Technical Manual

For the Construction, Surfacing and Court Repairs of Netball Courts

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The following manual has been prepared by Netball Australia to help clubs, associations, local government, the education sector, contractors and others in the netball community to understand better the technical aspects of netball court construction, surfacing and court repairs.

In the spirit of Reconciliation, Netball Australia acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of this ancient unceded land where we live, work and play netball on.

We honour the continuing cultures, languages, and heritage of Aboriginal and Torres Strait Islander peoples whose cultural, spiritual and ancestral connections to the lands, sky, and waters has endured since time immemorial.

We pay our respects to Elders past and present, and we acknowledge and value the significant and continuing contributions Aboriginal and Torres Strait Islander peoples make within our community.

Netball Australia is committed to Reconciliation. We acknowledge the need to reflect on our shared history in order to build a vision for a reconciled and prosperous future for all within our sport. One built on mutual respect, equity, authentic collaboration, and genuine truth-telling.

THIS GUIDE IS DESIGNED TO BE VIEWED ON-SCREEN, WITH A HELPFUL PAGE MENU AND PAGE ARROWS FOR NAVIGATION INCLUDED ABOVE.

Note: *Drop-down Page Menu only works on desktop computers. Use Page Arrows and Contents page for links when using Mobile devices. The NA Logo takes you directly to the Contents page.*

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Court Construction: Pavement

The most important design and construction element of a netball court is the pavement.

The court will be rendered unplayable if the base fails. The expense to rectify a failed pavement requires the dismantling of other elements, namely the surface, goal posts, light towers and fencing. This can cost more than the initial cost of constructing the courts.

NOTE: *During this phase of construction there are no shortcuts! The recommendations outlined in the Design and Construction sections of these guidelines should be considered to achieve a successful project outcome.*

Cut & Fill

When the site is uneven or sloping ground, the high areas will need to be cut, and the low areas filled to create a level platform.

The fill used must be compactable. It is imperative that 'cut and fill' sites are compacted well, as per the engineers' recommendations and in layers with no more than 150mm maximum thickness from the cut location or using imported fill or granular materials. This is essential to ensure a stable platform is provided.

Stormwater must be channeled away from the filled slope via a spoon drain or kerb outside the runoff area to avoid erosion. See 'Drainage' on page 7.

Where retaining walls are required, appropriate drainage both behind and in front of the wall will be required to achieve a long-lasting pavement. There are many types of retaining walls available, and each individual site & budget will determine the type used. Retaining walls may require a building permit. It is important to seek advice from a civil or structural engineer for retaining wall details specific to the individual netball court project.

Pavement Platform

The platform created should be longer and wider than the total area of the courts (including runoffs) where it should slope away from the intended pavement area in all directions.

The court platform is cut to remove all topsoil and provide a firm base. The depth and level of the cut will be dependent on the depth of the pavement structure the civil engineer has designed in order to achieve the required finished court levels. The court platform should also reflect the drainage fall required, being either a 1% cross fall in both directions or a 1% fall diagonally on a single plane.

To achieve the right plane a laser leveler is used to create the desired falls once the platform has been cut.

Pavement

Court Construction: Pavement

Subgrade Preparation

The preparation and compaction of the sub-grade is crucial in achieving a long-lasting court pavement.

Firstly, the site must be cleared of all vegetation, topsoil and any saturated foundation materials to establish a firm court platform on which to construct the pavement. The sub-grade depth is dependent on the final excavation depth required to locate the firm base layer in which to build up from. The subgrade should reflect the fall required in the finished pavement, be free of tree roots, foreign objects such as old drainage pipe, non-compactable material and the like. It should be trimmed and rolled ready for proof rolling. In situations where trees need to be cleared, the roots must also be removed. In these situations, the earth placed in the void must be compacted to ensure filled areas match the condition of the natural ground. The void area to be filled must be built up in layers with each layer compacted as it is placed. The thickness of each layer depends on the type of machinery used. The layers can vary from 100mm to a maximum 150mm depth depending on the compaction equipment being used.

During the compaction process, the FCR (fine crushed rock) is spread out by the use of a small grader, bobcat or similar machinery and then compacted with a smooth drum roller. It is critical to maintain the moisture content to the recommended tolerances to achieve maximum compaction.

The subgrade layer should be proof rolled and checked by the project manager to identify any “soft spots”. Proof rolling is a process whereby a fully loaded (max. 20 tonne) truck or smooth drum roller to the Geotechnical Engineers static weight requirement, passes in ‘runs’ across the prepared pavement area. Any signs of surface displacement (cushioning) should be marked and quantified for rehabilitation. Depending on the project managers qualification and/or experience, a Geotechnical Engineer may be required to attend site and determine the correct rehabilitation technique for the failed area.

An engineer is likely to require a minimum 95% standard compaction for natural subgrade and 98% modified compaction for any imported granular (fine crushed rock) filling.

The compaction testing should be carried out by a certified testing company to ensure the required compaction levels have been achieved. The reports should be kept on file for future reference.

If a stable subgrade cannot be achieved, the subgrade may need to be stabilised. In this case, advice should always be sought from the designing civil/structural and/or geotechnical engineer.

In most cases the geotechnical (soil test) report obtained in the investigation/design phase of the project will indicate the likelihood of issues within the subgrade. However, it is important to note that a geotechnical test will only test a select number of 100mm diameter locations per court. There are Australian Standards that can provide guidance on the correct number of test holes required for any given pavement size. It is impossible to test every inch of the pavement area, and, therefore, soft spots and isolated unstable ground can go undetected until the site is excavated, prepared and proof rolled. Cost variations can quite often occur at this stage of the project. Therefore a good contingency should be allowed for within the budget.

For more information regarding budgets and geotechnical testing see ‘Budget & Funding’ on page 23 – and ‘Site Investigations’ on page 25, of the current NA Technical Guidelines PDF.

Pavement

Court Construction: Pavement

Sub-Base Preparation & Compaction

The preparation and compaction of the sub-base crushed rock layers are also critical elements in providing a sound base for the court pavement.

The sub-base is the ‘structural’ layer which gives the overall pavement its strength. The civil engineer will design a pavement structure based on their site inspection and review of the geotechnical report. One, two or even three layers of fine crushed rock (granular material) may be required at this stage in the court’s construction. The number of layers and their depths will be dependent on the soil type and the base proposed by the civil engineer. There is no ‘one pavement design that fits all’. Each site will be different. Therefore don’t ever presume that the depth of sub-base material used in this layer at a neighbouring town’s court will be ok for your site.

It is important to note that these compacted granular layers give the pavement its strength. The granular layer (FCR) is made up of different particle sizes. These angular shapes will bind together when compacted to form a strong and rigid base.

Compaction of the sub-base material is essential. It involves the process whereby imported crushed rock materials, as specified by the civil engineer, are placed in compacted layers to a maximum 150mm per layer depth. This is done with a static or vibrating roller to achieve a hard, dense finish that achieves a 98% modified compaction or better.

The sub-base layer should be proof rolled and checked by an experienced project manager, civil engineer and/or geotechnical engineer to identify any “soft spots”. As stated in the previous sub-grade section, proof rolling is a process whereby a fully loaded (20 tonne) truck or a smooth drum roller to the geotechnical engineers static weight recommendation, passes in runs across the prepared pavement area. Any signs of surface displacement (cushioning) should be marked and quantified for rehabilitation.

A civil engineer is likely to require a minimum 98% modified compaction for all imported granular filling (ie: crushed rock – normally Class 3 and/ or Class 2 Fine Crushed Rock (FCR)).

The compaction testing should be carried out by a certified testing company to ensure the required compaction levels have been achieved. The reports must be approved by the project manager and designing engineer and approved. The reports should be should be kept on file for future reference.

Importing the crushed rock layers – sub-base


Spreading the crushed rock layer


Compacting with a roller


Compacted FCR

Pavement

Court Construction: Pavement

Drainage

NOTE: *Good drainage is one of the most crucial elements in court construction for both asphalt and concrete pavements, but unfortunately it is often overlooked. Do not make this mistake.*

The lack of efficient drainage systems often leads to premature pavement failures. This can be evident within a short period of time after construction! The addition of good drainage infrastructure is a very good investment in the longevity of your netball court.

Considering three main drainage design elements when designing a court is recommended:

- Good court surface drainage
- Good drainage surrounding the pavement
- Good sub surface drainage surrounding the pavement.

Good Court Surface Drainage

Outdoor netball courts should have the recommended fall of 1:100 which is 1%. This can either be (a) 1% fall in both directions (which gives you 1.4% or 1:70 fall diagonally) or (b) 1% diagonally on a single plane (which gives you .7% on all sides).

This was introduced many years ago to achieve a good balance between efficient court drainage and court playability. The courts should fall to a formed drainage system. This is usually provided by the installation of concrete spoon drains and/or grated drainage channels along the lower outer perimeter boundaries of the court pavement. The drains should fall to a large, grated inlet pit where the stormwater is collected and directed well away from the pavement areas.

Surface water should not be allowed to drain across more than two courts as it will delay the drying time and will affect play on the lower courts. To alleviate this problem, the courts can fall 1% diagonally and have spoon drains and pits installed so that stormwater does not empty over more than two courts before being collected.
It is important to note that drainage infrastructure such as this cannot be positioned within the required 3050mm clear run-off zones surrounding each court. Therefore, additional pavement space will be required to accommodate this drainage infrastructure.

To Clarify: If drainage infrastructure like spoon drains or pits are placed between courts, then the 3650mm between court run-off zone standard becomes irrelevant. Instead, a minimum 3050mm will be required between each court's sideline and the spoon / grated drain or pit edge (whichever is closest). Therefore if an average 600mm spoon drain runs between two courts, then 6700mm minimum will be required. This will add cost to the overall project due to the increase in pavement area, but it will offer superior play & drainage outcomes.

