

# Riding Arena Footing Material Selection and Management

## Riding Arena Surface

Unfortunately, there are no universal recommendations for the perfect arena surface or footing material. A “perfect” arena surface should be cushioned to minimize concussion on horse legs, firm enough to provide traction, not too slick, not too dusty, not overly abrasive to horse hooves, resistant to freezing during cold weather, inexpensive to obtain, and easy to maintain. Cost of footing materials is dependent on local material availability and transportation expense. The intended use of the arena for jumping, reining, or driving, for example, also influences footing material attributes such as traction and depth of loose material. Manufactured or trademarked materials are options that depend less on local availability and provide more guarantee of uniformity in material properties. Naturally occurring inorganic materials (sand, etc.) are offered by quarries that can provide raw materials or mixtures that have

defined characteristics of particle size and composition.

A handicap to recommending a strict formula for footing materials is that materials vary greatly around the county and country. For example, sand from one location is often very different from sand in another location. Local terms for materials can vary widely and contribute to the confusion. However, it is possible to develop some guidelines and use common sense to get a good, workable footing material. Quarried inorganic materials (sand, stonedust, gravel, road base mix) from quarries can be designated according to standard adopted nomenclature that relates to particle sizes and the distribution of sizes found in the purchased product. Particle size distribution describes a footing material in a “standard” format. The distribution is determined by shaking the footing material through a set of sieves that have increasingly smaller holes so that finer material ends up on the lower sieves while larger particles are held on the upper sieves.



## Table of Contents

|                                           |    |
|-------------------------------------------|----|
| Riding Arena Surface.....                 | 1  |
| Understanding Footing Raw Materials ..... | 3  |
| Common Footing Materials .....            | 4  |
| Challenging Footing Materials .....       | 6  |
| Locally Available Materials .....         | 7  |
| A Footing Recipe to Try .....             | 7  |
| Characterizing Footing Materials.....     | 7  |
| Dust Management .....                     | 8  |
| Water Use and Techniques .....            | 9  |
| Surface Maintenance .....                 | 11 |
| Summary.....                              | 12 |
| Additional Resources .....                | 12 |
| Acknowledgments.....                      | 12 |

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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone 814-865-6713.

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Produced by Information and Communication Technologies in the College of Agricultural Sciences

Code # UB038

3M6/06mpc4502

Footing is actually a rather dynamic material that undergoes compositional and property changes with time and use. Almost all arenas will have manure “naturally” mixed in over the years and the result can be a good, workable footing that no longer has a simple description. In addition, footing materials break down from the impact of horse hoof action. In some cases, the arena surface started as one material that broke down into smaller particles or compacted over time. As older material breaks down, these arenas are topped off with fresh material that may be different to support or renew the property that was lost. Many successful arena surfaces

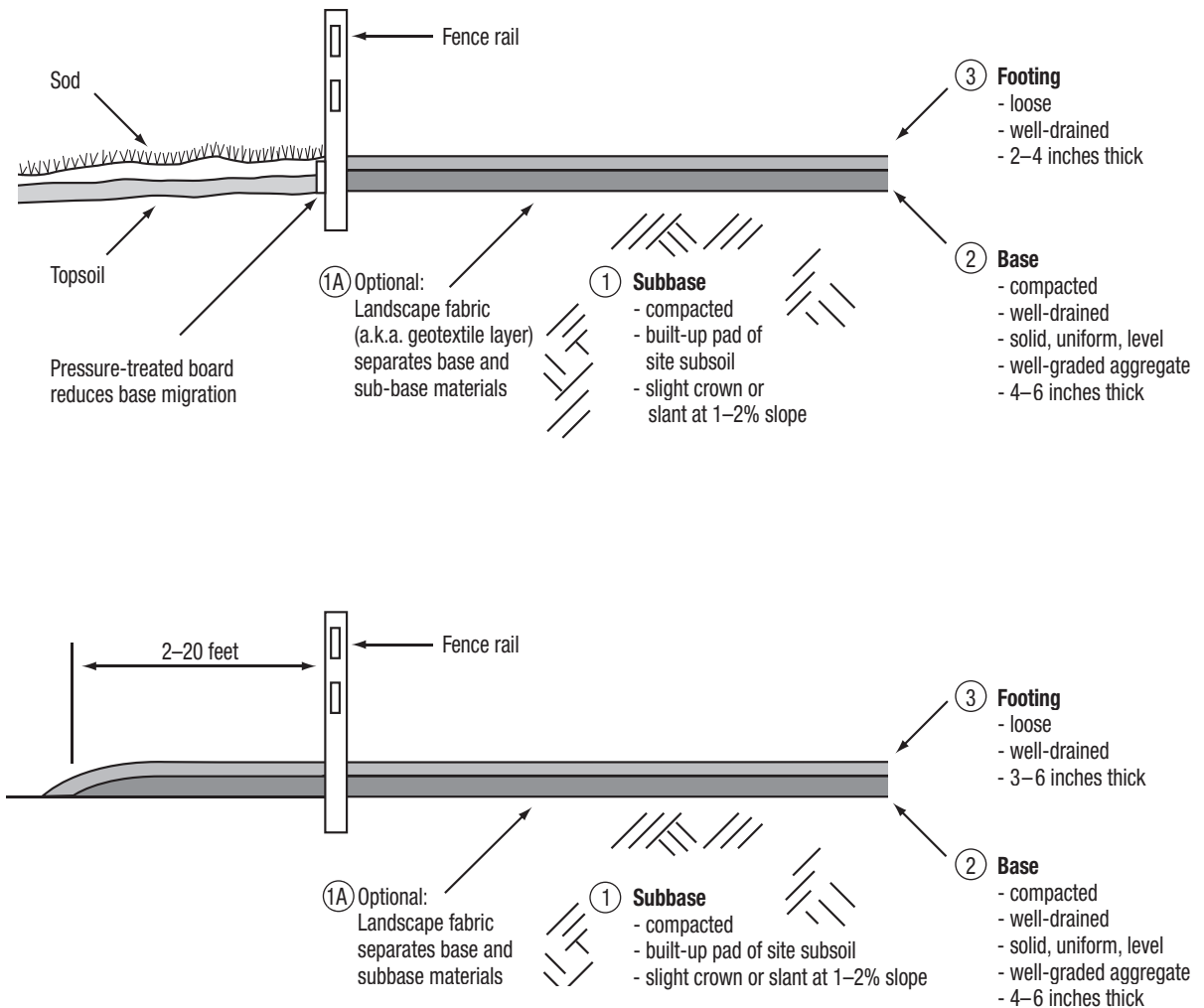
start out as a composite of two or more materials.

