

TENNIS COURT INFORMATION BOOKLET

INTRODUCTION

We hope that this booklet will be of assistance in answering a great number of questions about tennis courts as well as giving you ammunition to become an informed consumer. Tennis courts are just like most products in that they can be either well...or poorly built, present maintenance and repair problems or be virtually trouble free. The difference is in how they are designed and how they are built.

The quality of information is normally only as good as its source---so here is a little bit of background about the folks who "Wrote the Book" on tennis courts. We are Saviano Co. Inc., a fully licensed Contractor serving the Western United States, founded over 40 years ago, specializing in the construction, renovation and maintenance of tennis courts. We can do all phases of the work from grading, excavation, retaining walls and drainage to courts that include asphalt - concrete - concrete post tension - grass and clay, fencing, surfacing and lighting.

We maintain our own crews and operate our own equipment and are just as accustomed to building a single private court as we are constructing 8 or 10 courts for a country club.

The Saviano family name is an integral part of the tennis world, both in Northern California as well as internationally. On nine separate occasions, a Saviano family member has competed in the men's tennis tournament at Wimbledon. John Saviano, a principal in the firm, played #1 men's singles at San Jose State University. In addition, there are literally thousands of courts between California, Oregon and Nevada --- private courts, club courts and public courts, which have been built or renovated with the Saviano brand of quality and genuine concern that makes courts look good, play well, enjoy low maintenance and add value.

We know tennis and tennis courts!

For your convenience, this booklet is broken down into two primary sections:

Section I --- NEW CONSTRUCTION --- deals with private, club and public installations, and touches on our consulting services for detailing specifications for courts.

Section II --- MAINTENANCE, REPAIR, RENOVATION, LIGHTING OF EXISTING COURTS --- Summarizes information for preventive maintenance, resurfacing and major renovations of private, club and public courts; also deals with upgrading existing lighting.

Because of the volume of information, we have also broken the major headings into separate topic headings that are detailed in the table of contents, allowing you to pick and choose topics of special interest.

SECTION I

THINGS TO CONSIDER WHEN PUTTING IN A TENNIS COURT

HOW MUCH SPACE IS NEEDED FOR A TENNIS COURT?

Exterior dimensions of a regulation tennis court are 60' x 120'. These are the dimensions of the fence line, not the playing lines. Playing lines are 78' from baseline to baseline and 36' between the doubles lines. Thus, you have 21' from baseline to fence line and 12' from the doubles sideline to the adjoining side fence line.

When pondering the question of how much space is needed, you also have to consider the issue of

"setbacks". A setback is a requirement, in almost all jurisdictions, that tells you how close to a property line (or an access easement, in many cases) that you may build a "structure". You can find out the setbacks by checking with the Planning Department of your local community. If you are not in a city, then your county setback requirements come into play. In addition, most homes are subject to Covenants, Conditions and Restrictions (CC&R's) that were placed on them when the land was subdivided. These normally deal with a wide variety of property uses and limitations in addition to establishing, in all likelihood, setback requirements.

Assume that your city setbacks are 15' in the rear, 10' on the sides, and 60' on the front --- and your CC&R's state 25' in the rear and 15' on the sides, and 50' on the front. Taking the MOST RESTRICTIVE, you cannot build a structure any closer than 15' to the rear property line, 10' from the side property lines, nor closer than 50' from the front property line.

While you have that information firmly in hand, let's further confuse the issue by stating that many CC&R's, and some cities and counties, don't consider a tennis court a "structure" and, therefore, the setbacks do not apply; HOWEVER, installation of customary 10' high tennis court fencing generally exceeds the fence height limitations set in most cities, counties and CC&R's --- 6' in most cases. In some instances, this can be overcome by placement of the court some distance inside the property line --- in other cases, you may well have to get a variance or some form of approval.

The message should be clear --- you (or your contractor) definitely need to check this information before you start making decisions. If needed, Saviano Co. Inc. can assist in the permit process.

A logical question is whether or not you can have exceptions made to these setback requirements. The answer is, "Yes, in some cases". Most cities and counties follow a set of rules that determine under which circumstances they can grant exceptions. In general, the rule of thumb is that they will not grant it just as a convenience for you, and you must be able to show that you would suffer an unreasonable hardship in the use of your property if it were not granted. In almost all cases, getting an approval involves a public hearing and takes four to eight weeks plus an appeal period. Setting forth the circumstances of your "unreasonable hardship" will require the use of some of your creative writing skills. Getting letters of support from contiguous neighbors is a logical starting point.

We recently handled the entire process of gaining a "zero setback" approval for 10' fencing on one side and the rear property lines for a client while the city (no CC&R's) setbacks called for 25' on the rear and 10' on the side and 6' fence height limitation. We thoroughly enjoyed the whole process, as the then mayor of the city lived right next door and already had a zero setback and 10' high fencing around his tennis court. We have never had a variance flow through so smoothly!

Getting relief from CC&R provisions is usually handled through an "architectural committee" that was created when the CC&R's were first recorded. In many instances, these committees have been inactive or nonexistent for years --- but don't assume this means that you don't have to conform to the provisions of the CC&R's. You, most probably, have a copy of the CC&R's in your "house file," together with all the other documents from when you bought the property. You can also ask a title company for another copy, or you can go directly to the county recorders office and buy a copy. Bear in mind, that not all properties have CC&R's, but check it out to be sure so that you avoid problems in future years. To determine if your property is subject to CC&R's, look on your property title report. CC&R's will show as an exception to the property.

While looking at setback restrictions, also look for any other restrictions that might apply to your court, such as lighting limitations, fence height limitations, etc. Among the "other" things to look for are any "easements" that are in the intended area for the tennis court. Be aware that many communities are now limiting the percentage of a lot that can be covered with a non water permeable surface --- house, driveway, patio, pool, tennis court, etc. We recently had an extreme case in a town on the San Francisco Peninsula where the owners had 4 ½ acres, a large home, a long winding driveway and a pool surrounded by patios, and we absolutely could not get approval for a tennis court. (Four and a half acres!!!!) According to the town's formula, they needed to have six acres!

An easement allows someone other than the property owner, the right to access and some form of use of a portion of your property. This is normally a utility company that wants to have either aboveground or

underground wires, pipes, etc. If you build a court (or any structure) over an area affected by an easement, you run the risk of the holders of the easement coming in to dig up their pipes, put in another pole, etc. and they then have no obligation to repair any damage to your court. Many city building departments will not issue permits for structures that are planned to be over easements. This is an area in which you can, most probably, fight city hall and win, --- but it will take some time and an attorney.

Thus, be aware of any easements and make an informed decision as to whether or not you want to assume the risks of building over an easement. Another note of caution is that access easements (someone has the right to travel across your property) in many instances are treated just like property lines, in that setbacks are measured from them --- just as if they were property lines!

In addition to setback and property line restrictions, sometimes a proposed court installation will involve potential problems with an adjoining structure or a terrain issue (an existing retaining wall, etc.) That would involve significant additional expense if the court is placed in a certain position. You have some variable to work with, such as putting in 45 degree angled corners on the court (the angle is created by coming in 10' from the theoretical 90 degree angle). You can also make the court a little bit less than the regulation 60' x 120'.

If you build the court less than 60' x 120', you will probably want to forego the 45 degree corners. If planning on a reduced size court, you should go to a regulation court and "create" your intended court size using chalk or string and play a few sets to make sure that you are comfortable with your proposed reduced dimensions. We can be a source of some judgment on this issue. If you go too small, you might well be putting in a court that meets your needs, but reduce the normally significant increase in resale value that a regulation court will add.

HOW ABOUT THE DIRECTION OF THE COURT?

A North-South court that favors West by about 10 to 12 is considered close to ideal for Northern California while due North-South is considered best in Southern California. This positioning keeps the angle of the sun's rays at a minimum during the most popular hours of usage -- mornings and afternoons. Many, many courts, out of necessity, have positioning that varies from this "formula" and they still play very well -- even an East-West court is better than no court at all.

If you really want to be concerned about the court positioning relative to the sun, --- you can put in two courts, one north-south and the other east-west, --- which is just what one entertainment personality did!

DOES THE AREA HAVE TO BE LEVEL?

In the ideal world, the area for the court will be naturally close to level and have exactly the right type of solid. So much for the ideal! Reality is that grading, excavation, deep concrete piers and retaining walls mean that you can put a court just about anywhere you want it built. Courts can be cantilevered out over steep canyons, built over garages, cut back into hillsides and have sides or ends supported by piers or retaining walls, etc. Understandably, cost can be a significant consideration.

At the time of this writing, we are just completing the engineering for a post tension concrete court that will be TOTALLY supported by twenty-eight 18" diameter concrete Piers going down into the soil approximately 34'. The reason for this is that the soil is very unstable, and the hillside is very steep. The court has been engineered (in conjunction with a soils engineer) to not only be a tennis court, but to stabilize the hillside as well.

By saying that the ideal is a level area, we don't mean to imply that we want you to make it level before we come in and go to work, because it is in your best interests to have all of the earth work and court construction done by the same contractor. The reason for this, is that a failure to correctly perform the underlying soils work can cause a later problem with the court and almost predictably,

two or more separate contractors are going to blame each other. A contractor specializing in tennis court construction, working with a qualified soils and engineering staff, can be your best source of advice as to the best court placement and method of construction to meet both your budget and future expectations.

A vital piece of information about where you want to put your court is to know whether or not the area is "fill". "Fill" means that the soils are not naturally there and have been previously placed there. If this fill was not properly compacted when it was placed, or if it contains vegetation or other foreign materials, it can cause major problems in future years.

WHAT OTHER CONSIDERATIONS GO INTO COURT POSITION DECISIONS?

.... VIEWING AREA

A court that is intelligently planned to be compatible with the house, pool or possible pool site, neighbors, fencing, trees, landscaping and other factors can add charm and value to your home. Courts that are just "put in" often stick out like a sore thumb and therefore miss the mark when it comes to complete enjoyment and maximizing the value added to your property.

Part of your positioning decision making should be to give consideration to creation of a tennis viewing area. This will generally be at midcourt and be slightly higher than the grade of the court and approximately 10' in width and 20' in length. The viewing area should provide shade, perhaps via a canvas awning structure, a wooden trellis, sleeved holes to securely hold umbrellas or whatever shade solution blends with both the court and your other landscaping, structures and architecture.

We also like to see people put in the other "creature comforts" at the time of construction. It costs less to do it then and it also assures you that such amenities are all fully planned and integrated into the court area. These comforts include: a water source, an intercom to the house, a phone jack, (possibly an intercom to the front door or gate), a refrigerator, a microwave and cable TV. What you are creating is an entertainment area that will add greatly to your comfortable use of the court. Items such as the TV, phone and refrigerator should go into a cabinet (teak is the best exterior wood) and, if putting in a cabinet you might well want to include a small sink and an area for the storage of glasses, blender, etc. A television not only provides alternate enjoyment for those watching tennis, but it also facilitates video replay, either for general fun and enjoyment or as part of a lesson program.

