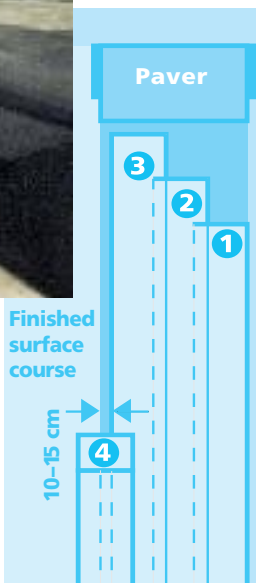


asphalt

Guidance for Asphalt Paving Operations



Guidance for Asphalt Paving Operations

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Preface

Asphalt technology has evolved due to new requirements, designs and mix materials, thus requiring a revision of the popular dav guidelines „Guidance for paving operations“ from 1989/95.

„Guidance for hot mix asphalt paving operations“

is intended to help practitioners to produce high-quality asphalt courses by carefully planning and executing paving operations. It also discusses specific designs and methods to make their use easier.

These guidelines are based on the authors' current expertise and practical experience and existing publications. This information does not claim to be exhaustive.

**Successful work
always depends on
a well-organized,
qualified, and well
informed staff**

1

Preparation of sub-base

Granular base course (anti-freeze/ crushed stone base)

Producing a smooth, durable, and adequately compacted base course to specifications is vital for evenly solid asphalt pavements.

Acceptance and hand over of the sub-base should always be completed in due time before starting paving operations.

Placement can only start if there are no defects in:

- Bearing capacity
- Evenness
- Grade and cross-slope
- Contamination
- Required level

The paving foreman must communicate any obvious failures to the site manager, who will promptly inform the client.

Bound base course (Pre-existing bases or bases that have been laid formerly within the project)

Existing bound bases must be tested for suitability and released for use in due time prior to the commencement of paving operations.

The paving foreman must communicate any obvious failures to the site manager, who will promptly inform the client.

Preliminary works:

- Thoroughly clean the base surface of all dust, dirt and other debris.
- Ensure that manhole covers, fire hydrants and utility covers are at the right level or adjusted to the required level if required.
- **Leveling courses** or milling: usually a paver is used to pave the leveling course. Minor areas can be prepared manually.
- The mix should be applied in a separate work phase at all times.
- Make sure that the leveling course is densely compacted.
- Slight irregularities do not need a leveling course and should be leveled out when placing the next layer.

Appropriate mixes for leveling courses:

Asphalt-base course	Layer thickness
0/32	8,0 to 14,0 cm
0/22	8,0 to 10,0 cm
0/16	3,0 to 8,0 cm
0/11	< 6,0 cm

Tack coat:

A tack coat should be applied to the existing surface in compliance with table 1 and 2 of the M SNAR* guideline to ensure a bond between the existing surface and the new asphalt overlay, see next page.

* Merkblatt für Schichtenverbund, Nähte, Anschlüsse und Randausbildung von Verkehrsflächen aus Asphalt (Guidelines for layer bonding, seams, joints and edging of asphalt roads), 1998 edition, FGSV No. 747.

Application rate of tack coat based on type of base....

**Table 1: ...for heavy traffic categories:
Category SV, I to III (g/m²)**

Type and quality of existing surface		Overlay to be applied		
		Base	Binder	SMA
Base	f	PmOB Type C U 60 K 150 to 250	PmOB Type C U 60 K 250 to 350	x
	m	PmOB Type C U 60 K 250 to 350	PmOB Type C U 60 K 250 to 350	x
	o/d	PmOB Type C U 60 K 300 to 400	PmOB Type C U 60 K 300 to 500	x
Binder	f	–	x	PmOB Type C U 60 K 150 to 250
	m	–	PmOB Type C U 60 K 250 to 350	PmOB Type C U 60 K 250 to 350
	o/d	–	PmOB Type C U 60 K 300 to 500	PmOB Type C U 60 K 250 to 350

The cited quantities have yet to be matched with the surface qualities since practical experience shows that the upper limits are set at a very high level.

Observe the manufacturer's instructions when using new, refined products.

Table 2: ...for the categories IV to VI (g/m²)

		Overlay to be applied						
		Base	Binder	AC		SMA		
Type and quality of existing surface	Base	f	U 60 K 150 – 250	U 60 K 250 – 350	U 60 K 150 – 250	HK 200 – 300	x	
		m	U 60 K 250 – 350	U 60 K 250 – 350	U 60 K 250 – 350	HK 200 – 300	x	
		o/d	U 60 K 300 – 400	U 60 K 300 – 500	U 60 K 250 – 350		x	
		d	–	HK 200 – 300	HK 200 – 300		x	
	Binder	f	x	x	U 60 K 150 – 250	HK 150 – 250	U 60 K 50 – 250	HK 150 – 250
		m	x	U 60 K 250 – 350	U 60 K 250 – 350	HK 200 – 300	U 60 K 150 – 250	HK 150 – 250
		o/d	x	x	U 60 K 300 – 400		U 60 K 250 – 350	
		d	x	x	HK 200 – 300		HK 200 – 300	

Base = Asphalt base course

Binder = Asphalt binder course

AC = Asphalt concrete surface course

SMA = Stone mastic asphalt

f = fresh

m = milled

o/d = very porous structure or disintegration/raveling

d = dusty

x = to be evaluated from case to case

– = should not occur

Guidance for tack coat application:

- Apply the tack coat on the previous day, if possible. Allow enough time for setting. Cover kerb restraints and ironworks etc.
- Apply a thin and even layer; avoid fat spots, especially when using hand-held devices (avoid slip planes in wet condition).
- Use truck mounted spray bar, whenever possible.