Good Drainage Surrounding the Pavement

The areas surrounding the pavement should also be shaped so that water is directed away from the pavement areas.

Adequate drainage to the pavement surrounds can be achieved in a number of ways:

- The court platform should be higher at the lowest point than the surrounding land, if possible. This will minimise the possibility of ground water ponding and seeping under the courts.
- The platform and the surrounding area should be shaped so that storm water can be directed away from the pavement areas.
- Earthen swales can be cut in around the pavement to capture water and prevent it from emptying onto the pavement areas.

Pavement

Court Construction: Pavement

Good Sub-Surface Drainage Surrounding the Pavement

Moisture variations within the subgrade, which is where the subgrade is saturated and then dries out or vice versa, often leads to base cracking, heaving and lifting, and base collapse.

This can also cause certain areas of an acrylic surface to delaminate, create new cracks and cause existing cracks to enlarge and widen. As a result, this allows more moisture to enter the pavement, sub-base and subgrade which can lead to further pavement damage and rapid deterioration of the court.

Ideally, the subgrade underneath the pavement should remain at a constant moisture level, without dramatic moisture variations. This can be achieved by preventing water ingress under the pavement.

Surface and subsurface drainage systems work hand in hand, one should not be without the other.

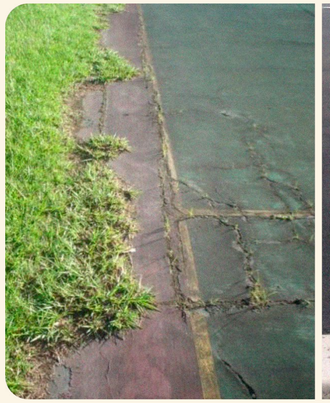
Sub surface drains can be placed around the pavement perimeter by installing slotted agi drains approx. 500-700mm below the pavement level – this will depend upon the depth of the pavement and crushed rock design and will be nominated by the civil engineer. There should be inspection shafts placed periodically around the agi drain to assist with maintenance and performance inspections. Agi drains should be fitted with a geotextile sock and be connected into all adjacent pits to ensure efficient drainage away from the pavement areas.

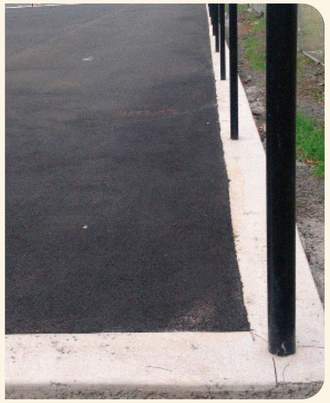
In conclusion, correct drainage systems include the combination of:
Platform raised above the surrounding land
Swale / batter drains around the perimeter of the courts
Good sub surface drainage surrounding the pavement
Sub-soil trenches around the perimeter of the courts with an agi-drain backfilled with a no fines 10mm dia course aggregate wrapped in a geotextile fabric (sock)
Spoon / grated drains along all lower pavement boundaries
Large grated inlet pits to collect and outfall pipes to drain water away from the pavement areas efficiently
A 1% gradient fall either both directions or diagonally across the pavement on a single plane

Tree Root Barriers

To minimise pavement failures, tree root barriers should be installed to all boundaries where existing and/or future plantings may occur within 10-15m+ of the pavement.

Moisture variations caused by the trees drawing moisture from the surrounding ground and tree root invasion, can result in significant damage to a netball court pavement. A narrow trench is usually excavated, and a 1.2m deep tree root barrier (either high density plastic membrane or concrete) installed and backfilled using suitable site excavated soil free of organic matter. Moderate compaction should be carried out to the fill material to avoid water ingress and ‘wetting up’ in the trench. Do not backfill with a granular material.





Concrete Plinths

Concrete plinths should be installed around the perimeter of the courts to help secure the asphalt and minimise the effects of ground movement and consequent pavement damage along the pavement boundary edges.

The concrete plinths also provide strength and support to the pavement and minimise structural cracks from occurring at the edges due to the normal shrink/swell characteristics of the asphalt base. Where fencing is installed along the pavement edge, concrete plinths should be installed on all asphalt and concrete pavement boundaries so that the fence is supported and fits neatly with the court pavement. This will also assist with perimeter maintenance. Concrete plinths are designed to prolong the life of asphalt courts and also help reduce and control the growth of vegetation from creeping onto and through the court pavement.

Court Base

Court Construction: Court Base

Factors to consider when deciding whether to use concrete or asphalt base

There are 4 main factors to consider when deciding on the court base:

- Soil type
- Initial construction cost
- Ongoing repairs required
- Cost of total reconstruction or major rehabilitation at the 40–50 year mark.

It is important to consider the longevity of both pavement types, as poor resistance to the elements and the need for frequent repairs can make any pavement costlier in the long run.

It is very important that you carry out geotechnical testing of the proposed construction site and seek advice, recommendation and design drawings from a civil engineer to detail the type of base required. An asphalt base may not even be an option. Reactive soil types or siting in a flood prone area is likely to require a concrete base if a long term outcome is desirable. Asphalt pavements are likely to fail rapidly in these conditions.

The following lists are provided to ease the confusion surrounding pavement bases. It is important to note that concrete bases can be chosen even if the soil test and site conditions indicate that an asphalt base would suffice but not vice versa.

Concrete Pros & Cons:

- The initial outlay for a concrete pavement is approx. 30-35% more than asphalt. However, the long-term repair costs are minimal in comparison to asphalt.
- The expected lifespan can be 50 years to a lifetime if the subgrade and crushed rock base course layers are constructed well and the concrete depth is adequate and installed well, with adequate and constant fall gradients
- Good court surface and surrounding ground drainage is paramount, and root barriers must be installed if there are trees near the pavement area.
- Concrete pavements are more resistant to high temperatures and will not become soft and/or brittle like an asphalt pavement. However, if not constructed well they can be susceptible to frost heaving.
- Concrete cannot be played on without an acrylic surface due to slipperiness. Concrete bases need to be resurfaced with an acrylic every 7-10 years depending on the degree of use and maintenance. This will be a concrete base's major ongoing costs plus minor repairs, at the time of resurfacing
- A plastic membrane is required under the concrete slab to prevent water ingress through the slab and delamination of the acrylic surface.
- Construction joints and saw cuts are required to minimise random cracking of the concrete and allow for movement. The construction joints (CJ) open and close as the weather/ground conditions conditions change. These CJ's should be placed outside of the principle playing areas (PPA) usually half way between courts or outside the run-off zones.

NOTE: Never design or construct a netball court with a construction joint within the court area

Asphalt Pros & Cons:

- The initial outlay for an asphalt pavement is approx. 30–35% less than concrete. However, the long-term repair cost is greater over time as it is not as durable as a well-built concrete base.
- Usual lifespan is 20-30 years if the subgrade and crushed rock base course and asphalt layers are constructed well and the pavement and surrounding areas are maintained. If it is not constructed well, this can be shortened dramatically to 3-5 years, or even less, leading to costly repairs or total reconstruction.
- Good asphalt pavement support is very important. Concrete plinths and spoon drains installed around the entire perimeter of the pavement to 'hold' the pavement together is important. Court drainage and surrounding ground drainage is paramount, and root barriers must be installed if there are trees near the pavement area.
- Asphalt courts are more adapted to colder climates, because constant exposure to high temperatures tends to make asphalt soft. In such circumstances, cracks and grooves may appear on the court, necessitating increased repairs.
- Asphalt is petroleum based. It is very elastic at the time of installation. Over time, the oils are oxidized and lose their moisture. The colour of the asphalt lightens to grey, and the structure becomes more brittle, making it prone to cracking. Sealing the asphalt with an acrylic can help.
- A good asphalt pavement doesn't need a surface treatment to enable play. However, expect a shorter lifespan if it isn't surfaced, as the asphalt does deteriorate faster without the protection of a surface material.
- If surfacing with an acrylic, then these costs will need to be considered also. Expect the pavement to require resurfacing with acrylic every 7-10 years, depending on degree of use and maintenance (as per a concrete base)..
- Asphalt will most likely develop some form of cracking or pavement damage over its live, even if it is if constructed well. Any cracks or signs of pavement damage should be repaired immediately to prevent further deterioration as water penetrates and undermines the pavement's subgrade and sub-base material. Periodic repairs are a worthwhile ongoing investment for an asphalt pavement.
- The main advantage of asphalt is the low installation cost. If you consider durability and maintenance costs, concrete pavements can be the economical choice in the long run if designed and installed using best industry practice.

Court Base

Court Construction: Court Base

Asphalt Base – also known as: asphaltic concrete (AC), hot mix, tarmac

Standard asphalt is a mix of bitumen, sand & aggregate.

An asphalt base used for netball courts usually has a 7mm aggregate compared to the asphalt used for roads which contains the larger 10mm or 14mm aggregate.

An asphalt road is continually trafficked by heavy vehicles which continually bind the asphalt together. A netball court, however, is not trafficked by vehicles and therefore has a tendency to become brittle and weaken over time.

7mm Type L consolidated asphalt to a depth of approx. 30mm minimum, as a finishing pavement layer provides a firm and tight surface that binds well for light trafficked asphalt sports pavements. It is important that a civil engineer stipulates the type and depth of asphalt pavement required for each project and if a certain standard is required ie: council standard drawing, traffic authority standard.

If the asphalt is to be coated with an acrylic sports surface, it is especially important that the aggregate material in the asphalt mix is free from ferrous materials such as mineral pyrites and marcasite. It should also be free of wood particles, clay or other deleterious materials which may cause staining/discoloration or interfere with the planarity, structural stability or aesthetics of the netball court and/or an acrylic sports playing surface installation and expected lifespan.

See 'Rust Stains/Pyrites' page 20.

Asphalt can be porous or non-porous. Porous asphalt or popcorn asphalt (vernacular) has no sand and can be found in many European countries. However, in Australia the more typical construction methodology uses a non-porous asphalt for netball court construction.

