

Guide to Constructing a Rigid Paving System

A rigid paving system will generally comprise the following components:

- (1) Concrete base. Minimum 20mpa compacted reinforced concrete minimum 75mm thick including control/expansion joints as per engineer's detail.
- (2) Bonding slurry. This is applied at the interface of the concrete base and the bedding mortar and at the interface of the bedding mortar and the paving to assist bonding
- (3) Mortar bed Paving shall be fully bedded into a mortar mix of a minimum thickness of 15mm and a maximum thickness of 40mm. The pavers are to be fully supported by the mortar bed with no voids in the mortar bed.
- (4) Grouting material. Paving shall be grouted to the full depth of the paving slab using a non-shrink cementations grout.

MATERIALS

The following raw materials should comply with the relevant Australian Standards:

- (1) Cement. Portland type HE Off White Cement AS3972.
- (2) Sand. Concrete aggregates A2758Pt1-1985
- (3) Water. Shall be potable and free from contaminates.
- (4) Bonding Agent/Damp Proof. An approved mortar admixture to improve workability, adhesion, strength and impermeability of the mortar bed.

BONDING SLURRY COMPONENTS AND MIXING PROCEDURES

The bonding slurry should consist of:

- (a) 1 (one) part fine washed sand by volume
- (b) 6 (six) parts Portland Type HE Off White Cement by volume.
- (c) Approved bonding/damp course agent.
- (d) Sufficient water to form a slurry of workable consistency.

Mixing

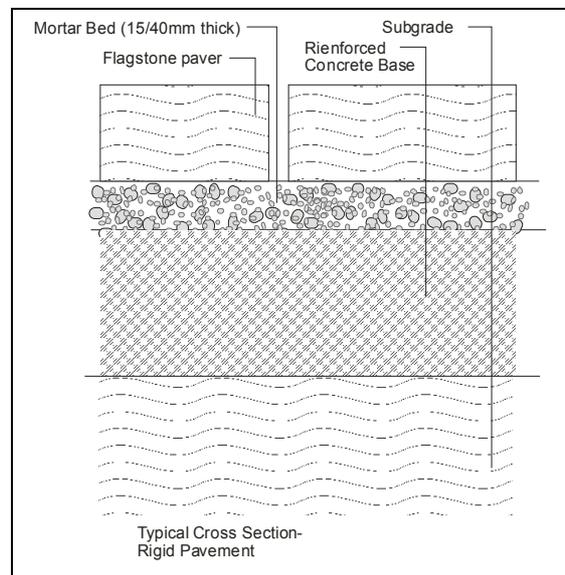
Mixing should be performed either by hand, using a clean container and mixing tool, or in a cement mixer by adding sand and cement to water, whilst mixing continuously to ensure a smooth consistency which is free of lumps.

The volume of mix made at any one time shall not exceed the amount required for the quantity of pavers to be laid within 45-60 minutes from the initial mixing time and is dependent on climatic conditions.

MORTAR BED COMPONENTS AND PREPARATION

The mortar mix should consist of:

1. 6 (six) parts blended washed sand by volume.
2. 1 (one) part Portland Type HE Off White Cement by volume.
3. 1 (one) part water (more may be added during mixing to achieve the correct consistency).



- 4 Damp Proof/Admixture as per recommended dose.

MIXING

Mixing shall be performed in a cement mixer free of fresh loose residuals, by adding the aggregate to the water, damp proof mix (which shall initially be proportioned as one part per volume) whilst mixing continuously to ensure a consistency which is free of lumps. All components shall be measured by means of calibrated containers. Water/waterproofing mix may be added in the specified proportions to give the mix a consistency such that it can be loosely shaped by hand and will remain whole when released whilst leaving hands moist but not wet. The volume of the mix shall not exceed the amount required to lay the quantity of pavers within 45-60 minutes from the initial mixing time and is dependant on climatic conditions.

CONTROL JOINTS

Control joints for movement and thermal should be placed at spacing as recommended by the Architect/Design Engineer, or as required in each instance.

All control joints in the concrete base slab should be followed with a control joint of the same width in the pavement filled and treated to the appropriate engineer's details.