The quality of the entire overlay hinges on the base!

2 Ordering and release orders for asphalt-mix

Ordering the asphalt-mix

Every order should be made in writing and as early as possible. Orders must comply with the specifications set forth in the construction contract. The dav guidelines „**How to organise quality**“ include a form for asphalt mixture release orders attached as annex 4. It is recommended that this order form be used.

4

Asphaltmischgutabnah

Projekt: _____ Datum: _____

Strasse: _____

St. Nr.: _____

St. Name: _____

St. Nr. 1: _____

St. Nr. 2: _____

Asphaltmischgut	Menge	Lagerort	Verpackung	Abgabe	Lager	Anzahl

St. Nr. 1: _____

St. Nr. 2: _____

The order should include the following items:

- Contractor
- Construction job (cost center, if required)
- Specific features of the job site
- Name of mix/ type test No.
- Desired delivery date
- Quantity: Total/daily/ hourly output
- Type and size of trucks, if possible
- Name and phone number of paving foreman

Ask the mix supplier for an order confirmation!

Release orders for paving operations:

- Ensure effective communication between paving foreman and mix plant
- Ensure prompt communication in the event of failures
- Ensure effective coordination regarding the start of paving operations
- Take weather conditions into account.

Clear and effective communication between the paving foreman and the mix manufacturer is vital to ensure smooth delivery of the mix!

3

Mix Transport

The number of haul trucks should be planned so that the transport rate matches the paving rate, thus ensuring a constant supply for the paving job site.

The following factors should be taken into consideration:

- Haul distance and haul time
- Traffic holdups, e.g.
 - other construction sites,
 - Traffic jams occurring every day at certain times (e.g. rush hour traffic),
 - Detours that are required due to weight limits for bridges and certain road sections.
 - Heavy and/or unpredictable traffic (congestions and detours)
 - Rest periods for drivers

The following points should be taken into consideration for mix delivery:

- Select weight, size and type of the trucks to match the conditions on site. Vehicles with half-round trailers are the best choice.
- The truck bed of the haul truck is to be **thoroughly** cleaned. Only use release agents that are suited for asphalt when spraying the truck bed or bitumen impregnated crushed aggregate/sand mixtures. Make sure that there is no puddling when using liquid release agents.
- The use of oils, e.g. diesel oil, can cause severe damage to the asphalt layer and is thus strictly prohibited.

- The mix should not be hauled to the paving site if defects are detected visually already during loading (e. g. segregation, wrong temperature, fatting-up or dry mixes).
- All vehicles must be equipped with **windproof** tarpaulins; the load has to remain covered during transport and while the truck is stationary.
- Vehicles should stay as close to the paver as possible during backups.

The banksman and driver should always have visual contact!

A continuous mix supply for the paver is vital to the evenness and regularity of the applied asphalt layer!



Table: Reference values

Type and grade of binder in Mix	Asphalt base course	Asphalt binder	Asphalt concrete surface c.	Stone mastic asphalt
	Base	Binder	AC	SMA
30/45	130 to 180	130 to 180	–	140 to 180
50/70	120 to 180	120 to 180	130 to 180	140 to 180
70/100	120 to 180	120 to 180	130 to 180	130 to 180
PmB 25	–	130 to 180	–	–
PmB 45	–	130 to 180	–	150 to 180
PmB 65	–	120 to 180	130 to 180	140 to 180

For Warm Mix Asphalts, the bottom limit of the regular mix temperature should be used as reference value based on the additive applied, the process technology, and the boundary conditions.

The lower limits are applicable to the unloaded mix during paving operations; the upper limits are applicable to the mix when discharged from the mixing plant or silo.

4 Mix inspection prior to paving operations

Measuring the mix temperature

The mix temperature is decisive when evaluating the workability and compactability of a given mix. Measuring the temperature is an important and absolutely essential measure when evaluating the mix delivered to the paving site.

Aspects to be considered:

- Ensure that you use fast response thermometers (e.g. probe and radiation thermometer; follow the manufacturer's instructions!)
- As a general rule, the mix temperature must be measured prior to paving.

for mix temperatures in °C

Combination of Base and Surface	Compact asphalt	Porous asphalt	Thin overlays - hot applied
BS	CA	PA	TOH
–	130 to 180	130 to 180	130 to 180
120 to 180	120 to 180	130 to 180	130 to 180
120 to 180	120 to 180	130 to 180	130 to 180
–	130 to 180	–	–
–	130 to 180	130 to 180	130 to 180
–	120 to 180	130 to 180	130 to 180

Refer to the manufacturer's instructions when using special binders and organic additives to improve workability.