Many clients, particularly those who have already owned courts at previous homes, tell us that having a viewing area not only made the court more "planned" and attractive when viewed from the house, but also that they now have spouses, family and guests willingly sitting and chatting while they watch others on the court. Perhaps the greatest use and enjoyment of a viewing area is to have three or four couples over and rotate in men's, women's and mixed while the rest of the group chats, watches a sporting event on television and enjoys refreshments.

If well planned, a tennis viewing area can also serve to provide a look at an existing or planned swimming pool. If this is the case, it sometimes makes sense to expand the viewing area facilities to include a barbecue, wet bar, changing rooms, bathroom, etc.

DRAINAGE

It is essential that uphill waters not drain into the soils beneath your court, as this can cause soils movement and damage to your court. So, if you have the luxury of considering a number of different court locations, give some preference to the site that minimizes the drainage issues. See the main heading titled DRAINAGE.

ACCESS

Many courts enjoy use by others, who are not members of the immediate household. These people need a place to park and should have access to the court other than through the house. If you plan for this when the court is being installed, the additional cost is normally negligible. A typical solution is to provide additional parking, perhaps just off the driveway, a gated access and then a pathway to an entrance to the court.

TREES

Trees are an integral part of both attractive landscaping and the enhancement of a site; however, their proximity to a tennis court needs to be given some serious thought. Shade from trees can influence not only playing conditions but also drying times. Close proximity of trees also guarantees leaves, bark, small branches and other normal debris from a tree. These become a source of irritation when they have to be swept up before using the court. Leaves and shedding from some trees will stain your playing surface as they become alternately wet and dry over the course of several days.

Roots from trees have one basic mission in life, and that is to locate moisture and channel it back to the tree. The slab of a tennis court tends to trap and hold moisture beneath its surface (no evaporation) and, therefore, roots will head straight for a slab. Different types of trees have different root structures. Some go straight down and others travel outward close to the surface. Those that have surface, or near surface type roots can crack and uplift the playing area of a tennis court. In some cases, communities restrict cutting down trees without getting sometimes impossible to obtain approvals. If you have this situation, or definitely want to plant trees close to the court, you will want to consider the installation of a "root wall". This is an underground concrete wall, usually down about 4', that extends out in both directions to prevent the roots from getting in under the court.

WHAT KIND OF SOIL DO I NEED?

Most people think of soil as just being soil. This is, unfortunately a major misconception. Soils movement beneath a court (particularly an asphalt court) will do extensive damage that includes cracking, upheaval and settlement of the playing surface. While these problems can be fixed, they almost invariably return, unless a considerable amount is spent to redo the soils properly.

Almost all soils, under certain circumstances, can move. The approach in soils engineering is to use soils that have a minimum capacity for movement, compact them to the correct specifications, and then restrict variations in moisture levels. A change in the moisture level in most soils will cause them to expand and contract. One of the signs of this is surface cracking when soils have dried out. This cracking and, therefore movement, is typically both lateral and vertical and you can readily imagine what this can do to a tennis court surface.

Adobes and clays are the most obvious soils examples that can be difficult to deal with, while decomposed granite and sandy soils tend to be very stable. It makes a great deal of sense to retain the services of a soils engineer (one experienced in tennis court construction) when planning to put in a court. The resultant soils report will give specific recommendations as to the best ways of constructing your court based upon the conditions of both your soils and drainage. Saviano Co. Inc. Can either obtain a soils report for you or recommend a number of qualified soils engineers in the field.

There are solutions for just about every soils problem. The trick is to determine them BEFORE the court is build.

DO I NEED A BUILDING PERMIT FOR A TENNIS COURT?

This depends on the individual community. The first step in this process is to start with the planning department of your city or county. In general, the planning people get to approve in concept WHAT is built and WHERE it is built, before you go to the building department to get approval as to HOW it is built. In a high percentage of cases, you need approvals and permits for fencing over 6' and you almost always need both approvals and permits for lighting. Lighting approvals are becoming more and more difficult to obtain and absolutely impossible in some cases. If you think that you might EVER want lights, get them NOW.

As already mentioned, some communities are now restricting the percentage of a residential lot that can be covered with a "water impermeable surface" (house, driveway, tennis court, etc.), and a calculation is made to make certain that you are under the correct percentage. This means that some homes absolutely cannot put in a court. It also means that many older homes cannot be remodeled into larger homes because of this restrictive approach to limiting building. If you are buying a house with the intention of putting in a court, this is a critical issue to check out before the purchase.

Most cities and counties require a grading plan submission and permit if the grading involves moving more than a certain number of cubic yards of soil. The number of yards varies greatly by jurisdiction; however, they all are consistent in the fact that they add significant additional requirements as the total number of yards increases. At a minimum, a grading plan usually has to be drawn and signed by a qualified engineer. This normally also requires a soils engineer's report addressing the soils conditions.

Many communities have also adopted hillside ordinances that do not permit ANY grading or construction on grades exceeding certain percentages of slope. Related to these hillside ordinances are restrictions that limit what can be built as it might influence the hillside view from downhill locations.

Adding to this bureaucratic maze is the fact that some communities will not issue grading permits from November through March (or later), because they are concerned about earth slides, earth movement and mud tracked onto city streets, etc. during rainy winter months.

In some cases, cities and counties have held that installation of a water impermeable surface creates additional water runoff (that would otherwise soak into the ground), and which will now go into a storm drain system at some point. Therefore they charge a storm drain fee. Just as creative, are some of the homeowner's associations, which maintain their own roads in a gated community. Many have decided that trucks hauling soils, asphalt and concrete, etc. shorten the life expectancy of their roads and, therefore, have decided that trucks cannot travel the roads unless they pay some really significant fees, in some cases, add up to thousands of dollars.

Either you or your contractor should assume the responsibility of checking your CC&R's and all pertaining city or county regulations to find out just what can and cannot be done, and which permits or approvals are needed. Make sure that you don't "cut any corners". You might get away with it initially, but our litigious society tends to catch up with such things when it comes to a resale, an unhappy neighbor or a city inspection. A tennis court is a difficult thing to move.

WHAT ABOUT GRASS, CLAY OR HARD COURT SURFACES?

Grass and clay courts are clearly in the minority, both in this country and throughout the world, nonetheless, they do hold some appeal. It is important to understand that they are both more expensive and more maintenance intensive than hard courts.

CLAY COURTS

The clay material for clay courts is not anything like the local clay soils. It is material that is mined out of a vein on the East Coast.

Another aspect of clay is that it needs to be maintained at a fairly constant moisture level. If it is too wet, it is gooey and if too dry, it is powdery. Overhead sprinklers on a time clock are one solution; however, evaporation and water consumption make it a very costly affair during drought conditions. Another approach to the water issue is an underground system of pipes which flow water into the "sandwich" at the direction of moisture sensors. The underground water system will reduce overall water use.

The lines on clay courts are actually strips of a canvas-like material which is nailed down. Clay courts need to be "resurfaced" after a certain amount of play and this entails removing and then replacing the lines. The resurfacing can be done with a hand pushed roller or a rid-on type of unit. Either piece of equipment requires a "clay box," which is the replenishable source of additional clay to level and smooth the court to replace clay that has either washed or blown away.

A clay court is a labor of love. Playing on a clay court is also quite different from conventional hardcourt tennis. The principal difference is the need to literally slide on the clay surface as you get into position to hit shots. This sliding action also creates the great benefit of having a clay court. It reduces the running and pounding action on feet and joints and, therefore, is much easier on your system. One should also be aware that playing tennis on a clay court is very difficult if you are only used to hardcourts and, while many people enjoy an occasional match on clay "for the fun of it," they find it very difficult to switch back and forth between the two.

GRASS COURTS

Just as a clay court plays quite differently from a hardcourt, a grass court creates a totally different game. The bounce of the ball is as if someone has punctured it. A high lob landing on a hardcourt might bounce up 10', while the same lob landing on a grass court might bounce just 2'. To add to the confusion, is the fact that the bounce is almost predictably erratic as it is coming off an uneven grassy surface and not the flat surface of a hardcourt. The other significant difference is that a ball hit towards you tends to skid on the grass, rather than having traction as on a hardcourt surface. Therefore, it doesn't "come up". So, while you might expect it at 30" to 36" above the playing surface on a hardcourt, it might only "come up" 10" to 12" above a grass surface.

Nonetheless, playing on a grass court is a lot of fun and some folks really get into it by playing barefoot. How professionals can switch from hardcourt to clay and then to grass and continue to maintain peak tournament performance, is a major tribute to their skills. We maintain that they have different bionics from those we ordinary folks have.

The construction of a grass court is very much like the technique used in building a putting green on a golf course. It starts with underlying soils preparation, followed by layers of increasingly smaller drainrock materials, followed by nutrient soils through which water can flow. The grass actually grows in a granular, sandy and nutritious soil that drains extremely well. This allows moisture to provide sustenance, but allows water to flow on through into either underlying soils, or into a drain system for removal from the court area. The type or mixtures of grasses used varies greatly, just as the golf course greens on the San Francisco peninsula are quite different from those 20 miles away in Contra Costa County, or other section of the country.

A grass court takes a real beating. If you have ever set up a volleyball net on the back lawn you will remember that the 30 minutes of volleyball on the 4th of July left marks that were visible well into August. Constant mowing, regular feeding and protection from disease are major items in the maintenance of a grass court.

Grass courts are particularly easy on the joints, as the grass and soils have a cushioning effect. Playing lines are chalk and are laid down with a small, roller type of chalk feeder, similar to those used to place playing lines on a baseball diamond.

SHOULD A HARDCOURT TENNIS COURT BE CONCRETE OR ASPHALT?

In Southern California (generally considered the tennis capital of the world) almost all tennis courts are built out of concrete, as opposed to Northern California, where exactly the opposite is true, with most courts being built out of asphalt. This trend is changing with a greater number of concrete courts being built in Northern California. Once surfaced and color coated, asphalt and concrete courts look alike, play alike and other than looking at construction related details, no one can tell one from the other. The principal reason for the geographic difference is the concrete in Northern California is significantly more expensive than in Southern California, costing some two to three times what it does in Southern California.

Thus, in Northern California, the initial cost of an asphalt court is lower than that of a concrete court; however, soils movement that readily cracks asphalt normally, has little effect on a concrete court. This explains why asphalt court maintenance costs are traditionally far greater than those of a concrete court.

A persistently stated opinion is that an asphalt court is "easier on the feet." Unfortunately, engineers tell us that this is pure fiction. For this to be true, an asphalt court would have to "give" (actually depress) when you walk or run on it. Put simply, it doesn't. The materials under both asphalt and concrete courts are compacted to very high densities and levels of compaction, --- normally 90% to 95% and the asphalt itself receives a very high compaction and density when paved with 4 and 5 ton rollers.

Neither surface will "give" under the approximate 30+ square inches of a tennis show. What creates the misconception is that if you try to hammer a nail into both a concrete and an asphalt surface, you will find that it can be driven into asphalt and not into the concrete. Thus, most people think of asphalt as

being "softer" and, therefore, "easier on the feet". It isn't, it is the same as concrete.