There are two main elements that make up an asphalt base. The first is the structural layer also known as the "sub-base", "granular layer" or "fine crushed rock (FCR) layer" which consists of compacted layer(s) of FCR. The thickness of this structural layer(s), the class of fine crushed rock used, and the number of layers required is best determined by a civil engineer. This will be largely based on a review of the geotechnical report (soil test) findings. The layer(s) should be spread and compacted in maximum 150mm depth layers.

See 'Sub-Base Preparation & Compaction' page 6

Once the FCR has been spread out and compacted in layers (to achieve the right density) and tested, as per the engineer's drawings and specification, a bituminous or polymer material will be sprayed over the granular layer as a "prime coat" also known as "asphalt primer". This will be allowed to cure before the asphalt is installed. The purpose of the prime coat is to bind the compacted material in the granular layer to preserve its integrity, stabilise moisture levels and to provide the essential bond for the asphalt.

The unsatisfactory alternative to the prime coat is known as a "tack coat". This cheaper method is not recommended as it has less FCR binding and sealing properties.

This is then covered with a layer of hot mix asphalt, usually at about 30mm minimum compacted thickness. Depth to be determined by the civil engineer.

A paving machine is used to install the asphalt pavement. The asphalt is laid in strips, usually 2.74m or 3.66m wide depending on the type of paving machine used.

The machine paver uses bitumen with a high melting point of 180°C. In Australia the temperature during the laying and compacting process can vary between 100°C to 160°C.

The finished asphalt is rolled continuously until it achieves a "close and dense" finish. Particular attention to the seams between the asphalt runs is required. These should be flat and as seamless as possible. If not installed and compacted sufficiently, these joins can become weak and open over time.

The asphalt layer must be compacted to industry standards of a minimum of 95% density, or as per the civil engineer's instructions.

The asphalt layer provides a sound and smooth surface for playing as well as a moisture barrier to protect the sub-base (FCR layers) from erosion and water ingress.

A concrete plinth/edge beam and/or concrete spoon drains should be installed around the perimeter of the sub-base and asphalt base layers; these should be set accurately to the height of the finished asphalt surface. In addition to providing a strong and stable edge to the court, the concrete edge allows the asphalt to be compacted right up to the edge without the edge collapsing or flaking. The installation of concrete spoon drains will also allow efficient catchment and movement of stormwater away from the pavement area. Insufficient drainage infrastructure or pavement support can result in premature pavement failures. All concrete edges must be treated with a tack coat to ensure the asphalt bonds to the concrete edges.

See 'Concrete Plinths' on page 8 and 'Factors to consider when deciding whether to use concrete or asphalt base' on page 9 in these guidelines for more information.

The operator should take great care to ensure the asphalt joins are essentially negligible whilst the machine controls the plane tolerance of the finished surface.

CONTINUED NEXT PAGE

Court Base

Court Construction: Court Base

Asphalt Base – also known as: asphaltic concrete (AC), hot mix, tarmac Continued


Prime coat on the FCR


Surveyed and marked

Asphalt paving machine


Asphalt laid in runs

Concrete Base – also known as: reinforced concrete (RC)

Standard concrete is a mix of aggregate, sand, cement and water.

Concrete is the more substantial base when compared to asphalt, particularly when the geotechnical investigations indicate that the existing sub grade condition is expansive, has a reactive soil type, is made up of uncontrolled fill or is in a flood prone area. The concrete base can be designed to suit once the soil report has identified the severity of the sub grade issues. A standard concrete slab may not perform well in severe conditions.

The concrete required for a netball court is likely to have a recommended strength of 25MPa, 32mpa or 35mpa (depending on the civil engineer's advice) with a slump specification of 80%. The concrete is made to various strengths according to the particulars of the job, and this should be specified by the civil engineer. The strength is measured in 'MPa' (Mega Pascals) and is delivered to site ready for installation.

Concrete slabs have high compression strength and withstand heavy loads without crumbling. Unfortunately, they have a low tensile strength, and therefore, will crack easily. The tensile strength in concrete is raised by the use of reinforcing mesh.

The most common concrete base is between 100-150mm depth reinforced concrete base (must be advised by a civil engineer). When the subgrade is of poor quality then a post tensioned concrete base or a waffle pod design may be considered.

Post tensioned or waffle pods are designed to float on top of the subgrade without causing structural cracks. Although significantly dearer, these can outlast any conventional concrete slabs making them an attractive investment.

A standard concrete base will usually consist of a sub-base with compacted layer(s) of FCR. The thickness of this structural layer(s), the class of fine crushed rock used and the number of layers required is best determined by a Civil Engineer. This will be largely based on a review of the geotechnical report (soil test) findings (the FCR layer(s) should be spread and compacted in maximum 150mm depth layers).'

See 'Sub-Base Preparation & Compaction' page 6.

The FCR is then covered with a moisture barrier consisting of a layer of a thick .38mm thick vapour membrane overlapped and taped. This plastic will stop water being drawn up through the concrete from the subgrade and sub-base layers and prevent delamination of the acrylic sports surface. There is a reinforcing mesh (reo) installed in large sheets across the entire pavement area. The reo is installed on bar chairs set at a height to allow an approx. 30-40mm cover of concrete over the mesh. The strength of the mesh required is determined by the engineer. Normally an SL82 mesh is used for a standard court but this can increase to an SL92, SL91 or even a SL102 for slabs on problematic sites with reactive soil types. SL stands for "Size & Length" this first number relates to the thickness of the steel and the last number relates to the size of the squares. For example, SL92 mesh has 9mm thick steel and 200mm squares/centres. The mesh must be overlapped by two whole squares and well tied down to ensure the specified side, top and bottom cover.

The concrete should be installed with construction joints and numerous saw cuts to minimise and/or control cracking.

CONTINUED NEXT PAGE

Court Base

Court Construction: Court Base

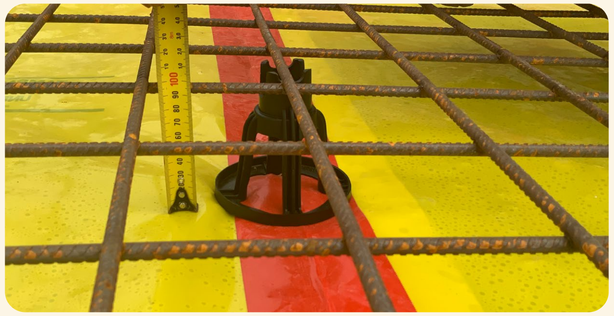
Concrete Base – also known as: reinforced concrete (RC) Continued

In saying this, construction joints positioned through the PPA of a netball court should be avoided. The designer/contractor must locate the construction joints outside the court's playing area, either half between the courts or totally outside of the run-off areas.

NOTE: Most concrete slabs will suffer from shrinkage cracks. These are normally referred to as 'superficial surface cracks' or 'hairline cracks' and should not cause any structural issues. The biggest issue with these types of cracks is usually the aesthetics. Shrinkage cracks should be minimal or negligible when the slab is designed adequately for each individual site. Slowing down the curing process (particularly in warmer weather) by keeping the slab continually wet during the first week after being installed will dramatically decrease shrinkage cracking. The reinforcement mesh within the slab should prevent the pavement from shifting vertically. Any cracks that appear should remain flat and not cause a trip hazard. Like the asphalt base option, all cracks should be sealed and/or repaired quickly to avoid further deterioration or issues, and/or treated prior to installing the acrylic surface.

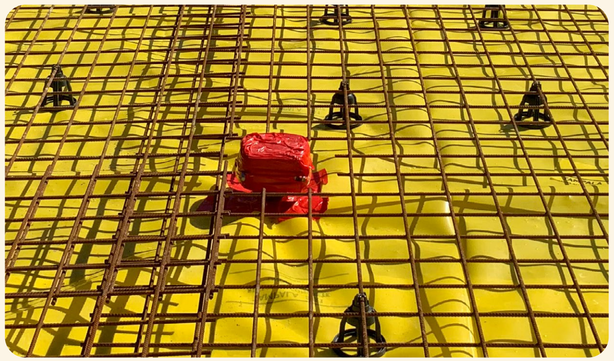
See 'Surface and Base Cracks' page 17.

All sub-base and prep works must be completed according to the engineer's advice and detailed design and approved by the project manager before the formwork (boxing), plastic membrane and reinforcing mesh is set up. The boxing is usually set to the finished slab height. The timber formwork should be straight without dips or warping.



The steel mesh sheets are normally overlapped by one squares and securely tied with wire. The mesh is to be fully suspended by being evenly seated on bar chairs at the nominal design height.

All plastic vapour membrane joins should be overlapped and taped. All membrane holes, joins and penetrations must be taped to avoid moisture being drawn up through the concrete slab, resulting in bubbling or delaminating of the acrylic surface



The concrete is normally designed and ordered as a slump of 80% and is usually delivered in batches of 6m3. A crew of 6–10 people is considered necessary depending on the size of the court/s to adequately finish the concrete and achieve the standard tolerance required.

The crew is broken into groups where some are spreading the concrete, some setting the levels with the aid of laser levels and others screeding.

The finished surface tolerance for concrete is +/- 3mm under a 3 meter straight edge when measured in any direction on the court.

Finally, workers will be assigned to "bull floats" and "helicopters" to achieve the necessary surface tolerances.

Court Base

Court Construction: Court Base

Saw Cuts

Saw cuts should be installed to a concrete slab to minimise random cracking and encourage cracks along a set alignment which appear more aesthetically pleasing. Please note that random hairline/shrinkage cracks can still occur and will reflect through a basic acrylic sports surface.

See 'Court Surface' on page 32 of the current NA Technical Guidelines

See 'Cushioned Acrylic Installation' on page 24 in these guidelines.

Saw cuts are usually 25mm deep and are best installed while the concrete is still 'soft' – usually 7am the day after the concrete was poured (depending on temperature and weather conditions). Saw cutting mature concrete slabs is generally a waste of time and money.