Visual inspection of the mix

Flawless mix:

- Even black coating and light sheen
- Load in the truck bed is „topped off“
- Slightly steaming (exception: warm-mix asphalt)
- Does not segregate on the truck bed or when tipping it into the paver hopper

Visual inspection of the mix

Excessive cooling of mix:

- Crusting on top while on the truck bed
- No steam when tipping mix into the paver hopper (exception: warm-mix asphalt)
- Generally stiff appearance
- Mix builds up chunks when tipping into the hopper

Overheated mix:

- Yellow vapour while tipping mix into the hopper
- Dull, brownish appearance
- Loss of cohesive strength; mix can be easily pushed apart – a typical indicator that the adhesive force of the binder has declined or has been entirely lost

**Defective material
may not
be paved!**

How to proceed with mixes that failed the visual inspection

Excessive cooling of mix:

- Mix may not be dumped into the hopper. Contact the mix plant and agree on how to proceed with the rejected mix.

Overheated mix:

- May not be dumped into the hopper, either. Contact the mix plant and agree on how to proceed with the rejected mix.
- Overheated mix can be used, if at all, as granular base course material, e.g. as back-up material for shoulders and slopes.
- It is advisable to retain a sample of the mix.

The following action should be taken after identifying defects in the mix delivered:

- Inform the mix producer
- Retain a sample of the rejected mix
- Record the defects
- Get advice from the mix producer on how to proceed.

5 Paving

Getting started

The following steps should be taken prior to paving operations:

The paving rate has to be adjusted to the delivered mix.

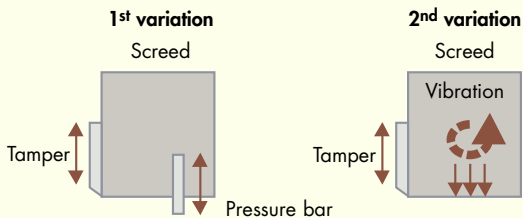
Paving speed is of the essence and is influenced by the width and thickness of the layer being placed.

The paver should be set up and adjusted in accordance with the mix that is being laid.

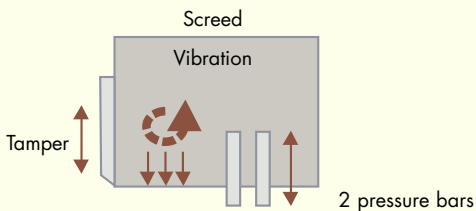
- Angle of attack for the screed
- Choice of compaction equipment and desired pre-compaction by adjusting the screed
- Compliance with tolerance range
- Pre-heat the plate on the bottom of the screed
- Type of slope and grade control, e.g. floating beam equipped with shoes, string line, 3D-control, ultrasonic or laser system
- Adjust augers to the maximum width of the screed.
- Match screed with the longitudinal joint
- Ensure that the paver is ready for operation
- Screeds should be synchronized during pre-compaction when using two pavers

Different kinds of pre-compaction with paver screeds (Voegele equipment as example)

„Traditional design“ (not to scale)



3rd variation: High compaction (not to scale)



Options on
high-compaction
screed

	Base	Binder	AC	SMA	BS	PA	Thin overlay	WMA
Tamper	++	++	++	++	++	++	++	As with standard Placement
Vibration	++	++	• to +	•	+	-	-	
Pressure bars	++	++	• to +	•	+	-	-	

++ = especially suited
+ = suited

• = suited under certain circumstances
- = not very well suited



Guidance for paving operations

The following points should be considered during paving operations:

- The tolerance range is based on material type, thickness, pre-compaction and temperature. The tolerance range has to be verified during the entire paving operations and adjusted, if required.
- When directing the haul trucks avoid situations where trucks would approach the paver diagonally or back into the paver.
- Ensure a constant paving speed during the entire paving operations to the greatest extent possible.
- Do not empty the hopper to the extent possible (segregation)
- In the event of stoppages, continue paving until the hopper begins to empty and the amount of material in the screed chamber decreases below normal operating level. Stop the paver at his point and construct a transverse joint.
- Cold mix that builds up between the baffle and the screed may not be laid (to be discarded at the end of paving operations).
- Adjust the screed settings (T, V, P) when extending the paving width.

- As a general rule, narrow radii (e.g. roundabout) should be laid with the standard width of the screed (pave large widths with two pavers).
- Pave surface courses without automatic grade and slope controls (with the exception of special cases, e.g. utility installations for buildings).
- Re-adjustments of the screed should be reduced to a minimum.
- Especially on surface courses the spreading out of additional material to close holes or to level out irregularities should be avoided.

Tests during paving operations

The following tests should be carried out at regular intervals during paving operations:

- Mix temperature
- Visual inspection of the mix (appearance, quality)
- Amount of mix being placed and layer thickness, ratio between maximum aggregate size and layer thickness
- Correct pavement profile and smoothness
- Alignment of edges (correct location and true alignment)
- Visual inspection with regard to uniform surface condition of the placed layer.
- Quality/condition of longitudinal and transverse joint

A record should be kept of the tests cited above!



Stop paving operations
at a temperature below

Manual placement

The asphalt mix should be placed by hand only in exceptional cases. Use an extendable screed to accommodate changing paving widths. Pave spandrels manually, while continuing laydown operations with the paver. Manual work may be required in the following cases:

- Very small areas (repairs, excavations)
- Cable trenches
- Driveways
- Spandrels

It is vital that manual work only be performed after you have completed preliminary work e.g.