The reaction of a tennis ball striking and leaving a court surface is determined by the finishing materials on the court. Materials used to finish and color coat both asphalt and concrete courts are identical. Thus, they play identically the same.

The structural weakness of asphalt (relative to concrete), means that extra care needs to be taken in building the court. The degree of compaction and the nature of the underlying soils are key elements in asphalt court construction, because whatever happens in or to the underlying soils is transmitted up through the asphalt.

An informed decision as to asphalt or concrete should be made in conjunction with data from a soils engineer and by comparative pricing of both types of courts.

WHAT GOES INTO THE ASPHALT USED ON A COURT?

Asphalt is simply aggregate rock of varying sized held together with a petrochemical mix of heavy residue tar and oil materials. The strongest part of asphalt, as with concrete, is the aggregate that it contains. The larger the aggregate in the mix, the stronger the asphalt, with particular emphasis on resistance to cracking. The smaller the aggregate, the smoother the finished paved surface, but this is at the expense of structural integrity. For this reason, contractors not really used to tennis court installations, tend to opt for the smaller aggregate to get a smoother paving job and, unknowingly create increased cracking risks in years to come. The roughness of an asphalt paved surface, using larger size aggregate, simply means that more time and materials are used in the leveling, surfacing and color coating process, which is a small price to pay for added structural integrity.

The type of oil specified in the asphalt mix will vary with weather and temperature conditions where you live. The importance of using the right oil is emphasized by the fact that before surfacing can take place, the residual oils on and in the asphalt surface need to either evaporate or be thoroughly washed and scrubbed from the surface. Otherwise, the color coating materials could have trouble bonding.

The thickness of the asphalt is typically 2" on new courts. If you go much less than 2", you are sacrificing strength and, if you go much more than 3" the rollers cannot generate complete compaction from top to bottom and the bottom portion remains structurally weak.

Invariably, during slow economic times, we find paving people who normally do parking lots and driveways becoming "experts" in the art of paving tennis courts. What their customers fail to realize is that the accepted tolerances of level, and uniformity of finish and drainage for parking lots and driveways are dramatically different from the minimums that are acceptable for a tennis court. Correctly paving a tennis court takes specialized paving equipment, as well as a highly experienced crew. If you are missing any part of this formula, you can end up with a 7,200 square foot disaster. We have been called in to "fix" some of these mistakes and they invariably entail either completely taking out what has been done (and redoing all the soils work), or doing an overlay of additional asphalt.

WHAT GOES INTO CONCRETE AND POST TENSION CONCRETE COURTS?

It is important to realize that when concrete cures, it has a tendency to shrink slightly and the more rapidly it cures (hot, dry weather together with a breeze), the greater this shrinkage tendency. Shrinkage produces cracks, and while they might not impair the structural integrity of the court, they are undesirable. You will also note that most sections of concrete, such as a driveway or pathway, have a pattern of expansion joints made of wood or rounded depressions in the concrete. These are designed to induce the cracking into areas that are not exposed to view. When it comes to 7,200 square feet of a tennis court, the last things that you want are expansion joints anywhere other than directly under the net line.

"Top of the line" in concrete courts are POST TENSION CONCRETE COURTS. Rather than using rebar for strength, these courts have ½" thick greased and sleeved cables that run about every 3' to 5' across both directions of the court. The cables have tension plates on both ends and one end of the cable is left exposed until after the court is poured. The cables, and a perimeter of rebar, are poured right into the

middle of the concrete slab. After the concrete pour, tension is placed on the cables and the exposed cables are then cut and the exit holes patched with concrete. A tensioned slab becomes what is called "monolithic" or one structural piece, much the same as many of the high arcing sections of freeway overpasses.

Post tension courts seldom have structural cracks, but often develop hairline cracks. The use of post tension cables is now almost standard practice in new home construction for slabs that are placed on expansive soils.

As with the installation of asphalt on a tennis court, a tennis court concrete crew needs to be highly skilled and experienced.

WHAT GOES UNDER THE CONCRETE OR ASPHALT?

In a perfect world with perfect soil the answer would be nothing. In reality, subject to your soil conditions and the recommendations of the soils engineer, you might have sand, Class II base material or just highly compacted soil -- or some combination of the foregoing. The primary considerations are to minimize the changes in moisture levels in the soils beneath the court and to also have materials under the court that are the least affected by moisture level changes. Class II base material is a Cal-Trans classification of material, in which the aggregate rock is no greater than 3/4 of an inch and the balance of the materials are non-expansive in nature. Non-expansive means that when moisture levels are varied, the material does not expand and contract. Class II base material is excellent for tennis courts when compacted properly.

Some asphalt court installations have required the removal of as much as 36" of existing soils that are then replaced with newly purchased non-expansive soils and/or Class II base material. This approach costs a fair amount of money, due to the costs of excavation, trucking out the old material, new material purchases, trucking in the new materials as well as the machine time to place and compact the new material in a series of layers. As you perhaps recall in the section on asphalt, you can't compact material in very thick layers, or the tractors and rollers won't be able to compact the lower portion of the new material. As a general rule, new soils material must be placed in layers of about 6" to 8" thick, and thoroughly compacted before any other material is placed on top of it.

During the process of earth preparation for a court, water typically has to be added to obtain moisture levels specified by a soils engineer. The addition of water aids in the compaction process.

In addition to the integrity of the soils work beneath the court, it is very important to make certain that water does not and cannot get in under the court slab.

DRAINAGE CONSIDERATIONS

There are four water sources with which you need to be concerned:

1. WATERSHED COMING OFF THE COURT

The court should drain SIDE to SIDE at either 1% or 1.1% and this water needs to be dealt with or it can soak directly into adjacent soils (and therefore back in under the court) or it can be a source of settlement or erosion. In most cases, a concrete steel reinforced open faced V-ditch drain immediately adjacent to the court can capture this water and then dispose of it a good distance from the court.

It is best to drain a court across the 60' section. It provides the most true playing surface. However, there may be cases where the court slope has to vary.

2. WATERSHED COMING TOWARDS THE COURT FROM UPHILL AREAS

Water flowing towards the court tends to soak into the soils adjacent to the court and then find its way back in under the court and become a source of damage. In some cases, it will make sense to slope the court INTO a hillside so that the drain mentioned in #1 can serve the dual purposes of catching water coming off the court and receiving water from uphill areas. Routing these waters away can best be

accomplished by taking them to a downhill location or, if your area is primarily level, by routing them to a rock filled water sump pit that is built thirty or forty feet away from the court.

3. UNDERGROUND WATER FLOWING IN UNDER THE COURT

Underground water flows in strange and unpredictable ways. In some cases it will soak in until it hits a water-impermeable layer of soils (such as clay or adobe), and then travel laterally, perhaps between two such layers and then even uphill. There was a court where we were installing a retaining wall, secured by 18" diameter concrete piers going down into the ground approximately 15' deep. These pier holes were dug 6' apart along one side of the court (21 of them in a row) and every hole was dry except for two, about 24' apart. Both immediately filled up with water, one with about 2' of water and the other with over 6' of water. We had encountered two, entirely separate underground flows of water!!!

If underground water is suspected, one of the best protections is a French drain and a lining of the court side of the trench with a water impermeable fabric liner. This stops lateral flow of water and traps it into a drain system that can then route it to a safer location. This underground drain system should be on the uphill side or, if the area is relatively level, possibly encircle the entire court. Complete encirclement creates a "skirt" around the court to reduce the possibility of additional moisture moving in laterally. Remember, it is neither moisture nor the lack thereof that causes expansive soils to expand and contract. It is the variance between the two, so, the objective is stabilization of moisture levels.

4. LANDSCAPING AND IRRIGATION

Landscaping and irrigation right next to a court or uphill from a court is like handing a loaded gun to the enemy. Water doesn't just soak straight down, it also moves laterally, and it is not unusual to find water damage to a court back in 8' or 10' from an edge, where a water source has allowed water back in under the slab. The telltale signs of cracking related to this are cracks parallel to an edge or an end of the court. It is also common to see several rows of these parallel cracks.

Time and money spent wisely on court drainage issues can add greatly to the security of your investment in a tennis court. Surprisingly few tennis court proposals from contractors touch on this issue, a certain sign that they lack experience in court construction.

WHAT SKILLS ARE NEEDED IN PUTTING IN AN ASPHALT OR CONCRETE COURT?

A quality court starts with knowing the soils and drainage issues related to the site. This is then followed by an intelligent construction plan to deal with these issues. Once the specifications are set, the actual work and supervision of the work are the key issues. For example, heavy equipment operators can easily put in a 12" to 18" layer of soils before taking the time to wet and thoroughly compact them, versus placing an absolute maximum lift of 6" to 8". While this saves time and saves someone some money, it also creates a soft uncompacted layer that can settle at a later date. Contractors who use subcontractors for their soils work (rather than having their own equipment and their own crews), take a significant risk as subs get jobs based upon having given the lowest bid in the first place. Most want to get the work done as fast as possible with a minimum of machine time and expense, seldom the objectives that result in a quality court.

In most cases, it is in the owner's best interests to have the soils work verified by an independent soils testing laboratory or soils engineer. A tennis court is only as good as its underground foundation, the soils work. Having a contractor who has a solid reputation and has been in business for a good number of years is another basic to make certain you get the quality of work that is specified.

The next step, is forming the outer perimeter of the court. This is accomplished with Douglas fir removable forms if it is a concrete court, or redwood if it is an asphalt court. The headers stay there permanently and material other than redwood, or pressure treated wood, will not last as long.

If soils and terrain suggest the need for it, in lieu of redwood perimeter headers, you might want to consider a concrete border around the court. This concrete "mow strip" should also be color coated at the same time the court is color coated. In some instances, this concrete border will extend down 36" to 48" to form an underground wall to act as both a soils stabilizing influence and as a moisture barrier to stop

the movement of sub-strata water under the court. This type of wall also acts as a "root wall" to protect the court from adjacent trees or bushes.

As soils work is completed, the next critical phase is the fine grading, particularly on an asphalt court. The 2" layer of asphalt obviously follows the compacted contour of the fine grading and, if it is off, the tennis court is off. Without lasers it is almost impossible to get the fine grading within acceptable tolerances.

The skills of a typical driveway or parking lot paving crew are close to worthless when it comes to doing tennis courts. They have neither the equipment nor the skills to do the job. Two key questions to ask a potential tennis court contractor are, --- "Approximately, what was your total volume of business last year for all work that you did?" A second question is, "How many tennis courts did you build last year?" You should be able to roughly calculate what percentage of their business is dedicated to tennis courts.

UNITED STATES TENNIS ASSOCIATION (USTA) STANDARDS

The USTA does not really have absolute standards. They have a series of recommendations and it is important to note that they are not specific with respect to strict construction standards because construction techniques vary greatly across the country and throughout the world. They do have recommendations on drainage, the placement of playing lines, location and height of nets and they also make reference to the degree of uniformity of the court surface.