The saw blade must be sharp and not tear or chip the concrete at either side of the cut. The saw cuts are usually placed in line with every adjacent fence post (approx. 3m spacings if there is no fence). The contractor must take care to continue the saw cut or trowel cut to the fence post and/or light towers. A relief joint or trowel cut should also extend from the fence or light tower posts to the outer edge of any spoon drains or plinths.

Shrinkage Cracks

Shrinkage or commonly known as hairline cracks, can appear during the first days or weeks of the curing process. During this time, shrinkage occurs and the concrete strength increases. Shrinkage cracks can appear and are quite common, however, these should be minimal. Severe shrinkage cracking can appear if the concrete is allowed to cure quickly in hot temperatures. Minimising or eliminating shrinkage cracks by keeping the concrete consistently wet and covered with heshian will slow down the curing process and must be done when temperatures are over 19 degrees.

It is important to note that the strength and structure of the finished slab will not be affected by these cracks. Shrinkage cracks should sit flat and not cause a trip hazard. The main negative of shrinkage cracks is the aesthetics, as they will be noticeable through a non-cushioned (basic) acrylic surface.

Expansion Joints

Expansion or construction joint/s (CJ) should be installed depending on the size of the court or playing area and soil type. However, these must not be located in the playing area of the court. Instead, CJ's must be located half way between courts or outside of the run-off area completely.

The purpose of the joint is to divide the courts and/or slabs and allow each section to expand and contract without generating potentially damaging forces within the slab itself or to the surrounding structures.

Expansion/construction joints are usually a complete 'gap' between adjacent slabs, i.e.: there is a definite break between the concrete and reinforcing steel sections. Where adjacent slabs are 'tied' together by dowel bars, these dowels are sleeved in one of the slabs to allow expansion and movement to take place without generating stress within the concrete slabs.

There are a variety of expansion/construction joints available, and they can vary in cost. The civil engineer will determine which joint is suitable for each individual project/site.

Proprietary Metal Formers or Toby Joints

These are popular and are a quick method as the slab can be laid in one pour.

Laitance

Latency is caused by excessive water in the concrete or by overworking the concrete with a helicopter that can cause slurry to rise to the surface. Latency must be removed from the surface before applying any acrylic coatings by using a mix of hydrochloric or phosphoric acid diluted with water at a 4:1 ratio, scrubbed with a brush and pressure wash cleaned.

Effloresecence

This is the calcium salts that have risen to the surface by water after the concrete has set. An excessive amount of calcium salts rising from the concrete usually indicates poor quality concrete or a high level of trapped subsurface moisture escaping through the surface.

The salts are deposited on either side of cracks in the concrete slab leaving a tell-tale sign of a tram line appearance or a white streak following the fall of the court.

This is a key indicator of no or inadequate sub-surface drainage.

Court Base

Court Construction: Court Base

Accelerators

Accelerators are used in concrete to help the concrete cure at a quicker rate. They must NOT be used in concrete that is to be surfaced with an acrylic sports surface as the acrylic will not adhere to the concrete.

There are specially developed sealing products that are applied to the concrete slab after it is installed. These are designed to seal the concrete to allow surfacing with an acrylic sports surface earlier than the recommended 28 day curing period. This can enable a reduced project timeframe and where timeframes are tight it can mean the difference between surfacing the pavement prior to the cold and wet weather season or delaying the project many months until more favourable weather conditions return where the acrylic can be successfully installed.

NOTE: All concrete sealing products should be researched well and the advantages and disadvantages considered before installation. Ensure the same acrylic surface related warranties apply to the concrete slab and surfacing components of the project with and without the use of the sealing product.

Common Base Issues

There are many netball facilities across Australia where the courts have failed. This can be due to a number of reasons, such as:
Inadequate site investigations and engineering advice
Inadequate detailed design and specification
Insufficient budget for the works required
Poor selection of the principal contractor and/or the sub-contractors
Poor workmanship and attention to detail during the construction period
Inadequate contractor supervision/project management
Deterioration failures including flood, tree root damage and/or poor drainage issues
Poor selection of construction materials.

Advice should always be sought from the experts in the relevant industry.

NOTE: There are no shortcuts in building a quality sports pavement. Any short cuts taken during the planning, design and construction periods will result in more expensive pavement repairs or even total replacement.

It is much better to follow the recommended process outlined in these guidelines than dealing with disgruntled stakeholders and possible financial implications as a result of a failed netball court pavement.

NOTE: It is important to note that most land allocated for recreational purposes is leftover land not suitable for the construction of buildings or houses.

Construction Failures

There are many netball facilities across Australia where the courts have failed. This can be due to a number of reasons, such as:
Insufficient compaction of the subgrade
Failure to thoroughly remove all vegetation and detritus in the sub grade. This is known as “soft spots”. This will cause subsidence creating voids under the granular layer and in time this will collapse leaving a depression and/or cracking on the surface
Insufficient compaction of the granular (fine crushed rock) layer
Incorrect specification of the granular type and depth required in the sub-base layers
Incorrect specification of the concrete base type, depth, and strength
Poor installation of the concrete or asphalt base
Poor application of, or damage to the asphalt primer coat
Insufficient compaction of the asphalt layer
Insufficient time allowed for the asphalt to cool below the threshold before installation. This will cause delaminating and similar problems
Insufficient rolling and treatment of the asphalt cold joints (the join between runs with the paving machine). This will cause cracking over time and allow moisture to penetrate the sub grade.

Court Base

Court Construction: Court Base

Deterioration Failures

Deterioration failures are failures that are caused over time such as:

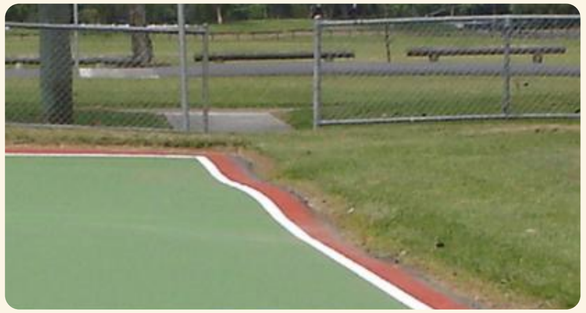
- Inadequate compaction of the subgrade, sub-base & base layers
- Excessive moisture changes under and around the pavement
- Uncoated asphalt will degenerate much quicker than coated asphalt by the loss of oils and binders from the constant exposure to UV
- Tree roots and other vegetation will cause severe cracking resulting in an uneven surface and allowing the penetration of moisture through the damaged areas
- Water (flood) inundation
- Lack of appropriate surface and surrounding court drainage
- Lack of a regular pavement, surface & drainage maintenance program
- Deleterious or mineral particles in the court's base material, such as clay or ferrous particles (also known as pyrites or iron particles) in asphalt. This can be especially damaging when asphalt courts are surfaced with an acrylic sports surface – rust stains, blisters and pitting can occur depending on the severity.

See Section 'Rust Stains/Pyrites' page 20.

NOTE: Construction and deterioration failures are very much preventable. By applying a standard measure of quality from the planning stage through to the construction and maintenance stages of a netball court project, many failures can be avoided.

Subsidence

Subsidence can be caused by poor compaction of the subgrade and/or sub-base materials. It can also be caused when existing soft spots or deleterious/organic materials such as tree stumps, roots, grasses, timber and rubbish were not removed during the construction period. All of these materials will eventually decompose, settle and shrink, causing the courts pavement above these decomposing items to also settle over time. This can result in base movement and surface collapse in these weak areas.



Court Base

Court Construction: Court Base

Low Spots (“Bird Baths”)

This is another form of subsidence however, low spots can also be created during the construction of a new court. The industry standards state that the planarity of a sports surface is to be no more than +/-3mm under a 3m straight edge when measured in any direction. The court and run-off surface must be free draining and dry out evenly without channelling or ponding. Achieving this limited cross fall whilst also achieving the recommended tolerances requires an experienced court builder with an experienced crew.

When the asphalt or concrete is initially laid, the required finished levels are incorporated into the base preparation. If at any time during this construction, the ground is not properly compacted or evenly graded, the result will be low ponding areas (puddles). The severity of these puddles will depend upon the degree by which the grade or compaction was not properly designed or constructed. The repair options and long-term results will also depend on the design and construction mistakes and the likelihood of further base movement.

See ‘Surface & Court Repairs’ page 28

Untreated bird baths/ponding areas are clearly visible on a netball court by the mould (dark patches) or silt areas left behind when the water finally evaporates. Leaving the courts in this condition and untreated will result in the mould eventually working its way through the surface causing the acrylics to de-laminate and break away and silt deposits can be very slippery underfoot. Mould & silt are a potential slip hazard, especially in wet conditions and should be treated & removed immediately.






Court Base

Court Construction: Court Base

Surface and Base Cracks

There are generally two types of cracks: structural and superficial. Structural cracks carry completely through the asphalt or concrete base and perhaps through the sub-base layers as well. Superficial cracks are commonly referred to as surface or hairline cracks. Superficial cracks do not penetrate the entire layer of asphalt or concrete, only the extreme exposed skin of the acrylic or pavement. Structural cracks are permanent whilst superficial cracks can be repaired.

Structural Cracks

As stated above, structural cracks penetrate the entire asphalt or concrete layer of the netball court. They also penetrate through the entire base and sub-base. Structural cracks may vary in width, and they may vary in length from a few inches to many metres. Some possible causes and solutions are offered for consideration below:

SETTLING OR SHIFTING SUBGRADE

The most common cause is a settling or shifting subgrade (the ground on which the court is built) and/or sub-base (crushed rock layer). For a netball court to remain free of structural cracking the material on which the court is built must be compacted well, as per the civil engineer's advice, design drawings and specifications. If the compaction varies greatly across the court area, different areas of the court will respond differently to the same external conditions (such as a freezing event, saturating rain, weight of equipment and heat). These inconsistencies of compaction can result in the subgrade and/or sub-base shifting and adjusting at different rates and therefore resulting in separation of the pavement in isolated areas. This can cause stress and torquing of the court pavement, ultimately causing cracks.