- Cleaning
- Applying tack coat adhesive or emulsion
- Fitting sealing strips or applying joint sealants

Make sure you have enough hot mix available when starting manual work. As there is no screed affording initial compaction, the tolerance range has to be increased. Do not throw the material through the air. Instead, deposit the material from the shovel on to a small pile. Verify surface evenness with a straight edger before starting compaction.

Start with compaction immediately. Lightweight rollers and vibratory plate compactors are ideal for base and binder courses when working on excavations and small repair areas. A vibro-tamper or hand tamper should be on hand for corners and side areas.

Fast and uninterrupted work is of the essence when surfacing by hand.



Surface course +5 °C
Binder course 0 °C
Base course -3 °C

Surface temperature of the lower layer



As a general rule, the lower layer should not be frozen or wet, and should be free from snow and ice!

Cold weather paving

The ZTV Asphalt bulletin specifies that paving operations must stop at the specified air temperature. This might cause problems in practice. It is, therefore, advisable to monitor the surface temperature of the lower layer.

If there are any unfavorable weather conditions you should ensure that

- Additional rollers are on hand
- Haul trucks are insulated
- Surfaces are pre-heated with appropriate heaters, if required.

Ambient conditions and the mix type have a strong impact on paving operations

Paving during wet weather

As a general rule, surface layers should not be placed while it is raining or when the surface is wet, as this could cause insufficient density and layer bonding.

It is possible, however, to place thick asphalt layers, such as asphalt base courses, asphalt binders, and bituminous surface treatments, in drizzling rain. Nevertheless, these works also have to be halted in heavy rainfall.

If rain has been forecast, the layer should be placed in the sloping direction if possible. In special cases the surface can be dried and/or the water removed.

6 Compaction of the mix

Consideration should be given to the following points when selecting number and types of rollers:

- Type of mix
- Planned paving rate (expressed in m^2)
- Thickness of each layer
- Paving width (full or half width of the road)
- Temperature of air, surface and mix



Guidance for compaction

- Initial compaction should be matched with the type of mix.
- Start with compaction as soon as possible to ensure that the desired density is easily attained at 80–90 °C.
- When the layer thickness is less than 4 cm you should use the vibratory mode only for a few passes, if at all.

Various types and weights of rollers can be used for the following purposes:

Static three wheel rollers (10–22 t)

- Used for compacting asphalt layers, edges of the lane, transverse and longitudinal joints, and to smooth the layer after all roller passes have been completed.

Static tandem rollers

- For breakdown rolling of asphalt layers,
- For compacting asphalt layers up to 8 cm in thickness,
- For compacting edges of the lane as well as transverse and longitudinal joints,
- For smoothing the layer after the roller passes have been completed;

Tandem vibratory rollers

- Used for compacting asphalt layers up to 16 cm in thickness,
- Never to be used for breakdown rolling, on engineering structures, or on thin overlays or porous asphalt surface courses.



Tandem rollers with oscillation

- For compacting all asphalt layers; especially suited for engineering structures and overlays

Combination rollers

- For universal purposes. With each subsequent roller pass it is only the smooth drum that increases layer density.

Pneumatic-tired rollers

- Are only used sporadically; especially for rural roads and in all cases where thorough, perfect sealing of the surface course is required.

Getting the rollers ready

Ensure that the rollers are in good working order before starting compaction work.

Careful consideration should be given to the following points:

- Check the drum wetting system,
- Refill the water tank,
- Check the vibratory mode when using vibration rollers,
- Check and/or adjust tyre pressure when using combination rollers, and add the release agent.



Roller passes

A roller pass is defined as one complete coverage of the area to be compacted by the roller.

A rolling lane consists of two roller passes across the width of the drum.

Breakdown:

Roller pass without vibration

Compaction is affected by:

- Mix type and temperature
- Roller type and weight
- Layer thickness
- Number of roller passes

„Smoothing“ the layer or surface finish:

Two roller passes, if required

Edges of paved lanes:

- Use rollers with edge restraining devices to shape and compact the edges

Rolling pattern:

- Construct a test strip, e.g. by using a density gauge or similar device



Guidance for asphalt mix compaction

Compaction is always planned and executed taking due

consideration of the type of mix, on-site placement conditions, and the season



Guidance for asphalt mix compaction

- Typically, at least 2 rollers should be on site during placement.
- Follow the paver as closely as possible during the first roller pass (breakdown).
- Turn the roller slightly when stopping in front of the paver.
- Angle the drive wheel (of single drum rollers) towards the paver to avoid bow humps and cracking (exception: paving operations on steep sections).
- Begin the compaction process on the low side of the pavement lane and proceed upwards towards the centre or the high side, using the drum width as reference.
- When compacting curves with crossfall begin compaction on the low side of the road's edge. The lane first paved serves as an abutment for the next roller passes.
- Always stop rollers on completed asphalt layers and never on a hot layer that is still plastic.
- Change directions smoothly; when reversing directions switch off the engine and allow the roller to coast down; then restart the engine right away, thus avoiding a surge.
- When using vibratory rollers turn off the vibration with enough lead time before changing directions, to avoid vibratory roller marks on the layer that are unable to be ironed out by subsequent rolling.
- Vibratory compaction has to be consistent with the mix temperature.
- Moisten the drums regularly with only enough water (e.g. intermittent water spray system).
- Assign the longitudinal joint to a specific roller when paving two layers „hot on hot“.
- In no circumstance should the roller be stopped on the hot layer. After having completed the required roller passes, remove the roller from the cooling asphalt layer and park it outside the cold surface.
- Do not use the vibratory mode for cold layers!