CONSTRUCTION

1. Sweep the concrete base clean and remove dirt, dust & cement laitance.
2. Prepare mortar mix.
3. Prepare slurry mix.
4. Dampen concrete base with clean water.
5. Using a broom, apply slurry mix to concrete base thoroughly (approx 1mm thick) to an area, which will not exceed the extent of paving to be immediately laid. (Slurry must be wet for best adhesion).
6. Place prepared mortar mix into position and trowel the mortar so it is slightly higher than the desired thickness of mortar bed (approx 5mm).
7. Apply coating of slurry to underside of paver, ensuring it is stiffly brushed into the paver and build up the slurry thickness to approximately 1mm.
8. Bed down paver and tap with rubber mallet to finished surface level.
9. Fill any voids with mortar at front edge and/or front corners of paver.
10. On completion of the area cover the area with Hessian or builders plastic sheets. Keep all pedestrian traffic off the area for the first 12 hours of curing.
11. After a minimum of 12 hours curing the joints may be grouted. Where necessary remove residual material from within joints prior to commencing the joint filling operation.
12. Prepare grout mix
13. Dampen joints and inject/trowel grout mix into joints ensuring full penetration to the thickness of the paving. Ensure grout is evenly spread into all joints until filled to the top of the pavers. Remove excess grout with a trowel.
14. Wipe pavers clean with a damp sponge continually rinsing the sponge in clean fresh water. Remove all traces of grout and cement from the surfaces of pavers. After 12 hours check for any remaining cement or grout residue and remove using clean water and a stiff scrubbing brush.

GROUT COMPONENTS AND PREPARATION

COMPONENTS

The grout mix should be a dry bagged proprietary brand, fine aggregate/cement/admixture type grout with high flow and low shrinkage properties, non staining in the course of its application and of a compressive strength in excess of 20mpa.

Mixing

Mixing shall be in accordance with the manufacturer's specification.

QUALITY

1. Grout joints should be even and uniform 8-12 mm width.
2. Lipping of adjacent pavers should not exceed 2mm.
3. Finished surfaces should be level and any variation in level shall be no more than 4mm per 2000mm.

Guide to Constructing a Flexible Paving System

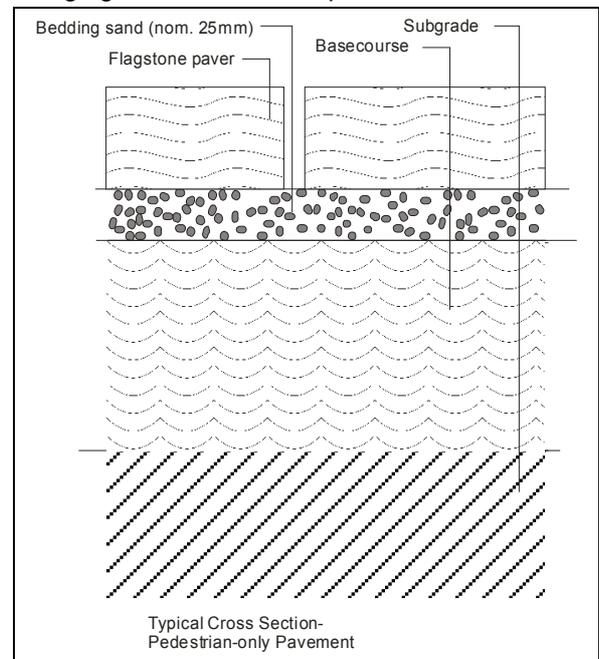
A flexible paving system will generally incorporate the following components:

1. **Crush rock base.** Minimum 100 mm after compaction (compaction of a crush rock base is best done in 3-4 layers, wetting the crushed rock and using a mechanical vibrating plate compactor to create a flat smooth surface, levelled to create a fall for drainage).
2. **Bedding course** of coarse washed sand. Normally raked and levelled, using a screed, to a depth of 25 mm.
3. **Jointing material.** Depending on the width of the joint, materials used can vary from coarse sands blended with fine washed sands, different types and colours of fine mineral sand and some rock dusts through to proprietary products such as Pavelok.
4. **Edge restraint material.** Either a concrete or treated timber edging must be used to prevent movement and keep the bedding course and jointing sand in place.

Tools and Equipment

- Wheelbarrow
- Shovel
- 1.2 metre spirit level
- Rubber Mallet
- Rake (a metal rake is best)
- Screed Rails (timber or PVC pipe 25 mm thick)
- Straight Edge Screed (2 - 3 metre long aluminium or timber straight edge that will not bend at all.)
- String lines and wooden or metal pegs.
- Vibrating mechanical compactor plate (available from all tool hire places)
- Angle grinder and stone cutting blades, if any cutting is required. ("9 inch" angle grinders can be hired also)

Should you need to run the Vibrating mechanical compactor plate over the pavers you must protect the surface of pavers by wrapping a section of old carpet over the plate.