SOLUTION

Reconstruct: The only permanent solution here is to remove the asphalt or concrete, re-compact or stabilise the subgrade, lay a new sub-base and then re-lay new asphalt or concrete. If however, the court has finished settling, isolated crack repairs may offer a possible solution. This approach will only prove effective if the crack has stopped opening and the ground has finished shifting. If the subgrade is still moving, the repair will split just as the original crack did. Unfortunately, there is no test to see if the ground has finished shifting, so there can be no assurance that crack repairs will work.

Geotechnical boring and cone penetration by an engineering firm is one way to identify possible causes of structural cracking. The hiring of an engineering firm to do this boring before any attempt to repair cracks is highly recommended. There are several crack repair systems and surface overlay systems in the market; however, there can be no guarantee that these will work. The money spent on doing the geotechnical testing may offer the best results in regard to understanding and treating courts that are affected by structural cracks.

COLLAPSE

Another cause of structural cracks is when organic materials are left in the sub-grade material. Organic materials will eventually decompose and rot, resulting in soft or collapsed areas. As the materials (eg: stumps, roots, timber, grass or rubbish) degrade, they shrink, and air voids appear.

This shrinking causes movement of the materials above the organic mass which results in pavement settling and eventually cracking. These cracks are generally distinguished by a sunken low area (ponding) adjacent to the cracks.

SOLUTION

The solution here is to remove the area that is sinking, re-fill and re-compact the excavated area and then add new sub-base material, a new base, and new pavement. The problem with this solution is that there is no clear method of determining cost prior to beginning excavation. If the area to be removed turns out to be much larger than expressed by the surface depression, then the cost could be equivalent to building a whole new court. It may be more beneficial to patch the cracks and fill the sunken area upon the surface, unless the problem area is severe. Filling depressions and cracks from the surface may offer only short-term results, but it may be enough time to further consider other more permanent solutions, while sourcing a suitable budget.

POOR COMPACTION

Improper compaction of the sub-grade and/or sub-base layers or poor application of the asphalt or concrete itself can create cracks. Again, the most important and critical area of a netball court is the supporting structural layers under the asphalt or concrete. If this is not of adequate thickness, density, compaction and consistency, then everything laid upon it will be inferior. If the material below the asphalt or concrete base is not solid, then no amount of money or material above the surface will solve the problem. You can't have movement below asphalt or concrete and not expect to have cracking in the asphalt or concrete.

This applies to the acrylic materials also. If the asphalt or concrete is not solid and firm, then the acrylic material laid upon it, is likely to also crack.

CONTINUED NEXT PAGE

Court Base

Court Construction: Court Base

Surface & Base Cracks Continued

SOLUTION

Reconstruct the affected area of the court. The key is to make sure that construction is monitored and that proof rolling and independent compaction testing is conducted on every pavement layer, including the subgrade, each sub-base (crushed rock) layer and pavement (asphalt or concrete) layer. The civil engineer will have specified the compaction rate required for each layer and this should be strictly adhered to, tested and approved by a project manager before commencing work on the next layer throughout the court construction process.

POOR DRAINAGE & TREE ROOTS

The lack of adequate surface and/or perimeter drainage can allow water to infiltrate the subgrade and sub-base material of the pavement. Trees that are in close proximity to the court pavement can result in tree root invasion under and through the pavement. The trees also draw moisture from the ground (subgrade). In both cases, poor drainage and tree root issues cause the subgrade to expand and contract as it dries out, and conversely, gets saturated. These moisture variations create movement in the subgrade and pavement layers and can result in significant pavement cracking.

SOLUTION

Reconstruct the affected area of the court. The key is to make sure the design and court construction includes adequate surface and perimeter drainage design and protection from tree roots.

Drainage: Agi drains installed to the outside perimeter of the entire pavement area to capture and direct subsurface water away from the pavement's subgrade is very important. This should include inspection shafts so that their efficient operation is monitored and they should also connect into surrounding drainage pits. Ensure adequate fall (1:100) across the pavement is achieved. This should fall to a formed drainage system, with wide concrete spoon drains to all low boundaries of the pavement and at the base of any raised or retained surrounding areas. These spoon drains should empty into large drainage pits to capture surface water and direct it away from the pavement area. It is also beneficial if the surrounding ground falls away from the pavement. Selecting a site that offers good natural drainage and is not flood prone is recommended.

Tree Roots: Tree root barriers should be installed to all boundaries where existing and future planting may occur within 10-15m of the pavement to ensure tree root damage is not an issue now or in the future. Avoid planting near pavements as moisture variations and tree root invasion in the subgrade both around and under the pavement can cause significant damage to the pavement. If tree removal is required, an arborist report and/or a tree removal permit may be required. It is best to check with your local council or relevant government organisation or landowner. Selecting a site that is clear of large trees and/or problematic vegetation is recommended.

Summary of Structural Cracks

Structural cracks can be prevented by following best practice construction standards, but they cannot be repaired permanently unless the area affected is removed and then replaced. This process is usually very expensive.

It is vitally important that cracks do not create a trip hazard for the intended users. If the crack is heaving or sunken to the point where a player may trip or slide, resulting in a loss of balance, then the area must be repaired. Any deviation that is +/-2mm is considered a trip hazard. If, however, the crack is level and flat with no discernible footing problems then the crack (with the knowledge that it will eventually get worse) is nothing more than an eye sore. It is advisable to repair the crack in the short term, to minimise further deterioration of the pavement caused by water ingress.

The only long-term repair of a structural crack is to remove the area affected, compact the subgrade and install new sub-base and base material. Any other method, such as patching or overlaying, will not keep the ground from moving and therefore not prevent the re-occurrence of the cracking. Every situation is different, as every crack is different, but generally structural cracks come back. The question is not if, but when.

CONTINUED NEXT PAGE

Court Base

Court Construction: Court Base

Surface & Base Cracks Continued

Superficial Cracks in Asphalt

Superficial cracks penetrate only the outer skin layer of the asphalt and/or the acrylic surface.

These cracks are generally caused by the drying out of the base (asphalt) or the acrylic materials. In some instances, they can be caused by spilled soft drinks, petroleum products, insecticides, tree droppings, etc. These cracks are always very fine and random in their path.

Superficial cracks are easily repaired. Although they do not pose immediate concern, it is very important to note that if left unattended for a prolonged period of time (over six months), especially in the winter months, these cracks can become structural cracks quite quickly as the open cracks allow water to penetrate the sub-base and subgrade materials.

In the winter when rain, frost or snow occurs, water can settle into any small cracks on the surface of the court. If this water then freezes, the expansion of the freezing water can also cause the crack to widen. A succession of freezes and thaws will turn a relatively small superficial crack into a structural crack in a matter of months. An annual or even bi-annual inspection should be carried out to identify cracks and repair them.

SOLUTION

Generally superficial cracks require patching with a recommended sports surface patch material/filler product. Where a court is surfaced with acrylic, the most important prevention of these cracks is to have the court surfaced at least every 7 years to prevent the drying out process that takes place after months of being exposed to the sun's ultraviolet rays. The resurfacing of the court/s will minimise the superficial cracks, and it may also help to prevent a superficial crack turning into a much costlier structural crack.

As with any product, preventative maintenance is always the cheapest form of repair. Weekly checks of the court surface for small slits or cracks could save future dollars. Remove any spilled drinks or petrol as soon as it is evident. Use a squeegee or broom to remove standing water after rain, as standing water can erode the surface and cause cracks. Above all, address problems as soon as possible.

Surface cracks are often treated by maintenance departments with LBE "liquid bitumen emulsion" as an easy form of repairing. This practice is not recommended due to the following:

Liquid bitumen emulsion (LBE) never sets, which makes it sticky under foot on a hot day. This is often a complaint issue with netball players.

Liquid bitumen emulsion is extremely difficult to remove and will eventually bleed through acrylic if surfacing is required in the future.

See 'Crack Repairs' page 30.

Cracked court filled with liquid bitumen emulsion

LBE leeching through splits in the acrylic surface

Court Base

Court Construction: Court Base

Bare Asphalt

Bare asphalt degenerates over time and constant exposure to the natural elements will eventually break down the surface exposing the aggregate. This is also known as "weathered asphalt" or "open and bony asphalt". The best way to preserve the quality of asphalt and prolong its life span is to coat the entire surface with an acrylic coating.

In almost all occasions, with open and bony surfaces, stress cracks will appear at various points on the asphalt. These cracks are often along the joins and can vary from hairline size to larger structural cracks. The asphalt joins are normally 2.74m or 3.66m wide (standard width of a paving machine) and usually run lengthways on a court (or the longest run).

The asphalt is laid in strips and when they lay the adjoining run, the temperature often differs between the freshly laid asphalt and the previously laid asphalt. This is called a "cold joint" and this may split or crack along the join over time. This is also known as a construction failure.

Random cracking throughout the courts can be due to a variety of reasons such as sub-base movement, moisture and/or poor compaction. When you have random 'bird baths' in addition to cracks, this indicates poor base preparation and subsequent pavement collapse. 'Bird baths' are easily located on a court by the collection of dirt and/or silt left behind once all the moisture has evaporated.

Cracked court filled with Liquid Bitumen Emulsion

LBE leeching through splits in the acrylic surface

Rust Stains/Pyrites

A secondary mineral such as ferrous particles (pyrites) can be present in the asphalt mix of an asphalt base netball court. Asphalt containing these ferrous particles should be avoided especially when the court is to be surfaced with an acrylic sports surface.

This is naturally occurring in aggregates from certain geographical locations and can cause unsightly brown stains, blisters and pitting to appear on new acrylic surfaces.