Compaction of the mix

Rollers for different asphalt types

		Base Binder	AC	SMA	BS	PA	Thin Overlay	WMA	
Static three-wheeled roller		•	•	+	++	-	+	++	+
Tandem roller	Static mode smaller 6 tons	•	•	+	•	+	++	•	•
	larger 6 tons	+	++	++	++	++	++	++	++
Tandem roller	vibratory mode normal	++	++	+	• to +	++	-	-	• to +
	Oscillation	++	++	++	• to +	++	-	•	• to ++
Combi roller		+	•	•	-	++	-	-	-

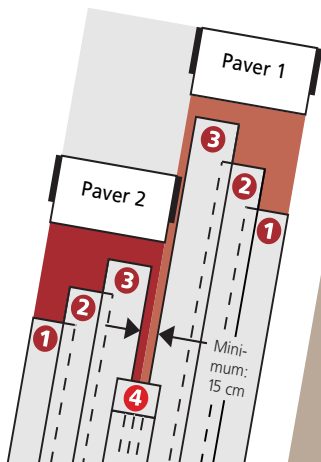
++ = especially suited

+ = suited

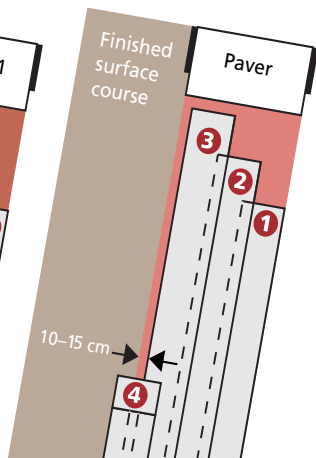
• = suited under certain circumstances

- = not very well suited

Roller compaction: 1st variation



2nd variation



Compaction of the mix

An excessive,
initial mix temperature
causes...



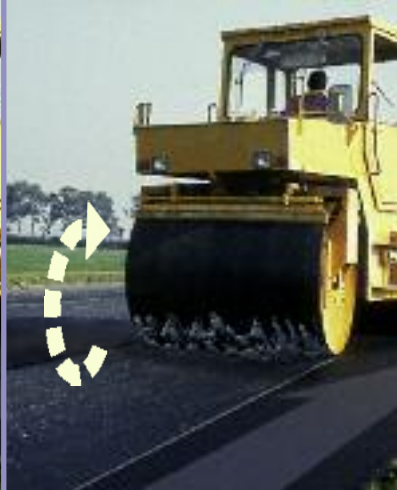
▲ ...lateral mix displacement outside
the wheelpaths

...a small wave in front of the roller
(excessive shoving) ▶

Compaction mistakes

Cracking is caused by
an excessive, initial mix
temperature and by the
following factors:

- Wrong rollers (excessive roller load creates shear cracks),
- Mix tends to shove under roller loads (too much tack coat, moisture or dirt on the existing surface)
- Yielding subgrade or base.
- Improper or poor mix design



▲ ...transverse cracks behind the roller drum,

▲ ...mix sticking to the roller drum despite wetting the roller,



As soon as defects caused by rolling are identified the root cause is to be determined as fast as possible and eliminated.

- Waves or roller marks are typically caused by poor workmanship

**Better
a roller too much
than a roller short**

7 Skid Resistance



Paving and compaction process

Initial skid resistance is ensured, inter alia among other things, with the following methods:

- Use aggregates with a particle size of 1-5 mm (with bitumen coating, pre-heated, de-dusted) for gritting
- Spread aggregates as soon as possible, at the latest after the second roller pass
- Correct metering and even spread
- Use smooth drum rollers with high line loads

Initial skid resistance is reduced, for instance, in the following cases:

- Fattening up (migration of bitumen to the surface),
- Premature opening to traffic (cooling time of at least 24 h),
- Wrong gritting material (e. g. crushed sand)
- Uneven spread.

Guidance

Anti-skid road surfaces ensure the safety of all road users. Paving operations greatly impact initial skid resistance. When the guarantee period expires, skid resistance is affected mainly by the mix that was used.

Ensuring skid resistance is just as important as all other acceptance criteria. Use the forms issued in the General Newsletter (ARS No. 2/2002) for your self-control.

**The appropriate
pavement technology
ensures
initial skid resistance!**

8

Design specific guidance

Consideration should be given to the following guidelines when applying a specific design:

Compact asphalt

Planning the job

- Select mix plants based on their supply rate. Then sort the plants according to binder and surface course material.
- Select one mix plant that coordinates all the other mix plants.
- Make sure that the mix plant and the paving crew discuss the production, process, choice of haul vehicles based on appropriate policies and procedures, and that clear roles and responsibilities are assigned.

Planning paving operations

- Check both screeds for camber and cross fall.
- When constructing transverse joints, approaching bridges, etc. both screeds should use automatic screed controls with a string line providing elevation input to the paver sensor.
- Direct and separate haul trucks according to the type of mix (binder versus surface course).
- Prepare a roller pattern based on the total thickness, type of mix and the available roller types.