Their number one recommendation for drainage is from one side toward the other side, with a uniform slope of approximately 0.85%. In the field, this 0.85% might well vary from court to court from .85% to 1.1%. We prefer 1.1% because it is not noticeable to the eye, does not impact either play or appearance, and offers a better draining court. It is important to understand that water on a court has to overcome a tendency to sit and puddle (engineers call it "surface tension"), and that it also takes time to drain from one side to the other. So, having a drainage grade that helps overcome surface tension, and therefore drains well, without having a negative impact on either play or appearance, is the best of both worlds.

This gives rise to an industry standard regarding puddles on a court. A well constructed court will not have any standing water, 45 minutes after flooding with water, that will cover a nickel laying flat on the surface. We are continually amazed at the number of proposals we have seen, which don't give the homeowner any guarantee whatsoever when it comes to puddles. This means that you can pay good money for a court, end up with an uneven and irregular surface with numerous puddles and not have a legal leg on which to stand.

The USTA is very specific as to the placement of playing lines (78' from baseline to baseline and 36' from outer doubles to outer doubles) and these should never be varied. A "regulation" court is 60' x 120' and, as already discussed, this can be varied somewhat without impacting either play or resale values.

The USTA does not have definite standards as to the "speed" of a court. The speed is varied from SLOW to FAST by adjusting the amount of sand mixed in with the color coating materials. This is discussed in the section titled THE PLAYING SURFACE OF YOUR COURT.

TENNIS COURT FENCING

10' high fencing is perhaps the "standard"; however, in some cases, you might want to consider 12' high fencing if the area beyond the fence is inaccessible for ball retrieval. In positioning your court to be compatible with its total surroundings, you may want to consider either creating or preserving a view with a section of lower fencing. Typically, this takes the form of the middle 80' on the viewing area (or house) side of the court being dropped down to either 3', 3' 6", or 4' in height. This creates a very welcome and inviting feeling for a court.

Some people want to preserve a "woody" or "natural" setting by using wooden fencing framework to which the regular fencing material is attached. If you do this, understand that wood ages and weathers and, as it does, it tends to twist, warp, and split. In most cases it will look very different five years from now compared to how it looks when first installed.

Metal fence posts and the fencing material itself (called "fabric", not to be confused with the windscreen material) can be either galvanized, painted or clad with plastic or vinyl materials. If you put in galvanized fence fabric, it is impossible to paint at a later time and upgrade to a colored surface. It is important to have the squares in the fence fabric no greater than 1 3/4", or you will be chasing balls that have gone through cheaper 2" square fencing. The next step up in quality is painted posts and fence fabric. The paint on the posts and hardware tends to hold up well; however, it doesn't work very well on the fence fabric where it tends to run or crack off at the friction points and it also has a tendency to oxidize and assume a dull and dusty appearance.

The next upgrade is to go to a vinyl coated or a vinyl bonded fence fabric material. They are different because the coated material can be peeled off, whereas the bonded fabric bonds directly to the wire material itself. You can also have the fence posts and hardware coated or bonded; however, it seems to add more expense than it is worth because it has to be dipped in custom sized vats. This also adds several weeks to delivery time. In general, a very high quality and good looking installation can be obtained by getting either the vinyl coated or bonded fence fabric and having the posts, cap rail and hardware painted to match the site.

Fence colors vary and, in general, black is the most popular with green in second and brown in third place. This is truly a matter of personal preference; however, black does tend to show dust far more than either of the other colors.

It is important that ALL of the fencing material, whether factory painted, painted on site or coated/bonded in vinyl, **MUST BE GALVANIZED** or you are wasting your money.

You need to be aware that not all fence material is created equal. The thickness of the material determines its strength and its strength will determine if it will even bend during high wind conditions. Major storms can routinely be accompanied by winds that gust well over 50 miles an hour. This is enough to bend tennis court fencing (particularly if it has windscreens) if the material is not the correct type and/or if it has not been installed correctly.

The key factors in the strength of fencing are the diameter of the posts and the thickness and type of metal. In general, 10' or higher corner posts must be a minimum of 2 7/8" in outside diameter (OD) and must be either SS-40 or Schedule 40. The upper railing, called a caprail, and braces should be 1 5/8" OD and should be SS-20 or higher in strength rating. Fencing under 4' in height can have both posts and cap rail materials similar to the caprail and bracing materials. The fence fabric, when coated, should be #8 gauge and the lower tension wire should be #7 gauge. The lower tension wire is a very tight wire at the base that holds the bottom of the fencing in and minimizes the risk of ankles getting caught under the fencing.

Avoid, as much as possible, the installation of fence posts **WITHIN** the perimeter of the actual court surface (particularly on asphalt courts). This creates a structurally weak area that can radiate cracking. Posts should be immediately adjacent to and outside the slab. Think about the location of gates. If you have 80' of lowered fencing on one side, typically, you will put a 4' wide gate right in the middle. It also makes sense to consider a "chase" gate, which is another gate on the far side from an existing entry gate. This gives you a reduced distance to travel when you have to chase balls that have gone over the fence.

Proper installation requires that the fence posts go into 36" deep concrete footings that are at least 10" in diameter and, needless to say, they should be correctly aligned, and line posts should not be spaced anymore than 10' apart.

In recent years 45 degree cut corners have become popular on courts. This means that rather than 90 degree corners you come in 10' in each direction from what would otherwise be the 90 degree corner, stop the fence there and then connect these two points with fence. This diagonal is 14' 2" across and softens the appearance of a court, compared to one with 90 degree corners. The 45's also tend to deflect balls hitting them so that balls tend to gather closer to the middle of the end of the court rather than in the corners themselves. The cut corners do not impact play and have become increasingly popular. They do not influence the cost of a court and they can also create a handy storage area (see next section).

STORAGE

It is predictable that you will need an enclosed storage area for your court. You will probably want a ball machine (or a minimum of a basket of balls), sponge roller, water broom, ball pickup hopper and an assortment of other "stuff". Good court design will include an enclosed, likable storage area.

There are a number of designs that we have created over the years; however, the one that almost always seems to work well is one that we use on 45 degree cut corner courts. We build the court slab out to the full 90 degrees and have the fence cut across at 45 degrees and place a gate in the 45 degree angled fencing. The gate creates admittance into a storage building that is accessible only from the court. This triangular shed is painted to match the fence and windscreen color and, therefore, "disappears" but, is immediately handy for regular use.

The storage area is also the logical location for both the hose bib for cleaning the court and for an electric outlet for a ball machine or other electric equipment.

WHAT ABOUT WINDSCREENS?

Windscreens are really misnamed because they don't screen the wind. Wind goes over, under, around and through windscreens and certainly isn't stooped by windscreens. What windscreens do is create a solid color and uniform background against which you can more readily see and "pick up" a ball coming toward you. If anything, windscreens interrupt wind patterns and cause swirling wind rather than a more uniform flow of air.

If you have the opportunity to view two courts side by side, one with and one without windscreens, you will instantly realize that windscreens greatly add to the appearance of a court. The improvement of appearance is both in viewing the court from afar and when playing on the court. Don't underestimate the value of windscreens for the creation of a solid colored background. This makes a great difference at all levels of play.

HITTING WALLS

It is nice to have a hitting area as part of your court as it allows players to warm up by themselves and to also practice repetitive strokes. If your court is going to involve exposed retaining walls, you might want to make one at least 7' in height to serve double duty as a hitting wall. It is important that the back of the wall be thoroughly waterproofed in order to stop water from soaking through because it will stain the exposed surface. It is this inside surface that you will most probably want to have color coated to match the inner playing surface of your court. Then place a 36" high horizontal white line across it to create a net line.

If your court doesn't need retaining walls, putting in a concrete hitting wall (20' wide and at least 7' high) can be a rather expensive item. The next option is a wooden hitting wall. While it costs less, there are two negatives: 1) balls hitting it tend to make considerable noise; 2) wood deteriorates over time and needs maintenance.

COURT LIGHTING

Many people find that having a lighted court adds greatly to their enjoyment of their court. If you think you might ever want lights, **PUT THEM IN NOW!!** Many communities are restricting new lighting installations and installing now not only gives you the lighting, but it also give you a major plus when it comes to resale value. Tennis players will pay a premium for a house with a court and a significant premium for a court with lights, in a community that does not allow new light installations.

It is distressing to see courts that have just 2 or 4 lights which cannot possibly provide adequate lighting. If you are going to go to the expense of putting them in (posts, trenching, switching and connection to the panel), why not do it correctly? Even a set of six lights on a court (3 on each side) will only give marginal lighting.

The best bulbs for lighting are 1,000 metal halide bulbs, as they give a true white light, are relatively efficient and have a long life expectancy (important when you consider changing bulbs at a height of 20'). They take a few minutes to warm up, but other than that, they work exceedingly well. You can also consider 1,500 metal halide bulbs; however, their life expectancy is about half that of 1,000 watt bulbs. The size and design of the built-in reflectors are quite important, not only to put the light where you want it but to accommodate 1,500 watt bulbs in the future, should you ever want to change to them.

It is important to realize that as soon as new bulbs are installed, they start a long process of wearing out. While good quality 1,000 metal halide bulbs will give 12,000 + hours of service before finally burning out. Over that life span they are going to lose around 30% of the light that they were originally putting out. So, when planning your lighting, don't cut corners. Put in more than you need, so that over the life of the bulbs, you will always have adequate lighting to keep your game in focus.

The quality of lighting on a tennis court is measured in FOOTCANDLES. Be careful not to just look at AVERAGE footcandles because this can be a misleading number. You need to be careful of the variation in footcandles across a court. So, while the average can be high, dark zones can make a court very difficult to play. To best judge court lighting, you need to look at a photometric diagram of the lighting pattern that proposed lights will give you on your court. This breaks your court surface into individual footcandle readings for every square yard of surface. You want to avoid the "dark zones" across the court which is the problem with just 4 or 6 lights, and you want to meet or exceed the following footcandle guidelines:

40+ footcandles without dark zones will produce barely acceptable lighting. You can play, but it is easy to not see balls, particularly as the caliber of play is increased. Most folks whose vision isn't what it "used to be" find this unacceptable lighting. (6 - 1,000 watt lights will meet this standard.)

50+ footcandles without dark zones produces somewhat acceptable lighting for private and club courts. Again, those who don't have the eyesight they had in younger years will find fault with the lighting, particularly if the caliber of play is stepped up. (8 - 1,000 watt lights will meet this standard.)

60+ footcandles and up without dark zones provides lighting that will accommodate a wide range of caliber of play. (8 - 1,000 watt bulbs with extra sized reflectors will meet and exceed this, or you can well exceed it with 10 - 1,000 watt bulbs with standard reflectors.)

70+ footcandles and up represent the "top of the line" when it comes to court lighting. High caliber and tournament levels of play are readily accommodated, as well as meeting the needs of those whose eyesight isn't quite as good as it once was. This standard can be met by 10 - 1,000 watt bulbs mounted in oversize reflector units.