This is seen too often in many areas of Australia. Caused by pyrite (iron particle) in aggregates used in the manufacture of the asphalt mix. As rain falls on the courts the moisture permeates through the acrylic colour surface system which moistens the aggregate in the asphalt layer. If pyrites are present, the oxidation (rust) process is initiated and with time the particles migrate to the court surface and become evident by a rust colour observed above these aggregate particles. These rust spots and streaks can create merely an aesthetic issue, or they can be capable of causing localised surface & pavement failures when they swell and blister as it oxidises and subsequently pops through the surface. It can take approx. six (6) to twelve (12) months after the courts are completed for the rust stains to appear. Ultimately, rust streaks form in the direction of the slope of the netball court. They can continue to increase in number over the following twelve (12) months or more.

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Court Base

Court Construction: Court Base

Rust Stains/Pyrites Continued

Treatment

Some courts can be severely affected, and unfortunately, once pyrites are in the asphalt base, not much can be done to prevent their effect on an acrylic surface.

Raised and/or blistered spots and pitting of differing severity can expose the asphalt to water ingress and increased pavement deterioration if left untreated. The remedial work required will depend upon the severity and quantity of the rust spots and pavement damage. Blisters may be ground down, patched or sealed and then resurfaced or in minor cases dug out and patched/sealed and then resurfaced. In saying this, it is very important to note that this is not guaranteed to stop the problem from recurring.

Some acrylic surface manufacturers have special sealers such as an epoxy moisture seal available which may minimise the recurrence of the rust stains. However, this adds cost and is not guaranteed to stop the reappearance of the stains. When resurfacing affected areas, it is a good idea to pick acrylic colours that closely match and don't contrast the rust colour (i.e.: brown, maroon, and red) to minimise the appearance of any new stains.

Prevention

Due to the lack of a known guaranteed permanent solution for courts affected by the appearance of rust, blisters and pitting on an acrylic surfaced asphalt pavement that already contains pyrites, it is clear that prevention is the best mitigation strategy.

Perhaps highlighting the potential issue to the proposed contractor/asphalt company may in turn result in assurances from the proposed asphalt plant or at least promote a discussion regarding the type and source of the asphalt proposed. It may be of great benefit to ensure the project brief, request for quote or project specification clearly articulates the need for a pyrite-free asphalt to the contractor. Something to the effect of "The aggregates used in the mix shall be free from mineral pyrites, marcasite, wood particles, clay or other deleterious materials which may cause staining/discoloration or interfere with the planarity, structural stability or aesthetics of an acrylic sports playing surface."

Properly informed contractors/asphalt producers who, through the course of time, have been shown to supply aggregate in their asphalt that fails to meet this specification should be held accountable and avoided for future netball court construction projects where an acrylic surface is required.

Some asphalt producers may not be attuned to such issues because they provide asphalt pavement primarily for roadways and car parks where the presence of pyrites is not as obvious. in contrast, if the asphalt contains pyrites and is used in an asphalt base surfaced with an acrylic sports surface, it will be noticed by many due to the acrylic's coloured surface.

Given that pyrites occur in natural geologic deposits in the earth. Pyrites are most commonly found in crushed stones and are not discernible in an aggregate pile by observation. Although there are tests for determining the presence of pyrites in aggregates, the difficulty is finding a representative sample of the crushed aggregate that contains pyrite. The ferrous bearing particle could be one-in-one thousand or more particles – making it extremely difficult to detect by random testing of aggregate samples. Fortunately, ferrous bearing aggregate is well-known by geographical sources and each asphalt producer should be aware of the presence of aggregate contaminants based upon each source as well as documented by local historical evidence.

Summary of Tips:

- Avoid the use of recycled asphalt.
- Avoid any asphalt source that is known to contain pyrites or other ferrous bearing aggregate.
- Research the type and source of the asphalt and aggregate proposed for your project.
- Talk to an experienced court builder, nearby acrylic surfaced netball facility owners & local councils.
- If in doubt use dark acrylic colours or colours similar to the colour of rust when surfacing your courts.
- Install a stain block sealer over asphalt prior to installing the acrylic top coats to minimise potential pyrite staining issues.

Surface/Base

Court Construction: Court Base

Court Base Conclusion

It is essential to have a good understanding of a netball court pavement's design & construction elements. It is very important to adopt industry's best design and construction principles to not only avoid the above common failures but to successfully address them if they do occur. Soil tests, sufficient excavation depth, preparation and compaction of the subgrade and sub-base, root barrier and drainage work are very important components of a netball court construction. Unfortunately, these important components are ignored too often, downgraded, or simply left out due to insufficient budgets. Cutting costs during the construction and remedial repair stages are likely to add many more dollars to the pavement's lifecycle costs and/or reduce the pavement's predicted lifespan.

Acrylic Surface Application

Application on Asphalt – Non-Cushioned Acrylic

A new asphalt surface should be left to cure for at least 2 weeks, and preferably four weeks before applying an acrylic surface. UV light from the sun as well as rain or other water will assist in the curing period. If surfacing is attempted while the asphalt is still volatile, splitting may occur through the acrylic coatings.

Before commencing surfacing, the asphalt should be water-blasted clean and flooded or inspected shortly after rain to identify any ponding areas. Allow the court to drain for a period of half an hour at a temperature of around 21°C or for a shorter period if the weather is hotter. Any low areas or 'bird baths' holding water greater in depth than 2-3mm [this can be measured using a 20-cent coin] should be clearly marked to be patched out with filling compounds prior to surfacing.

Additionally, carefully check the asphalt for small blisters while the court is wet. Blisters could indicate some foreign materials are present in the asphalt. Small blisters containing these materials can be remedied by water blasting. Larger blisters or bumps may have to be dug out and repaired with fillers. Asphalt containing ferrous particles (iron) such as pyrites can cause damage to an asphalt base netball court surfaced with an acrylic sports surface. It is best to avoid asphalt mixes that contain these particles.

See 'Rust Stains/Pyrites' page 20.

Carefully check the area where the asphalt run joins the next asphalt pass. These areas are 'bony', and the asphalt is less dense. Ideally these should be filled and re-compacted during the asphalt installation. However, if this does not occur, then these areas should be compacted by hand, and then filled to the correct profile prior to surfacing. Always use fillers as recommended by the acrylic manufacturer.

If ingrained mud is present, it will be necessary to water blast these areas clean. All patching and filling work should be carried out utilising the manufacturer's recommended products and specifications. Using alternative products may void the guarantees provided by the manufacturer/applicator.

On completion of patching and filling, all repair work must be sanded down or ground to produce a smooth even surface, with relatively uniform texture. The surface should then be thoroughly cleaned using a heavy-duty blower to present a spotlessly clean area ready for the acrylic coatings.

Filled and patched areas should be inspected, and a preliminary coating of the base coat applied to these areas, if required, to obtain the desired texture.

The base coat usually consists of an acrylic binder and a heavier grading of silica sand, so that small voids and variations of texture in the asphalt are masked. This coat is applied to the entire court area [fence to fence].

When the base coat is thoroughly dry, inspect for ridges and 'up-jumps' [squeegee marks], and scrape or grind smooth before proceeding with the topcoats.

Normally one or two base coats and approx. two topcoats are applied to a new asphalt surface, depending on the quality of the asphalt. No coating work should be contemplated if rain is imminent.

Additionally, the air temperature should be a minimum of 12° and rising. Coating will become difficult once the temperature passes 30°. Most experienced acrylic surface applicators will use an infra-red thermometer to measure surface temperature and will only apply material in the surface temperature range of 12° minimum to 35° maximum surface temperature.

All acrylic coatings are applied with a rubber squeegee. Sometimes a fine hair broom immediately follows the squeegee pass. If the surface is level, a well trained and experienced squeegee operator should not require a following broom pass. However, on uneven surfaces such as old asphalt or concrete, a squeegee finish can result in 'bald' patches on high spots and following the squeegee with a broom can eliminate this. A broomed finish is often better for surfaces such as netball where extra grip is required.

There are differing theories regarding the application of acrylics. Some manufacturers and contractors recommend that the topcoats be applied in an alternate direction to the base coat. Others say all coats should be applied in the same direction. Most experienced contractors tend to squeegee across the court, particularly on warmer days, as the shorter pass enables achievement of a more evenly textured surface.

On hot days the materials will tend to 'chaff up' and become unworkable. This tends to support the theory that the coatings be applied across the court for the playing area, and to utilise the shortest distance possible when applying the surrounds. In any event, the coatings should be applied evenly and to a uniform thickness over the entire court area. This will require an experienced applicator, and care should be taken in choosing the contractor.

Surface

Acrylic Surface Application

Application on Concrete

A new concrete slab must be allowed to cure for a minimum of four weeks (28 days minimum) before any surfacing is contemplated. The longer it is allowed to cure, the better.

It is imperative that the concrete itself is spotlessly clean, and no laitance or concrete salts are present on the surface. A simple test is to rub the palm of the hand on the concrete. If a whitish residue is apparent on the palm, then surfacing should be delayed until the migration of concrete salts stops.

Generally, a concrete slab is acid etched, that is treated with hydrochloric acid, using four parts water/one part acid solution, and then water blasted clean prior to any surface application. The surface should be thoroughly dry and clear of all concrete salts. All saw cut residues must be removed during the acid etch and water blasting treatment.

As with coating asphalt-based courts, all depressions holding water should be patched to correct the profile, utilising materials and methodologies recommended by the manufacturer, and any high spots removed by grinding with a concrete planer. Expansion/construction joints can be filled with an elastomeric polyurethane joint-filler. However, this is not essential. To ensure a bond with the surfacing materials, some fine sand should be rubbed into the joint-filler surface prior to the curing process. Do not use acrylic caulking materials for expansion joints.

When patching is completed, a prime coat as recommended by the manufacturer should be applied to the entire court.