Compact asphalt

During paving operations

- Maintain a constant paving speed (if possible > 3 m/min).
- Verify the thickness of both layers at regular intervals.
- Make sure that the tolerance range is kept.
- Document the tonnage placed on an ongoing basis.
- Inform the mix plant in a timely manner about the remaining material required to complete placement.

Porous asphalt

Planning the job

- Reduce haul distances (excessive cooling of mix).
- When placing multiple layers it is not possible to apply a bituminous binder, as this would considerably reduce the water permeability of the mix. Best practice is to place the layers immediately one after another (fresh on fresh) to attain sufficient layer bonding. It is very important to avoid contamination of the bottom layer.
- It might be advisable to prepare a test strip to avoid falling short of the required void content.

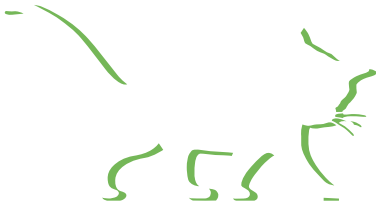


Planning paving operations

- If the mix is placed on an existing surface, ensure that it is sufficiently sealed.
- Special care should be given to preheating the plate on the bottom of the screed.
- When paving half of the road width, ensure that water drainage within the layer is not stopped by a sealing strip, etc. The same applies when repairing road damages.

During paving operations

- The tolerance range is considerably lower than for standard asphalt layers.
- Also, make sure to use smooth drum rollers only when compacting the mat.
- Operate the roller in static mode.
- Base courses laid under block pavements and permeable sports surfaces can also be compacted under vibratory mode.
- Be especially careful when the roller moves across the lane to the next rolling lane.
- Porous asphalt overlays are not gritted because the aggregates would clog the voids of the porous asphalt surface course.



Warm mix asphalt

Planning the job

- As warm mix asphalt has a lower heat potential it makes sense to use insulated or heated trucks.

Planning paving operations

- Special care should be taken in preheating the plate on the bottom of the screed.
- As this mix is more receptive to compaction, the initial compaction unit of the paver should be reset.
- Prepare a roller pattern based on the total thickness, type of mix and the available roller types.

During paving operations

- Ensure that the asphalt temperature is monitored around the screed area during stoppages. The remaining mix has to be removed at an earlier stage than is the case for standard asphalts.
- Excess compaction causes a lower air void content. Typically, the desired density level is generally reached after the fourth roller pass.
- The roadway can usually be opened to traffic sooner than with standard asphalt.

Light-colored surface courses

Light-colored surface courses can be produced with surface dressing and/or by incorporating light-colored aggregates into the mixture. Natural or artificial light-colored

aggregates can both be used for this purpose. The aggregates for the surface dressing should be embedded right behind the paver with the first roller pass.

Railway track beds

The asphalt base courses for the solid track bed are laid with the same technique as in road design. There is, however, a significant difference in the surface course which is compacted solely by the screed without using any rollers. Only when using this technique can the course be laid to the specified level. The course is laid using the approved equipment and in compliance with the specifications pertaining to the building of solid track beds.

The track bed should be placed while taking on-site conditions adequately into consideration and using equipment modified specifically for this purpose.

Hydraulic applications and landfill construction

Asphalt layers serve as waterproof sealing for hydraulic and landfill constructions. In such construction projects the base and also the embankments should be rendered waterproof. Asphalts used in these applications must have sufficient stability to be laid without sliding down the slope. Specific paving and compaction equipment is required in addition to a special mix design. The applicable contract specifications should be observed. The construction of joints and seams requires advanced techniques and special care.

Anti-icing surfaces

These surface courses are only placed on short sections that are particularly susceptible to black ice formation.

Such sections might include:

- Bridges
- Open strips in forests
- Sections exposed to unfavorable climatic conditions.

Special salt crystals are incorporated into the asphalt mix. The salt manufacturer's instructions for placement and compaction should be observed.

Colored pavements

Colored pavements are manufactured with the following methods:

- Colored Binders
- Clear binders and dyes/pigments for fillers

It is a good idea to blend aggregates of the same colour into the mixture to enhance colouring.

The entire equipment (including tools and footwear) should be carefully and thoroughly cleaned prior to paving operations.

**Special designs
require
special instructions
and information!**

9 Joints



Guidance

A joint is the interface between two adjacent and parallel HMA layers (longitudinal joint).

Joints can occur when paving in echelon („hot to hot“) or when paving half the width of the road („hot to cold“).

Joints at the end of each day's construction are referred to as transverse joints.

In all cases it is imperative that a permanent bond be created between both sides of the joint to avoid surface water ingress.

Longitudinal joints

„Hot to hot“ technique

Paving in echelon with two or more pavers is the best precaution to ensure a solid bond between the two adjacent mats.

Aspects to be considered:

- The pavers should follow each other as closely as possible to ensure that the edge of the first lane paved is still sufficiently hot.
- The rollers right behind each paver should be of the same size. Both rollers should begin to compact the layer from the outer edge towards the joint. Compaction ends about 15 cm away from both sides of the longitudinal joint. The mix across the joint is only compacted with the last roller pass. This method produces tight, solid compaction and adhesion between the two layers (see page 39).