It is important to stay with specialized tennis court lighting. Don't use baseball or parking lot lights. Tennis court lights are very directional, in that they put the light where you need it on a court and they also have very little "over splash" to areas adjoining the court. The directional nature of quality fixtures means that we can put 60 or more footcandles on a court and have fewer than 2 footcandles six feet outside the court itself.

Lights are mounted 20' above the court surface and need to be mounted on a minimum of 3 1/2" OD SS-40 or Schedule 40 poles set in 48" deep and 18" diameter footings. Conduit to the lights can either be underground or along the top of the fencing (painted to match so that it disappears). The above ground installation has the advantage of avoiding water seepage and provides ease of future access if needed. Lights always require an electrical permit and, in almost all cases, require additional planning department approvals prior to applying for the permit.

The switching for tennis court lighting should have a switch both at the court and in the house. This permits the lights to be conveniently turned on while playing (also denies opponents the excuse of interrupting a tie breaker just because they can't see too well at midnight). It further allows you lighting as you depart the court to head into the house. Prior to the switches, we like to recommend having a timeclock that makes the switches inoperative before and after certain times. The timeclock can prevent the lights from being turned on by mistake during the day and can also help to remind you of any local

lighting restrictions or agreements with neighbors to restrict lighting to not later than a certain time during evenings.

If you put in lights, it makes sense to also put in a GFI electrical outlet at the base of one of the light poles. This costs little to install and it will be needed for a ball machine or other equipment.

When lights are first put in, they obviously need to be connected to your existing electrical panel, which may or may not have either sufficient total capacity or have an available circuit with the needed capacity. In general, eight 1,000 bulbs will require just under a 50 amp circuit. Most lights can be wired to a variety of voltage levels.

RETAINING WALLS ADJACENT TO A COURT

Differences in grades can often be solved by grading techniques or you might want to address them with the use of retaining walls. There are a wide range of materials to choose from including:

WOODENTIMBERS --- *CRIBBLOCK CONCRETE --- *KEYSTONE CONCRETE BLOCKS

CONCRETE BLOCK WALLS --- CONCRETE POURED IN PLACE WALLS

*Trademarked names.

These vary in cost and appearance and what might be perfect for one site might be inappropriate for another. We do all of these types of walls and suggest the following guidelines for installation of any of them.

They all need a drainage system behind them. This is vital to relieve soils movement and pressures generated by the presence of water and is also needed to remove the waters from either under the court or to prevent them from soaking into soils adjacent to the court. Of equal importance, is the waterproofing of the back side of the wall if the front side of the wall is going to be exposed. Water which seeps through the concrete, carries with it chemicals from the concrete that will discolor the wall. In addition to tar waterproofing, there is a water impermeable rolled material that has little tunnels of vertical drain lines protected with a filter fabric (so they don't clog up) which works exceedingly well. A wall that is exposed to the court should be painted, normally the same color as the inner playing color, so it looks like it belongs there and is part of the court.

On a recent court installation, the end retaining wall only needed to be 5' high (to retain soils), but we recommended that it be built at a height of 7' with 3' of fencing above. This created a 7' high hitting wall (complete with white line) that added to the appearance and function of the court and kept the caprail height of the perimeter fencing consistent at 10'.

THE PLAYING SURFACE OF YOUR TENNIS COURT

Whether asphalt or concrete, the sequence is essentially the same:

1. Flooding to determine any defects;
2. Leveling and/or grinding to bring within specifications;
3. If concrete, acid etching to open the pores and then sealing the surface, if asphalt, scrubbing and washing out the oils and then one or more applications of either acrylic resurfacer or asphalt emulsion to fill open pockets;
4. As many leveling coats as are needed to bring the court to the correct specifications, with all coats being sanded and scraped;
5. Squeegee application of two or more 100% acrylic color coats of material, mixed with rounded and uniform sand; each coat is sanded and scraped to meet specifications;

6. Squeegee application of final "chrome" color coat with sand;
7. Application of white playing lines mixed with rounded silica sand.

The amount and size of sand panicles used in the color coating sets the speed of your court. The more sand, the rougher the texture of the finished surface, which causes it to "grab" the ball which results in the ball "coming up" a little higher than would otherwise be the case. By the same token, a reduction in the abrasiveness of the surface induces more "skid," resulting in less rise after the ball makes contact with the surface of the court. In all likelihood, you are used to a medium-fast court, as this is what you will find on the vast majority of courts. You will normally find public courts are "fast". This is because they are generally not well maintained and the sand in the surface coating has been worn off, which creates fast courts.

The surfacing process is preceded by the process of leveling and trueing the court surface to meet specifications. A well built and finished court should not, 45 minutes after flooding with water, hold sufficient surface water to cover a nickel laying flat on the surface.

The quality of the acrylic materials used are of great importance, as is the quality of the sand that is used. Lower quality acrylic materials tend to fade more with exposure to ultraviolet light. They also tend to show more wear. Angular and irregularly shaped sand tends to become dislodged from a court and will cause a court to continuously speed up over the years and hastens the time of resurfacing. This dislodging is particularly irritating, because it tends to take place in areas of the court exposed to high traffic and high contact with the ball. This, in turn, creates localized areas of the court with areas of varying speed, this can really throw your game off.

You have most probably noticed many asphalt courts have cracks that seem to follow the playing lines. This stark white surface dramatically reflects more heat and sunlight than is absorbed by the immediately adjacent playing surfaces. This causes the adjoining colors to heat up and the white lines to stay cooler. You can test this for yourself on a warm day by simply putting a finger alternately on the two surfaces. If you recall your basic physics, you will remember that heat normally causes things to expand and, you thus have two surfaces trying to expand only to find a line between them that isn't being subjected to the same tendency. This puts stress on the asphalt and causes it to crack. Once it is cracked, water has access to the soils and the process of deterioration is greatly accelerated and perhaps, celebrated by the emergence of some weeds.

Out of the many, tennis court surfacing products on the market, we have found only a handful of brands which really stand up and also back their products with a meaningful guarantee. Some have tried to create a "brand preference" by advertising, while others have tried to capture market share with fancy sales literature. The bottom line is the performance of the product on a customer's court, and we think that is a bad place to try cutting corners.

NET POSTS AND NETS

The best net posts are those that are set into aluminum sleeves and then set into concrete foundations. The sleeves mean that damaged net posts can be replaced without needing to be jack hammered. The net posts should be vinyl bonded over a strong, but hollow metal shaft that houses internal brass winding gears (not the outside type of crank) for the tightening of the net. The color of the post should be coordinated with your fence color.

Nets range from promotional to high quality without a great deal of difference in cost, but with a much longer life expectancy for the quality products. Avoid canvas across the top, string net webbing to form the net and cotton thread. All three of these tend to deteriorate badly. Nylon nets with a quadruple row of nylon stitching will give you many years of service at only a modest increase in price.

As you most probably know, net posts are 42' apart and the net should be 42" high at the posts and 36" high at the center of the net.

CUSHIONING MATERIALS

Cushioning materials are becoming more and more common. Cushion products are used at the U.S. Open, Australian Open, and a host of professional events. These cushion materials can minimize the impact on hips, knees, and ankles, and are a growing trend in the industry.

COURT COLORS

White playing lines are about the only sacred things left in court surfacing colors. Red and green have been the traditional favorites; however, green on green is becoming quite popular along the ever changing colors used at the professional events.

OTHER OPTIONS TO CONSIDER WHEN PUTTING IN A COURT

Perhaps 50% of all of the private courts we have built, have a basketball set-up at one end. Installation should be via a substantially larger fence pole that is built right into the fence line. Brackets should hold the backboard in, about three feet over the court. There are also backboards available which are adjustable in height, from regulation 10' down to 7' in 6" increments. The hoop is up and away from influencing play on the tennis court and shooting baskets does no damage to the court.

Another good idea is to install a shuffleboard court on the far side of the court, which means widening the court slightly. The shuffleboard court uses a slightly different surfacing finish than the tennis court (no sand), but is very compatible with the court.

We have also constructed courts with metal sleeves built into the concrete footings just outside the net posts, and volleyball posts can slip into these sleeves.

It is important that you place a hose bib close to the court for purposes of washing and maintaining the court. It also makes sense to run electricity out to the court, or at a minimum, to the viewing area.

As already discussed, a viewing area, a separate access to the court without having to go through the house and a separate parking area for the court (so as to not max out the family driveway), are some of the things which to give some thought.

It is also suggested that you get the ball machine and other necessary accessories at the time the court is built. These cost less if bought at the time of construction, and they give you everything that will be needed for the court, right from the beginning.

WHAT IS THE COST OF A TENNIS COURT?

Unfortunately, this question cannot be answered in this type of format because you might be reading this well after it has been written. In addition, the peculiarities and variations of your site can significantly influence cost. The major variables are:

1. The amount of grading necessary to create the site;
2. Any difficulties that might be involved in getting equipment access;
3. The extent of any retaining wall or drainage issues;
4. The degree to which your soils might influence costs;
5. Your specific location relative to bulk material sources.

Your location impacts price considerations because the cost of trucking logically dictates that we have to purchase materials such as base, concrete and asphalt from suppliers closest to your site. These prices vary greatly from area to area, even within metropolitan areas, based upon your proximity to a quarry, hot plant or mixing plant. We have seen as much as a 100% variation in pricing. Generally speaking, smaller remote communities tend to have higher materials costs, and trucking costs limit the feasibility of bringing them in from more distant lower cost sources.

Normally, we can give you a good approximation of cost after conferring with you and this can then be firmed up to a specific quote after we are able to visit the site and determine the closest availability of materials, related trucking costs, access and the other variables unique to your particular location.

THE TIME FACTOR IN BUILDING A TENNIS COURT

Once all permits and approvals are in hand, the time from start to finish will range from around 4 to 8 weeks on average, but can take longer depending on the grading and wall work. Once grading is completed and all the soils work is done, the actual asphalt paving or the pour and finish of the concrete only takes a day. Asphalt needs to cure for a minimum of two weeks and concrete needs to cure for up to 30 days (determined by weather), before surfacing can take place. During the curing time, generally the fencing, and/or lighting, is installed and is then followed by the surfacing and color coating.

The surfacing requires that the court slab (not the air temperature) has to be at or above 55 degrees. Some degree of sunshine to assist the materials to dry and cure is also desirable.

YOUR GENERAL CONTRACTOR

In our opinion, it is very important that you select a contractor who specializes in building tennis courts. Not only one who specializes in courts, but also one who owns and operates his own equipment, operated by his own crews and employees for the majority of the work to be performed. You also want a contractor who can do the whole job from beginning to end, that is, grading, excavation, drainage, retaining walls, viewing area, lighting, both concrete and asphalt, surfacing, fencing and final color coating and surfacing. If you follow these criteria, your odds of having a good quality, trouble-free court built at a fair and reasonable cost, are greatly enhanced.

Some major construction firms also build tennis courts when their regular business slows down. What they can't or don't know how to do, they subcontract out to others. As already mentioned, many smaller paving and concrete finishers put in courts when their regular business is slow. Quality tennis court construction is a highly specialized field, and unless the crews working on your court are used to doing it day in and day out, you are very likely to end up with driveway or parking lot standards, and not tennis court quality.