Construction

1. Mark out with string lines or chalk **the area** to be paved.
2. Measure the area and then calculate the **quantities of materials** you will require. eg. crushed rock base – number of square metres of paving X .11 = cubic metres of crushed rock required (50 sq m X .11 = 5.5 cubic metres of crushed rock) bedding course sand - number of square metres of paving X .025 = cubic metres of bedding sand required (50 sq m X .025 = 1.25 cubic metres of bedding sand) jointing material/sand - number of square metres of paving X .00018 =cubic metres of jointing sand required (50 sq m of square metres of paving X.00018 = .09 cubic metre of jointing material).
3. **Excavate** the area to a depth of 170 -175 mm below the required level of the finished paving (take care not to damage or penetrate any buried pipes or conduits).
4. Spread and compact the **Crushed Rock** evenly in a 100 mm thick base, (approximately to a distance of 70 mm – 75 mm below the required level of the finished paving). Compacting crushed rock is best done in 3 or 4 layers rather than attempting to compact the full 100 mm. Use a vibrating compactor plate.(passing over the crushed rock after wetting the crushed rock will help achieve the best results).

- 5 Measure and carefully stretch string lines along the line where joints in the paving will be formed. Set the string lines at the height and level at which you wish the paving surface to finish.
- 6 To spread the **Bedding Course** evenly place screeding rails (either 25 mm PVC pipe or 25 mm thick timber strips in 2 - 3 metre lengths (or shorter if necessary) onto the compacted and levelled crushed rock base and then using a rake or shovel and a straight edged screed, working carefully around your string lines, smooth the sand evenly down to the level of the screeding rails. Carefully remove the rails with minimal disturbance to the levelled sand. The smooth finished surface level of the sand should be approx. 45 mm below the required finished surface level of the paving. The bedding course will compact 3 mm - 5 mm. during bedding down and compaction.
- 7 You can now start **placing pavers** onto the prepared bedding course. To start, it is generally easier to begin laying whole pavers butted nearly against any immovable structures such as buildings, walls or other solid constructions and work outwards from there. (in enclosed areas, start on a centre line and work to the outer edges, this will achieve a balanced and symmetrical appearance) You may bed our larger sized pavers down at this stage by using a rubber mallet to tap them down, using a spirit level and your string lines to maintain a straight joint gap at the surface of about 6 mm - 10 mm whilst keeping to the required finished height and level.
- 8 Sweep the **Jointing Material** into the joints. When the jointing material has been swept over the paving you may wet the area down and then check to see if all the joints have been filled, top them up if required. You may need to pass over the area with a mechanical vibrating compactor plate. If this is required (normally only our smaller sizes require this). Obtain some old carpet to protect the pavers from scratching and surface damage from the compactor, then 1 or 2 passes is normally all that is required.
- 9 Any exposed edges of the paved area will need an **Edge Restraint**. Edge restraints are needed to prevent the bedding course moving from under the pavers. An inefficient restraint may lead to the rapid loss of jointing material or movement and loose pavers in your paved area.
Concrete edge restraints can be formed by digging a trench (100 mm X 120 mm deep) adjacent to the finished edge of the paving. Into this trench place either concrete or reinforced mortar and then trowel solidly and evenly up to 10 mm - 20 mm below the surface of the paver.
Timber edge restraints can simply be a sturdy piece of treated or rot resistant timber. This would extend from to the surface of the crushed rock base up to 10 mm below the surface of the paver. Timber edge restraints must be solidly staked against the pavers and be immovable. You may backfill up against the edge restraint to both disguise it and reinforce it.

Note: For technical specifications of the above materials, please refer to our specification data sheets.

Note: when hiring electrical power tools and construction equipment make sure you are familiar with its manufacturers recommended safe method of operation and any written operating instructions from the Hirer (using some equipment may require hearing and eye protection)

Delivery and Handling

Pavers are delivered to site using a fork truck to the nearest kerbside unless other arrangements have been made prior to delivery. The product quantities and colour should be checked upon delivery and any discrepancies reported within 2 working days of delivery date. Stone pavers come with a protective layer between each paver. These sheets should be used when restacking the paving stones on the job site to avoid damaging the surface of the product. It is recommended that the product not be restacked for extended periods of time as this may result in shadowing of the pavers due to different drying rates. Any marks that occur because of restacking are not the responsibility of the manufacturer. If the order exceeds one pallet it is important to source from all pallets whilst laying as this will enable a natural blending to occur.

Warranty Claims

All products supplied by are guaranteed for 12 months from delivery, and will be replaced free of charge if found to be defective. This guarantee is strictly limited to product replacement and does not cover installation by others.