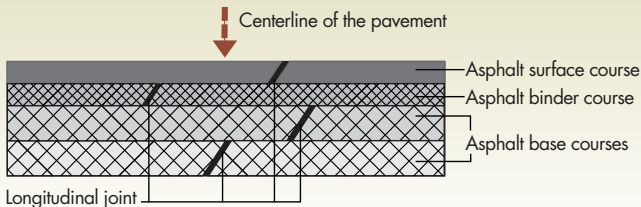
Joints: Not recommended! ...Best practice!

„Hot to cold” technique

Joints must be constructed with great care if traffic necessitates that paving be performed one lane at a time.

The following guidelines should be considered:

- As a general rule it should be ensured that the joint is **not** placed in the area of road markings or the wheel path.
- The required longitudinal edge (contact face) has to be constructed while paving the first lane...

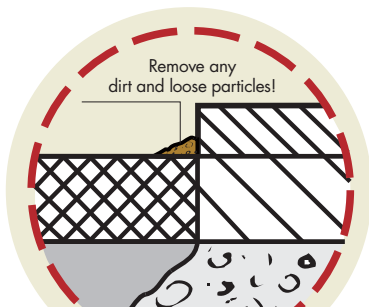


...The edge should have a 70 to 80 degree inclined face. Compared to a vertical face this permits a contact area that is larger than the layer placed. This taper is constructed with a joint taper attached to the paver and/or an edge compactor attached to a roller. It is not recommended to cut the edge after it has cooled because this would create a smooth face.

In addition, the cutting ooze contaminates the existing surface (poor layer bonding).

To ensure perfect adhesion between the two asphalt lanes, the face should be prepared as follows:

1. Thorough cleaning.
The surface adjacent to the joint should also be cleaned of all debris and loose particles.
2. Spray or paint vertical face with sufficient adhesive material. Coatings are placed with hot or cold applied materials.



Keep the following points in mind when placing and compacting the second lane:

- The second lane is placed with a narrow overlap (2-3 cm) and in compliance with the specified tolerance range.
- A poor overlap, or no overlap at all, would cause a lack of mix at the joint. This would lead to poor compaction and eventually would cause damage to the joint.
- If there is an excessive amount of overlap the paver would ride on top of the mix. This would cause aggregate crushing in the overlapping area and insufficient compaction across the joint.
- Before starting roller compaction the overlapping mix should be looted on to the new layer.
- See Chapter 6 for the use of rollers.

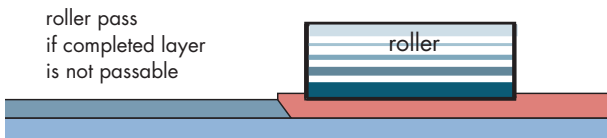
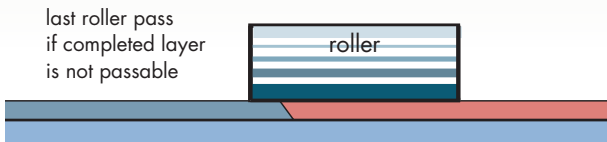
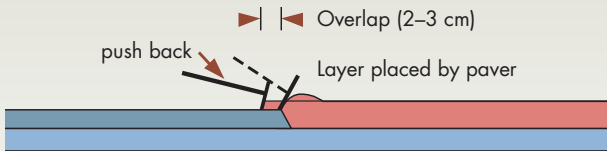
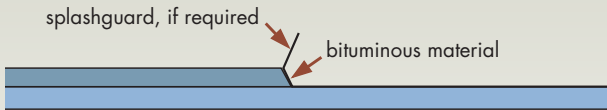
Transverse joints

Transverse joints are built at the end of each day's construction, or if there will be lengthy stoppages.

The following steps are required to construct a transverse joint:

- Run the paver empty.
- If the layer thickness is insufficient, cut back the mix by hand and construct a vertical edge.
- Place a board with the same thickness next to the joint.
- Grit the existing pavement surface of the ramp area with a thin layer of sand.
- Construct the ramp by hand on the gritted area using the rest of the mix.
- Compact the entire area and the ramp with rollers.

How to produce joints



- Remove ramp, sand and wooden board before re-suming paving operations.
- Use a straight edger to verify whether the old layer is level in longitudinal direction. If necessary, cut back the layer.
- Clean the ramp area and tack it with contact adhesive.
- Compaction is carried out using the „hot to cold“ technique.

Transverse joints and longitudinal joints can also be constructed as gap joints (see Chapter 10).

Material finishing/shaping

An overband to seal rough areas around the joint can help provide additional protection.

- Apply the sealant with a hand-held banding machine equipped with a narrow steel squeegee.
- Paint the joint area with an appropriate binder and then blot the material using crushed sand with low filler content.

**The best joint
is no joint at all!**

10

Gap joint



Guidance

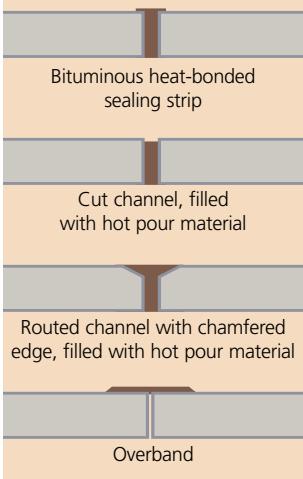
Gap joints must be built whenever there are transitions between layers with different properties.