At the time you enter into a contract it should spell out a specific time sequence for payment AFTER work has been done. It goes without saying, that your contractor needs to be licensed. If you hire an unlicensed contractor, you are dramatically reducing your possible remedies should you run into a major problem with the contractor. Unlicensed contractors are also normally uninsured contractors. This creates a significant potential liability for the owner.

Before the contractor starts work, insist that he gives you "proof of insurance," (both liability and workers' ompensation). Under California law, if the contractor is not covered, you can be liable for any injuries sustained to workers on your site. If you are subbing the work out to several subcontractors, you can in fact be determined to be a general contractor and accumulate the potential liabilities, such as responsibility for injuries, withholding, etc. You can make a meaningful judgment as to the degree of protection your contractor is going to give you, by the extent to which he voluntarily offers these types of protections in his proposed contract. You shouldn't have to negotiate to get these protections. They should be offered.

ADJACENT LANDSCAPING

We have already touched on the problems of trees which are too close to courts and irrigation systems that place water into soils immediately adjacent to courts. Large bushes, such as oleander, have sizable root systems and also need to be kept away from courts, unless the courts are protected by root wall systems. With plants close to courts, the preferred means of irrigation is a closely monitored drip system. By all means, avoid the sprinkler that causes water to run onto the court. This will stain the court and dramatically reduce the appearance of your windscreens.

POSTSCRIPT

This booklet gives you a tremendous amount of information about the best ways to design a court, the best ways to build a court and some of the basic protections you should have in dealing with your contractor.

In many cases you will find that some contractors will agree to anything to get a contract, and that many will add a variety of things to their proposals if you insist. If a prospective contractor for your court doesn't voluntarily offer the ingredients of quality that go into a court, or if his proposed contract isn't precise and easy to read with clear cut specifications (the kind of document YOU want to have in court), or if the offered contract doesn't give you some of the basic protections to which you are entitled, you have a serious concern about whether you have the right contractor.

Our best advice is for you to not let prospective contractors know of your newly found tennis court knowledge. Just listen to what they have to say and ask the appropriate questions. After their appointment and presentation is complete, ask that their written proposal precisely explain how they intend to build the court, and include any other matters that they think should be in the contract, (such as guarantees and other protections).

Evaluate the contract to see if it protects you and gives you the quality of court that you want. Then, look at the price. If you are like most people, you don't mind paying a fair price, but you only want to pay for the court ONCE, not over and over again because of problems and repairs.

CONSULTING SERVICES

We provide a consulting service to cities, schools, tennis and country clubs and others to assist them in determining specifications for either new court installations or for court renovations. Through this process, we are able to relay up-to-date information about the best ways to achieve the desired results. In many cases, these written specifications are used to obtain a competitive bid.

MULTIPLE COURT INSTALLATIONS

If you are charged with designing multiple courts for either a private club or for a public court facility, you will find just about everything previously discusses, is directly applicable.

We also offer the following thoughts:

1. Public courts, especially the surrounding fencing, tend to take a tremendous beating. For this reason, it makes a great deal of sense to eliminate the lower tension wire and replace it with a lower "cap rail" which is a lower section of pipe to securely hold the base of the fence in place. This better absorbs hits by bicycles, skateboarders, etc. If the fencing is to be 12' in height, you will also want to consider installation of a midrail.
2. The greatest mistake made in designing multiple courts is placing them side by side and only leaving 12' (or fewer) between the two sidelines of side by side courts. While this saves a few dollars in construction costs, it means that players on the side by side courts are going to be forever running into each other. It also means that you cannot safely put either fencing down between the courts or later install necessary light poles down between the courts. It is our advice to allow 24' between these lines and also to put fencing down between them, at least 20' down from each end from the end fences.
3. In order to get the maximum economy out of multiple court installations, the courts should be side by side, on the same grade and share common fencing and common lighting between them.
4. If you opt for fencing between the courts (and we recommend that you do), you can minimize costs by coming down 20' from each end with full height fencing and then drop to 3' 6" fencing for the middle 80' with an open 4' space. You will then find that a gate is not necessary.
5. Plan and allow for future access. It is likely that at some time of the future, some additional equipment will be needed on the courts. You can best facilitate this by planning the access now. Perhaps you can provide space for a gravel path instead of solid trees, and allow extra wide gate access for a later

installation.

6. The appearance of multiple courts in a private club setting can be enhanced by putting in a shaded seating area between the courts. The dividing fence posts at the center of the court can be extended upward and can support either a light weight wooden trellis or a brightly colored canvas awning. This adds to the appeal of the courts.

7. Many clubs have installed automated practice courts and have found them to be a great source of revenue and very much welcomed by club members. These are under-regulation sized courts that have one end, beyond the baseline, sunken down into the ground, so that any tennis balls which get into that area flow down into the base of an automatic ball machine. The ball machine control is at the other end of the court and the net is just a nylon fringe strip rather than a full net. Players wanting to practice can program the ball machine in a great variety of ways, set the sequence of balls and practice to their hearts' content without ever having to pick up a ball.

8. Many school courts have found that they are so abused by skateboarders, etc. that they have adopted policies of keeping courts locked other than during school hours and tennis team events, etc. Therefore, it makes sense to plan for locking gates.

9. Many public courts get phased-in lighting at later dates, when funding is available. The eventual lighting cost can be greatly reduced by preinstallation of conduit and footings during original construction, rather than having to rip up courts to install them at a later time.

10. Drainage has already been discussed; however, it needs additional emphasis because of the vast square footage of watershed that comes off multiple courts. Plan for effective drainage to protect the substrata soils.

11. Water fountains are needed near courts. Don't make the mistake of having the overflow go directly into the ground but, rather channel it into the drainage system. We did one city job that required the replacement of several courts because of a water fountain located in such a way that it created massive amounts of underground water flow and subsequent soils movement. The best water fountain is a commercial unit designed for outdoor use which not only cools the water, but also has a small automatic heater unit that protects lines from freezing weather.

12. Typically, multiple courts are designed by an engineer and the landscaping by a landscape architect. In many cases, the coordination of drainage and the impacts of irrigation runoff are lost in the shuffle. In countless instances, we see complete irrigation systems for lawns and shrubs placed immediately next to tennis courts. We are going to be redoing 13 courts at a private club because of excess watering from the irrigation system and a lack of control of other drainage waters.

13. When designing courts side by side, it makes good sense to put flush surface drains down between either every court or every other court. By doing this, you don't inadvertently take a whole bank of courts out of service as soon as you start washing the first one. There are a number of good surface drainage systems available and they should terminate at one of the main drain lines.

SECTION II

MAINTENANCE, REPAIR, RENOVATION AND LIGHTING OF TENNIS COURTS

This section is written to cover issues that range from private courts, homeowner association courts, private clubs and to public courts. Select the information that is applicable.

SIGNAGE --- POSTING RULES

Private club members typically know, or have posted on a bulletin board, policies as to when courts are open and closed, how long players have use of a court during busy times, and policies such as no black soled shoes permitted, no food or drink, no bicycles or skateboards, etc. -- but homeowner association and public courts also need to have this information posted in order to eliminate problems before they

start. Plan on signage locations.

Getting foreign materials into the court surface can be a problem because the court surface is porous and actually "breathes" to allow moisture vapors in and out. This porosity also means that stains can enter the surfacing and leave permanent marks. Not allowing food and beverages onto the court is a good start. This should be followed by allowing only white rubber soled tennis shoes, no bicycles or skateboards or other wheeled toys or vehicles.

WASHING

The single most important protection that can be used to extend and prolong the life of a tennis court surface is regular washing. Grit and dust in the air settles on a court. Twisting and running shoes which act like sandpaper, grind down the surface and wear it away. Club courts need to be washed once a week and the same is true for public courts which receive frequent usage. The unfortunate fact of life is that most public courts never get washed. Homeowner association and private courts, again subject to usage, need to be washed every few weeks to once a month.

The best means of washing is to use a waterbroom specially designed for this task. We had a problem with a club's courts about two years after we had resurfaced them, and found that the courts looked ten years old. The club insisted that it took good care of them with regular washing. We finally solved the mystery when we discovered that they had been using a firehose for court washing, because "it only took a little while to do it that way". High pressure washing isn't needed and simply wears away the surface. Use the proper equipment.

THE RIGHT CLEANING ACCESSORIES

Routinely, we see courts damaged by the use of inappropriate means for cleaning or getting rid of puddles. Brooms do not belong on a court and should only be used as a last resort for leaves and branches, when a blower is not available. Hard rubber squeegees that are pressed against the surface to remove puddles are harsh on the surface and will eventually cause rubber skid marks to appear on the surface. The right way to remove water from a puddle is with either a blower or with a sponge roller that both absorbs and pushes the moisture out of the puddle.

There are a couple of Greater Bay Area clubs which bought an item of equipment that "seemed like a good idea at the time". This was a wheeled, court cleaner that flushed down water, applied a light scrubbing action and then vacuumed up the water. This wheeled unit fit through a 4' gate opening. Today, those clubs have permanent wheel depressions in their asphalt surfacing caused by the summertime usage of the 4,000 pound piece of equipment, mounted on one inch wide wheels.

Properly maintaining a court is hand labor and doesn't lend itself to automation. The complete washing of a court and sponging of any small residual puddles can be done in less than a half hour. This process is also aided by having multiple hose bibs with ready access to each of the courts. Quick-disconnect couplers work well as they tend to eliminate unauthorized use.

TREE MAINTENANCE

A well designed court will not have trees located too close. Many courts do have trees, and they present a number of maintenance problems. The most visible are the droppings of leaves, sap, twigs, bark and occasional branches. Sometimes elimination of the problems requires either removal of the trees or significant branch cutting. If neither of these options are implemented, regular removal of the debris will be required. One of the most irritating problems is fallen sap that sticks to the surface, is not water soluble and, therefore, just stays and builds up. A related issue is that many leaves will stain a court surface as they become wet and then bleach out with a hot sunny day. Some of these leaf stains will eventually bleach out of the surface again, but they leave a dulled mark in the surface.

Leaves allowed to accumulate on a court also represent a liability issue because a player, running back to reach a high, bouncing lob can readily slip and sustain injuries sufficient to create claims, increased insurance premiums, etc.

Adjacent trees also need to be watched closely for roots seeking moisture under the slab of a tennis court. We have seen roots travel over 20 feet in order to get to moisture under a tennis court. Obviously, the type of root structure that a tree has is of great importance. Some have a tap root that goes virtually straight down and others have very large surface roots and still others have both. Roots under a court will raise, and eventually crack, a court surface. You are best advised to approach the problem before the symptoms get out of hand. This entails either tree removal or installation of a root wall. A root wall goes down approximately 4' deep and is normally about 20' long, centered on the tree and between the court and the tree. The wall is completely underground and is, essentially, a trench filled with rebar steel and concrete.