If a two-part epoxy primer is used, it is very important that the manufacturer's specifications are closely adhered to. The first acrylic coating should be applied while the epoxy primer is still 'tacky' to touch. This will ensure a strong bond with the concrete base while still allowing a degree of vapour transmission from the slab.

Once the initial coating of acrylic has been applied, it is best to leave the surface overnight. The remaining two topcoats can then be applied on the following day, given good drying conditions.

Line marking can then be completed in a similar fashion as described previously in Section 9.5 'Line Marking' of these guidelines.

Two Colour Application

If the court is to be in two colours, with a contrasting colour for the surrounds, the four corners of the playing area should be established and marked with a washable marker. Do not use timber crayon. A chalk line can then be applied to the marked-out area.

Two topcoats are then applied to the playing area using a squeegee or a broom finish. Each coat should be thoroughly dry before proceeding with the next coat. Drying time will vary according to the ambient temperature and humidity.

Once the playing area is completed it should be accurately taped off using a taping machine, then one to three coats applied to the surrounds in contrasting colours as chosen by the owner. The edges of the court should be finished off neatly with the bottom sections of the fencing posts taped off to prevent the acrylic coating marking the posts. A strip of masking tape around the edge of the court will provide a neat, straight finish to the lines.

It will take some time for the court surface to fully cure. This can vary depending on the weather conditions, so it is best to avoid playing on the court until the acrylic installer has given the all clear. Using the court before the surface has fully cured may result in colour and line distortion and can even result in premature surface wear.

Some important points to be aware of:

- Newly applied colour coatings may have slight variations in the surface. The squeegee blade moving across the court from side to side (or end to end) will cause the textured surface to reflect the sun and light so that it can appear 'streaky'. This is a somewhat similar effect to that made by large mowers on cricket or football ovals. A finished surface should be inspected for uniform colour and texture at a distance of 8 to 10 metres, with the sun directly above or behind the viewer.
- Some sports shoes will leave scuff marks on a newly surfaced court. This is caused by the sand content in the acrylic materials. It will decrease as the sand becomes polished with play and should not be of any concern. Black soled shoes (even those claimed to be 'non-marking'), however, leave very unsightly marks which are almost impossible to remove, and should be banned from use on any acrylic court.
- After the first few rainy spells, soap bubbles may appear on the surface of a newly coated court. Surfactants (like detergent) are added to the coating materials to assist with colour dispersion. After several periods of rain, the surfactants will be washed out, and this will no longer occur. On indoor courts the surfactant is not washed out, so if washed or wet, the surface may be slippery for a few weeks, and care should be exercised when initially using the courts.
- If the court is in an area where bird and flying-fox droppings are prevalent, it is best to have a regular inspection and maintenance program. These droppings are acidic, and can eat through the acrylic surface, causing a small piece of the court to lift out. They should be washed off with mild detergent and warm water before damage occurs.

Surface

Acrylic Surface Application

Drying Requirements

It is important for the water in the coating to evaporate out of the mix within three to four hours after application.

Water remaining in the film too long could affect uniformity of colour, adhesion, and sand retention. If the temperature is towards the lower threshold, do not apply the acrylic in the late afternoon.

Procedures to be avoided in applying Acrylic Coating Material

Procedures to be avoided include:
Do not apply coatings unless the surface temperature is 12°C and rising.
Do not apply coatings if the surface has been exposed to freezing temperatures the night before; i.e. allow the surface to rise to 12°C.
Do not apply material if surface temperature is above 40°C
Do not apply subsequent coat until previous coat is completely dry. The interval between coats is related to the drying conditions. Heat and low humidity accelerate drying.
Applying acrylic coatings during the night time hours of darkness is NOT recommended.
Do not apply acrylic coatings if the surface is wet
Do not permit excessive material to remain in low spots on the final coat, otherwise these areas will mud-crack and shine.
Do not pull material more than 18 metres in hot or windy conditions.
Do not play on court surface until the installer has advised that the surface is fit for purpose.

Surface

Acrylic Surface Application

Resurfacing

Before calling for quotations to resurface an existing acrylic surface, the owner should make a careful inspection of the court surface.

A list of defects should be made and discussed with the contractor/s so that both parties are aware of the scope of works to be carried out. All of the items to be attended should form part of the quotation. Generalised quotations simply stating "Repair existing surface and apply new acrylic coating" should not be considered.

The work to be carried out should be itemised in as much detail as possible. Quotations should also be accompanied by a copy of the manufacturer's specification for the use and application of the product to be applied.

Acrylic resurfacing of an existing acrylic surface may include some or all of the following:

Cleaning of existing surface

All mould and mildew must be killed and removed from the surface. Simply water blasting the mould will not eliminate all the spores, and new growth will occur within a short period of time. An appropriate algaecide must be applied to the entire area and then washed clean. The contractor shall be totally responsible for the collection and disposal of the waste products of this cleaning process.

Grinding back existing lines

All existing cracked, raised or glossy line marking paint should be ground back to the upper coating of the acrylic surface. If existing lines are level with the court surface and no build-up is apparent, then full removal of lines should not be necessary. It would be wise, however, to apply a wash coat to the lines prior to resurfacing to prevent the new product sliding across the polished lines.

Pressure cleaning

The entire surface should be pressure cleaned prior to applying any new product to the court surface. This pressure cleaning is undertaken prior to all patching work, filling of any depressions/low areas and tack coating. The contractor is to be responsible for appropriate disposal of all waste materials.

Delamination of surface

Pressure cleaning will reveal any weak spots or delamination in the existing surface. These areas may be ground back to remove all unstable product. Areas ground back are then brought back to the correct profile with the surrounding surface. The contractor should only use products recommended by the manufacturer of the acrylic coating to be applied. The patching materials should only be applied according to the manufacturer's specification, which should be made available on request.

Areas holding water

The pressure cleaning will also reveal depressions that hold water. These are termed "bird baths" and are defined as areas that after 15–30 minutes of drying are still holding water in excess of the thickness of a 20-cent coin at their deepest point. These areas are deemed to be unacceptable and should be patched to correct the profile. This definition should be clearly understood by both client and contractor and areas to be treated agreed to by both parties. Depressions are identified and defined only with a washable marking chalk to avoid permanent marking of the surface. These are then patched to the correct profile using specific products as recommended and specified by the acrylic surfacing manufacturer using a polyurethane self levelling product (not cement based).. Deep depressions may require two or three applications of patching materials to correct the profile. Each application must dry thoroughly before proceeding to the next layer. Inadequate drying may result in "ghosting" of the patch appearing in the finished court surface.

Repairing cracks

Invariably, most old court bases will have some degree of cracking that reflects through the surface. These can be defined as minor or major cracks.

- Superficial (minor) cracks are generally of a shallow depth and are due to the combined effects of shrinking and ageing of the base materials. As a guide, minor cracks and "alligator" cracking can often be successfully repaired with a flexible filler and coated with an acrylic surfacer (for asphalt courts) and then coated with the same acrylic tops coats as the court surface (for asphalt or concrete courts with an acrylic surface). It must be accepted that over time, however, some evidence of cracking may again reflect through the surface materials.
- Structural (major) cracks are of a structural nature mainly due to movement beneath the base. Typically, such structural cracks are of appreciable depth, and may be full depth through the entire base construction. The treatment of cracks may vary from contractor to contractor. However, both client and contractor should have a clear understanding as to the scope of the work and the likely results. Due to their nature, major cracks will inevitably re-appear within a relatively short period of time. The only long-term remedy with such cracking is to either rebuild or reconstruct the base after consultation with an engineer.
- Clients should be made aware that not all cracking can be eliminated by a resurfacing procedure, and contractors should also make this clear in their quotations.

See also 'Surface and Base Cracks' on page 17.

Surface

Acrylic Surface Application

Technique for Repairs

Depressions should first be tack coated to ensure proper adhesion of the patching materials. All patches should be feathered out at the edges so that no ridges are apparent. The patch should be sanded down so that the patch is blemish free. It is then advisable to apply one coat of base coat material over the patch to obtain a textured surface finish similar to the surrounding existing court surface. This procedure should be carried out prior to applying the first coating of resurfacing materials to the entire court.

Cracks should be thoroughly cleaned out, and all debris removed prior to any treatment. Major cracks should be treated by grinding out or using a V shaped chisel to compact and 'V out' the crack (asphalt only). All chiseling or grinding dust must then be removed from the crack. Crack filler or patching compound as recommended by the manufacturer can then be applied according to specifications. All crack filler materials should be thoroughly worked down into the crack. The materials should then be allowed to dry and then ground off to correct the court profile. All repair work should be pre-coated (as for depressions) prior to resurfacing.

Cleaning of Surface

Once all repair work has been completed and the repair work pre-coated, the entire court surface should be cleaned with a heavy-duty air blower, combined with an operator using a hand scraper to thoroughly clean the court surface.

Application of new Surface

Two or three coats (contractor should clearly specify in their quotation) of an approved netball court surfacing product should then be applied strictly according to the manufacturer's specifications.

Mixing of the materials should take place on site, and immediately prior to commencing the resurfacing procedure. Materials can be applied solely by a squeegee, or by squeegee followed by a fine hair broom, but should never be spread by broom only. It is preferable to keep the squeegee 'runs' as short as possible so that material does not 'chaff up' in hot weather. Each coat must be allowed to dry thoroughly prior to proceeding with the next coat. All work marks and minor blemishes must be scraped prior to a following coat. The surface can have either a squeegee or broom finish.

Line Marking

The line marking section in these guidelines should be referenced for detailed information relating to line marking preparation and application.

Limitations

Acrylic materials should not be applied in high wind conditions. Surface temperature should be in the range of 12°C to 35°C. The material will dry too rapidly in surface temperatures above 35°C, and will not cure properly in temperatures less than 12°C.