This is the case, for instance, with:

- Gutters (concrete, block pavement)
- Kerbs (concrete, natural stone)
- Concrete slabs
- Walls
- Ironworks.

Joints can be sealed by mechanically creating a reservoir to be filled with hot pour material or by using heat-bonded sealing tape.

Gap joint configurations



Joint faces

Ensure that gap joints

- have the same thickness as the surface course,
- are vertical,
- are clean and dry.

Filling the gap joint reservoir

Reservoirs/channels can be created by using the following methods:

- Placing an insert,
- Cutting, or
- Routing.

Gap joints



Application of sealant

The following steps are important and should be followed:

- Remove any debris with hot air blasting. Flush the reservoir if necessary.
- Dry the reservoir, e. g. with hot compressed air
- Apply the primer and allow it to cure
- Carefully prepare the sealant or filler material
- Follow the specific recommendations provided by the manufacturer of the material.
- Dispense the material with an applicator wand or pour pot

Outsource major jobs involving hot pour material to specialized firms!

Sealing strips

Sealing strips are anticipated joint filler. Follow the specific recommendations provided by the manufacturer of the sealing strips.

Application:

- Sealing strips are pre-fitted to the vertical face
- Sealing strips are placed as an overband covering the channel.



Application of sealing strips

The following steps are important and should be followed:

- Clean and dry the faces
- Apply the primer and allow it to cure
- Carefully melt the sealing strip to the cold face by using a propane torch; apply and press the strip immediately to the face
- If the reservoir is very long, the strip should be applied with power equipment.
- Make sure that there is no deformation or detachment of the sealing strip from the asphalt layer prior to paving

- The cross-section of the sealing strip should be consistent with the thickness of the surface course.
- Sealing strips placed as overband should be fixed in place by applying a blotter coat.

Sealing strips are less elastic than hot pour material.

**Seals and transitions
should be permanently
waterproof!**

11

Road Edges

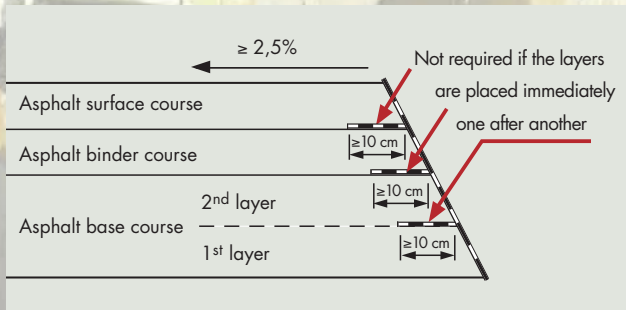
To prevent the ingress of water, dirt and roots penetrating the asphalt from the side, the outside road edges should be sufficiently compacted:

- With edge restraining devices
- With joint taper and edge restraining devices



Additional protection is provided to the outside edges by spray coating the edges, e.g. with hot bitumen or by applying asphalt slurry or pore filler. Such treatment is imperative for high shoulders. The lower edge of porous asphalt layers should not be sealed.

**Faulty sealing
damages
the asphalt!**



12

Taking Samples to verify quality features

Sampling

Samples should be taken in compliance with an approved sample drawing plan. Any additional samples are drawn for special testing (additional compliance tests).

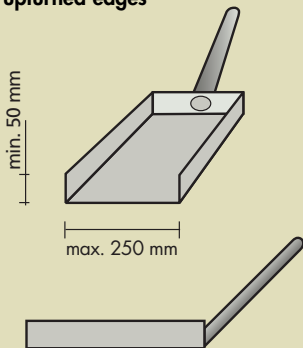
During taking mix samples for compliance testing the client or its representative and the contractor should be present. It is also a good idea for the mix supplier to be present.

The samples to be drawn should be representative of the areas allocated to them. Samples should be drawn in accordance with applicable specifications.

When taking mix it is imperative that a square-tipped shovel with upturned edges be used.

Make sure that the receptacles for samples are the right size and diameter.

Square-tipped shovel with upturned edges





Documentation

The sample drawing plan should be prepared and be available prior to paving operations. Every drawn sample should be put on record. It should be possible to identify the mix sample at any time. The following information is required to that end:

- Name of job site
- Date/time when the sample was taken
- Client and contractor
- Suitability test no.
- Exact position/lane
- Mix type
- Supplier/mix plant
- Delivery note no.
- Mix temperature
- Sample number/description
- Signatures of client and contractor on record



Guidance

Samples taken are used to conduct follow-up tests describing the quality features of the mix supplied.

Mix samples are taken for the following purposes:

- Self-monitoring
(conducted by paving contractor/mix supplier)
- Compliance tests
(conducted by client)

**Taking wrong samples
is a sure-fire way
to lose out!**

Additional information about the German Asphalt Paving Association (DAV) and further DAV-guidelines

More information about the German Asphalt Pavement Association DAV and the German Asphalt Research Institute DAI as well as an overview of their publications (brochures, guidelines and research reports) you will find on the internet:

www.asphalt.de





Notes



More information on the internet:
www.asphalt.de

Notes



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