WINDSCREENS

The greatest enemy of windscreens is exposure to water from a sprinkler system. This water exposure causes staining of the windscreens and accelerates the ultraviolet rays deterioration and tearing of the material. Water should not be permitted that close to the courts because it can do a great deal of damage.

Windscreens do not need to be washed and broomed down. Should you definitely need to clean them, do so uniformly, using just a garden hose.

You can add to the life of your windscreens by making certain that they are firmly attached to the fencing at intervals not exceeding 24". A section that is loose and able to flap will, very rapidly become beaten to shreds and begin to tear.

Concerning windscreens, buy either the cheapest (actually truck tarp material) and plan to replace them frequently or, get good quality open mesh material, rather than the solid. The low cost material doesn't need a hem or grommets, but a better material needs a reinforced hem that is quadruple sewn.

When you replace windscreens, try to do all of them at once, as one new windscreen suddenly makes all the others look much older and in worse condition than they really are. Black windscreens have twice the life expectancy of any of the other colors. As of this writing, the best value (cost versus life expectancy) in windscreens is open mesh polypropylene which is border hemmed and has grommets approximately every 24".

NET POSTS AND NETS

Many older courts have bent, damaged or rusted net posts with exterior crank systems that are rusted and barely operative. Unfortunately, most of these net posts are set directly into concrete and replacing them means jack hammering and damaging your playing surface. While you can get replacement cranks and try to straighten the bent poles, the outcome is seldom satisfactory.

Subject to the degree of rust, you can cut the old posts out, insert a metal sleeve which is then welded to both the old and a new post system. This will help bring the court into a whole new realm of appearance.

The old canvas and cord nets are still available, but seldom last much more than a season, as they are victims of both moisture and ultraviolet rays. The best value in nets is found in those with a nylon upper trim which is quadruple sewn with nylon thread, has nylon braided material to form the net, a vinyl steel clad cable and a quadruple sewn bottom seam at the base.

In California, nets get year-round use and are not, therefore, subject to winter removal. There is very little to do with respect to preventive maintenance; however, it is helpful to have a canvas needle and some white nylon thread to reinforce failing seams and get many extra months out of a net.

LIGHTING -- EXISTING

If you are happy with the quality of your existing lighting, you will want to do everything you can to properly maintain it and maximize its effectiveness. Bulbs, just like old tennis players, don't shine the way they used to. Therefore, you should have a regular program of bulb replacement. The means of access to 20' or higher fixtures can be solved by scissor lifts, scaffolding or a tall A-frame ladder. Beware of all of

these leaving tread marks on an asphalt court. At a minimum, the lower glass and the inner reflectors should be cleaned once a year. You will be amazed at the sudden improvement in light. These things get covered with dirt, grime and dead bugs. While this cleaning is taking place, it also makes sense to install some inexpensive strips of one side gummy insulation material you would use to seal cracks around a door or window, around the light housing door that opens which will minimize dust and insect entry.

You will also notice that light housings pick up overnight dew and then drip it onto the court below. If once a year light cleaning includes some spray paint, where needed, you can prevent the rust staining of your court that will otherwise result.

You will find that one-at-a-time bulb replacement is costly unless you actually own the right equipment to do it yourself. Many clubs find that it makes sense to set up a program to replace all the bulbs at one time. They end up with better lighting and a lower effective cost than just replacing bulbs when they burn out.

LIGHTING -- REPLACEMENT AND UPGRADING

Many older courts have the old style lights which have baseball or parking lot types of bulb housings that point up and out at an angle. This type of lighting is no longer favored as it is not energy efficient, and does a very inadequate job of lighting the courts.

If consideration is given to a lighting upgrade, it should start with a photometric analysis, a sectioned diagram of your court(s) showing the actual footcandles of light you are presently getting. We then take your present pole placement and, via computer, see what can be done to improve the lighting through better fixtures and with or without the addition or replacement of poles. This normally produces a number of options that will let you relate costs to FOOTCANDLES, versus what you have at present.

It is very helpful if the individual or committee involved can come to a determination as to the level of desired lighting. This becomes a target for the computerized analysis of the best ways to achieve it.

The bottom line on court lighting is that you want a MINIMUM average of 60+ footcandles on the playing surface without any dark zones. This level of lighting will normally satisfy from the youngest to the oldest players, virtually all levels of play and can also keep the neighbors happy. The neighbor issue is a significant one, because the newer light designs shine directly down onto the court with a minimum of overspray.

When you are thinking about the installation of brand new lighting, be aware that it might require the upgrading of your electric panel and service to accommodate the new energy demand. While this needs to be a potential concern, the opposite can sometimes be the result. Better and improved fixtures give better light and draw less current. New lighting should also be planned in conjunction with any court renovation or resurfacing because this may also entail having to excavate for conduit, poles, etc. and this can be accomplished inexpensively, in conjunction with resurfacing.

COLOR COATING

The symptoms of a need for new color coating are when colors are very faded, specific areas are worn through, the court has alternate fast and slow areas or a combination thereof. In the real world, most asphalt courts are scheduled for color coating well before any of these symptoms occur. In many cases, cracks that need patching will move up the date for color coating. We will talk about cracks and patching in the next heading.

When color coating is decided upon, you should also make a judgment as to any other problems that you want to address on the courts. Water flood the courts and see just exactly what puddling or ponding problems you have. The added cost of removing puddles (see next subheading) and grinding down uplifted areas is minimal when it is contemplated in conjunction with the already planned expense of color coating.

It is important to know that color coating is a business that some folks operate out of a pickup truck. They use the cheapest materials available and they might not be around if you ever have a problem with

their work. Our experience has been that it takes a new worker a minimum of 2 years of day-in-and-day-out experience in color coating before he or she can do a reasonable quality of work. Consequently, you need to use some judgment when it comes to the person hired to do the work. It is more of an art form than a science. All of the materials are applied with a squeegee, not a roller or a paint brush. The mixing of materials with water to get the recommended coverages during the temperature conditions encountered at the time of application, is again an art form.

We are all familiar with "blind items". These are items about which it is really impossible to tell value. Different merchants offer what appear to be the same thing, but at great variations in price. Color coating is this type of a "blind item". There are very low cost and low grade materials on the market and there are applicators who water down the product, skimp on the number of coats and use inexperienced personnel. While their courts look good when they leave the project, the courts simply don't have the life expectancy that they should. The sand needs to be thoroughly screened and of relatively uniform size. This is hardly the type of material obtained by one local applicator who gets his sand from nearby beaches, where he runs it through a sieve and bags it.

All of the acrylic color coating materials are diluted with a certain amount of water to match the temperature conditions at the time of application. Applicators can easily dilute the product down so that the actual amount of coating material is minimal. Watered down paint on a house will have exactly the same problems as watered down acrylics on a tennis court. You need to specify that they be applied per manufacturer's specifications and be prepared to either audit the correct application or trust the reputation and integrity of the firm that you have hired. You must know that the work will be done correctly and that if there are ever any problems, this firm will take care of them.

When you have your court(s) color coated, it is important that you get a written, minimum one year guarantee which covers peeling, flaking, delamination or surface cracking (don't confuse this with cracking of the asphalt).

Color coating is a place where it pays to use premium grade materials and experienced personnel. Consequently, your best value will normally not be the lowest bidder. Inferior materials or quality materials incorrectly applied will be characterized by sand working loose, a rapid fading of the brightness of the colors and wearing of the materials.

REPAIRING CRACKS, UPHEAVALS AND DEPRESSIONS IN COURTS

When you get cracks in an asphalt court, it is vital to understand that you are looking at a symptom, rather than the problem. Patching a crack and recolor coating is going to temporarily hide the symptom, but will do nothing to prevent it from recurring. You might optimistically disagree with the preceding statement, but we can assure you it is 100% accurate, even though a court will look perfect after patching and recolor coating. The cracks will return!

The following represents a listing of the types of cracks that you may encounter, followed by a brief description of each. Following these "definitions", you will find that the next section explains the most probable causes of each of the types of cracks and the alternatives with respect to repair or renovation.

HAIRLINE CRACKS --- very narrow, both sides of the crack level; the crack has been there for a long time and has not grown in either length or width;

VERTICAL DISPLACEMENT CRACKS --- cracks of varying widths where one side of the crack is higher than the other;

UPHEAVAL CRACKS --- a crack of varying width where both sides are uplifted;

DEPRESSIONS --- low spots that are saucer shaped in varying sizes;

UPHEAVALS --- high spots, like an upside down saucer, with the areas of varying sizes;

LINE CRACKS --- cracks that are primarily on, adjacent to or follow the playing lines;

NET POST AND CENTER TIE DOWN CRACKS --- circular cracks around these areas;

GROWING CRACKS OF SIZABLE LENGTH --- varying width, growing in width and can be measured as being wider when the slab is cold and narrower when the temperature is higher;

CRACKS THAT ARE PARALLEL TO AN EDGE OR END OF A COURT --- these cracks are clearly parallel to an edge or end of the court and over a period of time they develop into multiple rows, a few or several inches apart, and reach back into the court surface;

CRACKS THAT SEEP WATER --- varying widths and length; water comes out of the cracks for a few days after it rains and there are normally slight stain marks left from where the water has evaporated and left calcium or other deposits;

NICKEL SIZED UPHEAVALS THAT BLEED --- these range from dime to quarter sized upheavals (bumps) that grow; eventually, the top breaks open and they bleed and stain the court with a brownish red color;

SLIGHT UPHEAVALS THAT HAVE AN OPEN HOLE CAVITY --- they start out as described just above and ultimately become slight upheavals with an open core, much like a miniature, collapsed volcano.

We will deal first with concrete courts and then address asphalt courts. Concrete courts that develop cracks seldom become vertical displacement or very wide as the steel rebar reinforcement holds the slab together. An exception to this is where a major root has been growing for a significant period of time. This can cause vertical displacement upheavals and bend the rebar (and sometimes actually break it), and in the upheaval process, the cracks can become relatively wide. If the crack is relatively short in length (not all the way across a section of court), it normally means that it has not become an expansion crack, one with significant movement related to temperature changes. These cracks can normally be completely sealed by the use of a specialized concrete epoxy adhesive that bonds both sides of the crack together. The joint itself becomes stronger than other sections of the concrete. After the epoxy is applied, color coating completely hides the repair.

If a concrete court has developed an expansion crack that opens and closes with temperature changes, an epoxy application will only cause the court to crack again right next to where the original crack was located. The movement of the slab is not to be denied. In this instance, you fill the crack with a permanently pliable waterproof material that has a sanded upper coating. This material bonds to both sides of the crack and the sand permits the surfacing materials to bond to it. This pliable material allows the crack to expand and contract, yet maintain a watertight seal to stop entry of water to stimulate soils movement.

When it comes to asphalt, repair gets a little more complicated.

HAIRLINE CRACKS are very narrow and, typically, relatively short in length. These cracks (that have not grown in some time), can normally be filled with an asphalt emulsion material which usually prevents their return. In many instances, they are caused by the evaporation of oils and binders in the asphalt. The surface material has shrunken and cracked. These cracks are surface cracks and usually do not go all the way through the asphalt slab. This type of cracking is prevented in driveways, roadways and parking lots by slurry sealing the keeps the asphalt "tight". The color coating and surfacing materials on a tennis court perform a similar function.