This warranty is a general warranty that does not apply if:

The product is misused;

The surface is exposed to unusual and or excessive environmental conditions, including but not limited to rising damp and salt attack.

The products are purchased as weathered or are purchased as seconds, in which case they are purchased as is, and no warranty applies.

Colour variation may occur between displayed samples and production batches as a result of the use of natural raw materials and or other factors. Any rejection on the basis of colour will only be acknowledged if it is made with 5 days of delivery, and the product has not been moved or installed, and remains in original condition.

PAVING MAINTENANCE DATA SHEET

We recommend that the paving be cleaned on a regular basis (2 to 3 times annually) with a high pressure water gun.

If sealing is required please refer to a professional sealing company.

CLEANING.

High-Pressure Water Blasting. With the recent development of cheaper high-pressure water-jetting equipment, water can be used to clean hardened concrete and masonry surfaces effectively. High pressure water blasting relies on the force of the water rather than on abrasives. Pressures upto 55,000 psi (380 MPa) are available; however, most of the work is accomplished at 1,000 to 2,500 psi (7 to 35 MPa). Oils and grease are usually removed before water blasting.

A variety of equipment is available for this type of surface cleaning. Nozzles range from flat-fan pattern tips to a straight jet tip. The fan pattern acts as a blade that pries up and lifts away the undesirable surface accumulation. The straight jet could cut a hole completely through concrete. So be very cautious and trial an area to test the settings you require. See the following list for some specific cleaning suggestions.

NOTE: All the treatments listed below should incorporate a Pressure Water Blast as the final step of treating the particular stain.

STAINS TREATMENTS

Food and wine Pressure Blast and bleach soak then pressure water blast again to flush

BBQ spills & Cooking Oils Irrigate well with warm water with "Cloudy Ammonia" or "Sugar Soap". Use of a caustic solution such as dishwasher powder will emulsify oils.

Bitumens Harden with ice, or dry ice, chip off, follow with scouring powder scrub. Do not use solvents, which will "drive in the stain
Cutback See Petroleum oil and grease (Solvent base)

Caulking Compounds Scrape surface, then use denatured alcohol poultice, follow with scouring powder scrub. (Ask manufacturer for recommendation). hand polish with paver offcut and water

Copper or Bronze Verdigris Ammonium Chloride/Ammonium Hydroxide or Sodium/Ammonium Citrate poultice

Dirt Pressure Blast then Scrub with: Detergent; Bleach; dilute Hydrochloric acid or Phosphoric acid;

Epoxies Torch burn and/or abrasive blast or hand polish with paver offcut and water

Drying Oils (linseed, soy, tung) Trisodium phosphate/sodium perborate/liquid soap poultice.

Graffiti Commercial products; Methylene Chloride (hazardous); oxalic acid; hydrogen peroxide poultices; abrasive blast

Inks and Chemicals Solvent and/or bleaching poultices. Active bleaching agents including Ammonium Hydroxide, Hydrogen Peroxide, Sodium Hydroxide, Sodium Hypochlorite (commercial bleach, i.e. White King)

Paints (wet) Soak off, do not wipe in, scouring powder scrub; after residue dries, see paint (dried).

Paints (dried) Scrape residue; commercial paint remover poultice, solvent gel. hand polish with paver offcut and water

Petroleum oil Solvent poultice (alcohol, acetone, paint thinner, lacquer thinner, trichloroethane); detergent wash with warm soapy water if lightly stained.

Rust Sodium hydrosulphite poultice Pressure Water Blast

Smoke Pressure Water Blast. Scorched smoke use Scouring powder; Trichloroethylene (hazardous) or Sodium/Potassium hydroxide poultice.

Wood, Leaf & Garden Litter Stains, Moulds & Algae Sodium Hydroxide/Hydrogen Peroxide poultice Active bleaching agents including Ammonium Hydroxide, Hydrogen Peroxide, Sodium Hydroxide, Sodium Hypochlorite (commercial bleach, i.e. White King). Followed by Pressure Water Blast

Efflorescing Salts Application of diluted Hydro – Fluoric Acid

Note: The above advice is offered in good faith but does not constitute a guarantee of any sort and is to be considered and used at your own risk and discretion. Proper health and safety, materials handling and data sheets are the responsibility of the user. Testing of all recommendations is advised.

Frequently Asked Questions.

What type of construction system should I choose?

To make the selection of the appropriate type of construction that will best suit your situation and project, you may need the advice of a professional building consultant, architect or landscape designer.

