Under specific conditions and with synthetic surfacing contractors prior approval, a polyurethane underlayment material as recommended by the manufacturer can be used for correcting small low areas. Extensive use of Polyurethane underlayment is no substitute for proper installation and leveling of the asphalt. The depth of the underlayment layer must be limited to 1/4" (6 mm) or less.

3.4.9 High areas shall be remedied by cutting out the course to full depth (or to a minimum depth of 3/4" – 1" (20 - 25 mm)) and replacing with the correct hot mixture. The repaired area shall be thoroughly compacted to the specified tolerance. In some cases it is practical to repair high areas and ridges by heating with a "hot iron" or a butane torch and scraping them off. These areas must be rolled smooth afterwards.

3.5 Curing of hot mix asphalt installations

3.5.1 The asphalt-leveling course will have to cure a minimum of twenty eight (28) days prior to installation of the synthetic surface in order to allow the escape of surface volatiles, oils. Etc.

3.6 Disclaimer

3.6.1 The above recommendations are provided for general guidance only.
The responsibility for warranties and/or performance guarantees for the proper preparation of the asphalt and stone base rests with the responsible professional, asphalt manufacturer and/or the asphalt sub-contractor in the event of base failure
and not with the synthetic surfacing contractor.
The General Contractor, Architect, and/or Asphalt Sub-Contractor will be notified by the synthetic surfacing contractor of any evident defects or installation conditions, which could result in unsatisfactory performance. The responsibility for remedying defective work rests with the General Contractor and/or the Asphalt Sub-Contractor.
The synthetic surfacing contractor must be provided with the respective tests results in advance of visiting the project site if relevant commentary is expected.
The Owner can obtain written confirmation from the synthetic surfacing contractor, based on site observations and test results supplied by the contractor, that the bituminous concrete pavement appears satisfactorily finished and adequately cured to permit the installation to begin. *(Written confirmation from synthetic surfacing contractor of satisfactory completed and adequately cured asphalt pavement can be obtained by the Owner, based on synthetic surfacing contractors site observations, and test results supplied by the contractor)*
The synthetic surfacing contractor will not be held responsible for any delays past expected substantial completion dates, caused by the incorrect installation of the asphalt and/or stone base. As such no liquidating damages and or penalties will be imposed on upon the synthetic surfacing contractor. Any subsequent visits to re-inspect the corrected asphalt and or stone base will be at the Sub-Contractors/General Contractors or Owners cost.