VERTICAL DISPLACEMENT CRACKS are dangerous on a court because tripping becomes a major hazard. They are almost always the result of underlying soils movement, caused by expansive soils having varying degrees of moisture. This action has pushed up the surface, broken the asphalt and the course of "least resistance" is to allow one side of the crack to be lifted. The message is, that you have underlying soils problems and moisture is getting into the soils. Because the rupturing of the asphalt is so complete, temporary grinding down and patching is virtually guaranteed to fail. You need to address the moisture getting under the court (the least expensive approach) and/or digging out the court, reworking the soils and putting down new asphalt OR you can consider remedial moisture remedies and what is call

an OVERLAY (see later discussion).

UPHEAVAL CRACKS are usually indicative of root damage. This is a root growing under the slab and lifting the asphalt to the point of cracking. The upheavals and cracks normally have a pattern that can be followed to determine the location of the offending tree. We recently had a mystery court with classic upheaval cracks (indicating roots) but we found nothing but lawn adjacent to the court. Later, the owner "remembered" that a tree had been removed a few years earlier. The solution is removal of the asphalt, excavation of the root (you can't leave it to rot and collapse the asphalt), compaction of all of the soils and then hot patching with new asphalt. Attempting to bond new asphalt to old almost invariably means that a crack will appear between the two surfaces.

DEPRESSIONS can be paving defects that were not fixed at the time of surfacing or, more likely, caused by underlying soils that have settled. Underground soils will settle because they were not properly compacted in the first place, or because water is flowing into them and erosion or natural compaction is taking place. The good news is, that if it isn't water related, once the settlement has taken place and stabilized, the depression on the court can be filled in a number of different ways and then be followed by color coating without a high incidence of recurrence. Carefully investigate depressions along the side of a court area as these can also indicate settlement of a hillside or some other type of earth movement problem.

UPHEAVALS in many cases are underground soils that have expanded, but not enough to crack the surface. Look to soils moisture related problems or excavation and remedial soils work. If the situation has stabilized, it is possible to grind down the uplifting or heat up the asphalt to remove a sufficient amount to level the area, followed by color coating. The other major cause of upheavals is underground growth of a root or some form of plant life.

LINE CRACKS are normally the result of the application of too much line paint which caused a heat differential from the lines dramatically reflecting more sunshine (and therefore more heat) than the adjoining surfaces. The resulting varying rates of expansion cause the asphalt to crack. If the cracks are limited to the surface (i.e. not through the entire slab) they can normally be repaired and recolor coated. If the lines are applied correctly, there is hope that they will not reappear.

NET POST AND CENTER TIE DOWN CRACKS are caused by the concrete footing coming flush to the surface. Thus, the adjoining asphalt and concrete with different rates of expansion soon crack. Normal patching and color coating soon has these returning. Best solution is to thoroughly clean

the cracks, widen them to about 2/16" and fill them with a permanently pliable waterproof material (upper surface containing sand) that can accommodate the expansion/contraction movement without reopening and admitting water.

STRAIGHT GROWING CRACKS OF SIZABLE LENGTHS might have started out as a "cold joint" (when the court was built a portion of asphalt cooled before the adjoining layer was placed next to it) or it might have been created by soils movement. In almost all cases it is soils movement that has found "the weakest link in the chain", a seam between two sections of asphalt. This has caused a relatively straight-lined crack. Irregular cracks of considerable length are unrelated to any paving issues and are simply underlying soils movement that has cracked the surface. Once these cracks are above a certain size, you can never patch them and keep them sealed because they have become entirely separate slabs as far as concerns expansion and contraction. Even pliable sealant in them will be ruptured. Again, you need to look at water related, issues, remedial soils work and consider an OVERLAY (see later text).

CRACKS PARALLEL TO ONE END OR AN EDGE OF A COURT are where they are because they are signaling that adjacent and underlying soils are moving and causing the cracking. They fall into three general categories: those that are water related those that are hillside related, or a combination of the two. If the area adjoining the court is relatively level, the cracks are telling you where the water is coming from. It is coming in from the edge of the court, soaking back in under the slab, causing the soils to expand and contract and subsequently cracking the asphalt. Solve the water intrusion and you will have taken a big step toward solving the cracking.

If the edge of the court near these parallel cracks is a downward sloping hillside or embankment, put a

level on the fence posts. The chances are you will find that they are leaning outward. What is happening is that the embankment is slowly settling and as it settles, it is moving the edge of the court out and slightly downward. This action causes the cracking and the settlement. Soils such as this might not have been properly compacted, or they are moving because the sloped embankment is too steep and, in all likelihood, these soils are getting water into them. As the water gets into these adjacent soils (runoff from the court or from under slab water flow) it facilitates expansion/contraction movement that is also impacted by gravity, which causes it to settle down and outward.

Address the water issue and you will address the settlement. Downward and outward settlement can be resolved by a retaining wall, with either piers or a foundation down into solid material.

CRACKS THAT SEEP WATER are a clear indication of what is called hydrostatic pressure. That is, water getting in under the slab and pushing up. Patching of these cracks is difficult because you not only have the normal problems of asphalt patching, but you also have the underside water pressure. Search for how the water is getting there and sometimes you can solve the issue by vertically drilling in under the court and inserting a perforated drain line to bleed the moisture out of the soils. Again, attach the underlying problem, not the symptom.

NICKEL SIZED UPHEAVALS are caused by what is called "reactive aggregate" in the asphalt. This aggregate has iron ore or a closely related compound in it and moisture in the asphalt has seeped into the aggregate and it has begun to rust. As it rusts, it expands, causing the uplifting. It will eventually pop open with a slight opening and the rust will start to drain out. This rust stains the court and the staining will continue until all of the material has drained out and these become slight upheavals that have an open hole cavity.

SLIGHT UPHEAVALS THAT HAVE AN OPEN HOLE CAVITY. The first thing to accept is that there is water under the court (hydrostatic pressure) which is forcing its way into the slab. The second issue is that the asphalt contains reactive aggregate. Color coating over the stains will look good for a few months, but the stains will bleed through again. The first step is to address how the water is getting under the court. The next step is to examine the court during the early morning or late afternoon, or by flashlight, conditions which will more clearly reveal the upliftings. Each uplifting needs to be dug out, the reddish/brown powdery material cleaned out and the cavity patched before recolor coating. It is labor intensive, but it is the only way to permanently get rid of the problem, provided you have solved the source of the water intrusion.

A GENERIC STATEMENT ABOUT CRACK PATCHING ON ASPHALT COURTS

From time to time, a variety of repair people have come up with creative "gimmicks" to fix cracks in asphalt. These include epoxies, reheating the cracks (by torch, laser or some other means), etc. The bottomline is that these kind of repairs have a dismal track record. If any of these approaches really worked, one of the first things you would see is extensive testing and use of these methods by CalTrans and other cities and counties which maintain thousands of square miles of asphalt. These are the people who really know asphalt and they know what works and what doesn't. Epoxies don't work because the sides of an asphalt crack are very difficult to bond to and getting something to stick to a crumbling surface is next to impossible. Even if you can get it to stick to the outer layer, it soon separates very easily from the next inner layer.

The reheating gambit also overlooks two proven facts: the aggregate in asphalt is the strongest part of it, and it is almost impossible to bond new (or reheated) asphalt to old asphalt and have it strong enough to overcome soils movement or expansion and contraction pressures which caused cracking in the first place. We have seen numerous installations of "reheated" or "laser heated asphalt" courts that have re-cracked within months of doing this relatively expensive work.

Once asphalt cracks, other than the exceptions stated herein, if the underlying causes are not addressed, the cracks are going to come back. Even after addressing the underlying issues, patched or reheated asphalt will still tend to re-crack because these cracks have become expansion joints. Short of taking out the offending soils and cracked asphalt and starting over from scratch, the most effective approach is to do an asphalt OVERLAY.

ASPHALT OVERLAYS

If you have a badly cracked asphalt court, even after addressing the water related issues, you still have a problem. The problem is that, almost invariably, part of the issue has been the underlying soils which need to be either reworked or taken out entirely, replaced and followed with new asphalt. This usually costs a significant amount and the cost can be accelerated by limited access to an already existing court.

After addressing moisture related drainage and settlement problems, you can hopefully assume that the soils under the court are going to settle down. AT this point, crack patching and color coating will make the court look good until the heat/cold induced expansion and contraction causes the old cracks to reopen. Once they reopen, they will allow water directly into the soils and the cycle will start all over again.

An option to this scenario is a process call an OVERLAY. This involves patching and sealing the cracks, bonding over them with a very high strength material and then covering the entire court with a heavy duty paving fabric which is bonded down with a hot asphalt oil. The entire court is then covered with 2" of new asphalt, sealed and color coated. Net posts, center tie down and gates are raised approximately 2" and you virtually have a brand new, much stronger court than the original court. We have had excellent success with overlays. In addition to the basic overlay, it also makes sense to use special high strength sheeting materials to bond those specific areas that have cracks and then apply the overlay right over the bonding.

Asphalt OVERLAYS are routinely used by Cal Trans and just about every other jurisdiction in California as the best method (in addition to remedial soils and drainage work) for repairing cracked and damaged asphalt surfaces. You might have seen the large wide rolls of black material being used by Cal Trans crews. It is laid, bonded down to the old asphalt with hot oil before the new asphalt is paved right over it.

BENT FENCING

Fencing can appear to be bent if settlement is taking place when the fence foundations are starting to lean out. This can be remedied by solving the reason for the settlement.

Fence posts that have been bent because of high winds need special attention. Just pulling on them tends to put a new bend just above the first bend, which leaves them unsightly. The answer is to "sleeve" them. The sleeve is a new pipe with an outside diameter that is just slightly smaller than the inside diameter of the existing bent posts. The sleeve should be as long as the existing post and when you use a block and tackle to pull on the bent posts, the sleeve reinforces all of the pipe above the bend, so that your bending pressure is concentrated in correcting the bend. As the post straightens, the sleeve slides down inside the original post, you cut off the top and replace the cap and you have not only straightened out the problem, but you have permanently reinforced the fence posts.

PREVENTIVE MAINTENANCE VS. REPAIR AND RENOVATION

As with most things, building them correctly in the first place provides the lowest cost form of ownership. This is closely followed by regular maintenance and attention to preventive maintenance. A case in point is when cracks first appear in a court. If they are immediately sealed, you can stop water from seeping into the cracks, which reduces the deterioration of the asphalt itself and the damage caused by the seepage into the underlying soils.

Whether you have a single court or are responsible for 20 courts, they represent a significant outlay of capital. Intelligent maintenance can protect and preserve the investment.

CONCLUSION

We thank you for having taken the time to review far more information about tennis courts than you ever wanted to know. We trust that you will retain this booklet for future reference and, as a reminder, to call Saviano Co. Inc., "the tennis court experts" whenever you need tennis court related assistance.

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