Finished Courts

Surface

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Surface & Court Repairs

Identifying & Patching Bird Baths/Ponding Areas

Perhaps the most neglected area of surfacing or resurfacing netball courts is the identification and treatment of depressed areas that pond an excessive amount of water. Filling and levelling a depression is one thing, but doing it in such a manner that it does not reflect through the final coating takes experience and 'know-how'. Patching is best performed by an experienced applicator.

The traditional method of locating 'bird baths' is to flood the surface, wait 15-30 minutes, and identify any depression that holds water deeper than the thickness of a 20 cent coin. At this point the area in question should be outlined with a marker to show how far the patch is to be applied.

Any depression that is outside the required construction tolerances of +/- 3mm in any direction under a 3m straight edge should be filled with a polyurethane self levelling product. Do not use cement based patching products as these can crumble, swell and displace.

NOTE: It can be difficult to totally eliminate ponding areas. The aim should be to minimise the ponding areas as much as possible and ensure the tolerance of +/- 3mm in any direction under a 3m straight edge is achieved.

CAUSES AND SOLUTIONS:

SINKING/COLLAPSE OF SUBGRADE AND/OR SUB-BASE

Sinking can be the result of improper compaction of the subgrade (natural dirt) and/or the sub-base layer (crushed rock) prior to laying the base (asphalt or concrete). Also, all organic materials such as tree stumps, roots, grass, timber and rubbish must be removed from the subgrade prior to compaction and construction of the pavement. All of these materials will eventually decompose, settle and shrink, causing the courts pavement above these decomposing items to also settle over time. This can result in base movement and surface collapse in these weak areas

SOLUTION

Geotechnical core boring in the low area can be made to establish how large the underlying problem is. After the borings are assessed, a decision can be made to excavate the problem area or simply fill the existing low area with acrylic filler material. If the puddle is caused by settling or decomposition, there is no solution to the problem until the entire area has stopped settling or the area is excavated, and reconstructed.

Water Puddle Caused by Sunken Area

Surface

Acrylic Surface Application

Identifying & Patching Bird Baths/Ponding Areas Continued

CAUSES AND SOLUTIONS:

UNEVEN ASPHALT OR CONCRETE

Unevenness caused by improper rolling of the asphalt or the screeding of the concrete. The direction of fall is interrupted by a high area in the surface. This high area acts as a dam, stopping the water and causing a puddle.

SOLUTION

One of two things may be done in this case. First, the high area may be ground down to allow the water to continue its flow, or second, the low area may be built up enough to re-establish the necessary grade.

Water Puddle Caused by Raised Asphalt

DAMMING CAUSED BY BLOCKED WATER DRAINAGE PATH

This is generally caused by the accumulation of vegetation or dirt along the low side of a netball court. These items build up a dam or wall by which the water cannot penetrate or pass, thus holding the water on the inside of the court. Sometimes these areas can build up so high that the water will encroach back into the court area.

SOLUTION

Remove the debris and scarify around and down the low side of the netball court. If this problem is caused by roots or plants, they must be removed or at least cut back.

Landscaping around a netball court adds to the beauty of the court but unless carefully planned, it can cause expensive damage to the court surface and in some cases require the removal and re-laying of the pavement.

SUMMARY OF BIRD BATH/PONDING

Low ponding areas can create a hazard for netball players, and they should be repaired. In some cases, a puddle can turn into a very dangerous slip hazard on a netball court. If water sits in an area for a prolonged period of time, algae will grow, and silt will accumulate on the court surface. Algae and silt can be very slippery and unpredictable underfoot causing players to slip and fall. This can result in serious injuries. All low areas should be monitored, treated and cleaned regularly to minimise potential slip hazards. This is especially important prior to training and competition play commencing on the courts. This will also minimise the damage algae can cause to the courts' acrylic surface and/or base.

Area Preparation

On new courts, the patch area should be clean. New concrete surfaces should be acid treated prior to any patching. Once the patches are dry the court may then be primed with the manufacturer's recommended product. On old courts it may be necessary to chemically clean the area with an algaecide.

On old courts it is recommended the area be tack-coated with a dilution of 2-parts water and 1-part binder. A good method of applying the tack-coat is to use a pump sprayer and mist a uniform film over the entire depressed area. Do not allow the material to puddle. The tack-coat should dry in 10 – 15 minutes and enhance adhesion. The area is now ready to be levelled.

Surface

Acrylic Surface Application

Application of Patching Material

The professional installer (recommended) is likely to pour the filler mix at the edge of the marked depression and pull the metal screed across the low area, making certain no voids are left behind. If the viscosity of the mix is correct it will require a slow, steady pull of the metal screed straight edge, i.e. there is no need for a saw-cutting action. The metal screed should be held at an angle to the court surface so that the mix is forced down under the screed.

Once the body of the patch is acceptable, the edges are feathered to a fine edge using a steel trowel and brush.

NOTE: Misting the patch surface with the water solution does not affect the mix, because the water is on the surface of the patch mix and evaporates quickly. However, care should be taken to only apply a fine mist and not to leave any liquid solution lying on the screeded surface, otherwise skinning can occur, leaving the surface water sensitive and prone to surface delamination later.

Grinding Patches

Often properly installed patches do not require much grinding or sanding. However, if the planarity of the patch is not uniform and/or the edges are not properly feathered, it may become necessary to use a mechanical means to correct the condition. Minor problems may be corrected with a rubbing stone; however, a disc or belt sander is fast and thorough.

As a final step in hiding patches, it may be helpful to pre-coat the patches with the filler coat mix.

Crack Repairs

One of the most difficult tasks a contractor faces when surfacing or resurfacing netball courts is related to crack problems.

It is relatively easy to fill cracks so that they do not reflect through subsequent acrylic coatings for a short period of time. However, cracks are more than likely to reappear again over the longer term.

Cracks on outdoor surfaces are almost inevitable. The challenge is to keep the cracks to a minimum and hope those cracks that do return will be minor in nature. In this case, minor means ‘hairline’ cracks, which do not affect the playability of the surface. Cracks which are flat and do not create a trip hazard will still need to be repaired to minimise further deterioration.

Any surface is subject to cracking regardless of whether hot or cold mix asphalt, or concrete base is constructed. It is likely that post-tensioned concrete courts experience the least amount of serious cracking. Furthermore, cracks that do appear only amount to hairline cracks because the tension on the cables keeps them closed.

There are three common causes of cracks:

- Thermal expansion and contraction in which a surface reacts to rapid temperature changes
- Shrinkage cracks which usually result from a volume change of the surface material soon after installation
- Structural cracks which can be the result of subgrade movement and/or failure.

Cracks from volume change can occur in asphalt due to the nature of the mix design, or inadequate compaction. Rapid curing causes volume change in concrete. Of the three, structural cracks are the most severe and the most difficult to resolve.

The forces of nature are unpredictable and therefore the appearance or reappearance of cracks cannot be guaranteed. Many types of crack fillers and different covering systems have been used over the years, however, there is no known material or system that has proven 100% successful. However, some fillers and systems can deter the reappearance of cracks better than others, but inevitably they do return if there is movement in the surface or sub-surface.

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Crack Repairs Continued

Some contractors put considerable credence in the overlaying of cracks with a membrane; however, nature's force will tear or distort the membrane if the cracks are of a structural nature. Membrane overlays are best used only on hot or cold mix asphalt surfaces that have raveled, or experienced hairline cracks from volume change. A more expensive method is to overlay the surface with hot-mix or emulsion asphalt; however, this type of overlay system is not completely successful and reflective cracking often appears.

Once ground to a level and smooth finish, the surface then needs to be pressure washed with a rotary washer to thoroughly remove all loose and foreign materials before any acrylics can be applied.

Once the surface is thoroughly dried, then all cracks and bird baths can be addressed. The most expedient and economical approach is to 'V' cut the cracks and clean out all dirt and/or vegetation and then fill with an appropriate crack filler. All cracks are filled in and smoothed over with a rubber squeegee or trowel. Normally the crack filler is thoroughly worked into the crack with a broad knife. Simply bridging the crack with the filler will not produce satisfactory results.

Pressure should be applied on the filler in all directions in order to fill all of the voids, and all excessive material should be removed so that the filler will not reflect through any subsequent acrylic coatings. Once dried, some grinding may be necessary to remove any ridges. Usually, a rubbing stone is used for this purpose.

Crack repairs can be filled with a proprietary polyurethane sealant or similar. However, liquid bitumen emulsion is not recommended as outlined in Section 13.4.4 'Surface and Base Cracks' in these guidelines.

The advice provided in these guidelines should be used as a guide only, as the manufacturer's instructions for each individual filler product should be followed for mixing, application and drying procedures.

NOTE – REMEMBER:

1. 'V' cut and clean out cracks
2. Tack coat
3. Fill cracks
4. Remove ridges

Recommendation for Large Structural Cracks

Make a dry mix of sand and cement (3 parts sand to one part cement) and work the DRY mix into the crack.

The dry mix will fill the entire depth of the crack, thus eliminating any voids. Sweep off excessive dry mix to a depth of about 1cm from the top. Pour a solution of binder and water (mixed 1:1) on the dry mix. This will wick into the mix causing it to harden. After the mix dries, use a regular binder mix to fill and level the crack.

The only long-term treatment of a structural crack is to remove the area affected, compact the subgrade and install new sub-base and base material. Any other method such as patching, or overlaying will not keep the ground from moving and therefore not prevent the re-occurrence of the cracking. Every situation is different, as every crack is different, but generally structural cracks come back. The question is not if, but when.

NOTE – CLIENTS SHOULD BE ADVISED THAT STRUCTURAL CRACKS WILL REAPPEAR:

Repairs are likely to be short lived in most cases and are best referred to as short term fixes until a more permanent treatment is possible. The best way to prevent structural cracking is to ensure the court is designed and constructed to industry best practice and following the advice provided by the geotechnical engineer throughout the design and construction process. Thorough project management by an experienced sports facility design and project management expert during construction can also prevent short cuts or inadequate construction techniques by the contractor.

See 'Surface and Base Cracks' page 17.