Flexible Pavement System

In general, small simple purpose paved areas can be built as a flexible paving system. The home handy-person can easily construct a pathway, BBQ area, pergola or simple patio extending from your house. Paved surrounds of swimming pools should **not** use this method of construction. Some projects in localities with a very reactive type soil, (heavy clays that show prominent shrinkage drying cracks in summer will swell and move, often changing levels during winter) may show the effects of this over time, by resultant movement and changes in the finished levels of the paved area.(ref. to Technical Manual for Construction Guide and more info.)

Rigid Pavement System

Most newly constructed residences will require the paving and landscaping work be done by a qualified landscaper/paving contractor who has the requisite skills to plan and incorporate the necessary drainage, falls in levels and control jointing required by today's ever-more complex designs of multi-level areas with steps, retaining walls, elevated terraces, swimming pools/spas, feature entranceways and driveways All of the above design elements require a rigid concrete foundation to ensure the longevity of the projects functionality and appearance. Consequently we recommend that for larger projects the services of a suitably qualified professional are employed at both the design level and for the construction work. (ref. to Technical Manual for Construction Guide and more info)

What is the white sometimes powdery/fluffy or otherwise seemingly ingrained dust or crystals or white film on the surface of pavers?

Whitish discolouration of /on the surface of paving is generally either "Efflorescence" or poor workmanship in cleaning after grouting.

- Efflorescence is a salt bloom which normally occurs in all cement products but in a minimal amount. Large areas of efflorescence may be caused by a lack of waterproofer in the bedding course mortar especially if sands high in soluble salts content are used. In most instances natural weathering quickly washes most salt blooms away in a reasonable amount of time. Or simply brushing the salts away and off the paving, followed by rinsing will remove most salts.
- Poor Workmanship may leave a fine residual film of excess grout over paved surfaces. In most cases swipe marks (visible upon close examination) that often travel across adjacent pavers reveal insufficient cleaning. Other signs that residual grout slurry is the cause of discolouration are lumps of grout on the surface, or darkish patches that seem to take a long time to dry out shows where moisture is sealed into the paver under a micro film of gout slurry. If left more than a few weeks this will cause uneven weathering of the surface which may cause slight colour differences within a paver

Why has some paving cracked?

The three most common causes of cracking in pavers are:

1. Cracks caused by movement or cracking of the sub-base in either concrete or compacted crushed rock base-courses, which may be caused by an unstable or low strength subgrade (subgrade strengths may be estimated from soil classification data and normally involves consulting with a professional) these types of cracks tend to run through adjacent pavers following the movement or crack in the sub base, there may be a slight step in the surface levels from one side of the crack to the other
2. Cracks caused by variable expansion and contraction of both the paved surface and the bedding-course is nearly always due to thermal expansion in concrete with minimal or inappropriately located expansion joints. Courtyards of paving built tightly abutting against, and enclosed by immovable structures such as buildings or separate concrete slabs such as driveways or swimming pool structures, without appropriate control and expansion joints may be subject to pavers becoming loose, cracking or even flaking of the surface at the grouted edge of a paver
3. Cracks caused by the dropping of a heavy item can generally be readily identified by the shape and or pattern.
4. A network of very fine hairline cracks may appear as pavers are drying after rain and sometimes after wetting and cleaning. These cracks are commonly known as a form of "crazing". This is of no significance and has not altered the structural performance or integrity of the paving. These fine "cracks" represent points where more moisture leaves the surface of a paver than from other areas of the surface. Over time a well recognised process known as "crystalline autogenous healing" reseals these points of moisture exit with deposits of minute crystalline solids as the moisture evaporates and eventually they will disappear in most cases.

DESIGN TIPS AND SUGGESTIONS

- Tiles that are firmly attached to the base may crack if the base moves or cracks.

- Tiles that are loosely attached to the base may still crack if the grout joint is narrow or if the grout is hard and inflexible.
- Tiles laid in a stretcher bond pattern may be more susceptible to cracking through the laps if the base moves or cracks.
- Large tiles require a firmer or more stable base particularly under heavier loading.
- Contraction jointing in solid bases must be appropriately placed to coincide with the tile pattern, or tiles must be placed to conform with the existing jointing pattern.
- Contraction jointing in solid bases must be at appropriate intervals or not more than a 1x2 format: 1 width x 2 length or 2 meters x 4 meters maximum.
- Grouted joints must be wide enough to prevent tiles touching each other or fixed structures.
- Grout to be a suitable low shrink composition with some flexibility.
- Grout to be a flexible composition over contraction or construction joints in the base.
- Grout to be a flexible composition where tiling is in contact with fixed structures such as buildings, kerbs, columns, etc.