Regardless of type, most arena surfaces will need amendment at least every couple of years since arena footing material does not last forever. Every 5 to 10 years, plan on a complete footing replacement or at least a major overhaul. Even with proper management, the best, most carefully selected footing materials rarely maintain their good attributes indefinitely. The key is to learn to manage what you have at all stages of its “life.”

This bulletin focuses on arenas that have a moderate to high amount of horse traffic, such as at a commer-

cial facility. A private backyard arena, used once or twice per week, would be exposed to much less wear and tear and may suffice with a simple arena design. Most importantly, it has been proven that a successful arena surface is no better than the underlying foundation of base and subbase it rests upon (Figure 1). A good indoor or outdoor arena surface is just the top layer of a multilayer composite. The base material is hard-packed material similar in construction to the base supporting a road surface. See the Additional Resources section for publications with base and subbase layer design criteria for arena construction. The loose footing material

**Figure 1. The footing material is only the top layer of riding arena construction and is dependent upon the support of a suitable base and sub-base.**



discussed in this bulletin is installed on top of this supporting base. The footing needs to “knit” to the base material, meaning that loose footing is not allowed to freely slide along the compacted base as horses work in the arena. Knitting is naturally achieved with some footing material selection and is designed into other footing material installations.

Footing materials used on a farm’s indoor and outdoor arenas may be different. Consider the conditions and use of each arena. For example, the indoor arena may be primarily used during cold-weather months with an outdoor arena used the other seasons. The outdoor arena may have to shed considerable quantities of rainwater and snowmelt with the expectation that most footing material will stay in place, so a well-draining, heavy material that does not float would be desirable. An indoor arena footing mixture that holds moisture longer will reduce the need for frequent watering. The indoor arena surface material may incorporate salt for dust control via moisture retention. Alternatively, a wax, polymer, or oil coating may be added to reduce dust.

## Understanding Footing Raw Materials

The primary principle of selecting footing materials is to obtain materials that maintain their loose nature without compaction while providing stability for riding or driving activity. The major component of most footing is a mixture of naturally occurring sand, silt, and clay particles. In a sieve analysis (available from most industrial mines or sand producers) these are listed from largest to smallest particle size. In addition to the particles of sand, silt, and clay in the footing mixture, there can be organic material (original and/or added through horse manure droppings) and perhaps additives such as coatings, synthetic fibers, or pieces

of rubber. Compaction occurs when the voids between particles fill with smaller particles, thus “bridging” the matrix of particles together. Compaction is a function of the range of particle sizes and particle shapes found in the material. For the discussion that follows, “think small” while picturing common particle shape and its relation to neighboring particles.

There appear to be two main approaches to arena surface material selection. On one front are those who prefer to start with a large portion of the footing composed of the native soil. They then frequently manipulate the surface with equipment to achieve the desired riding characteristics. The other approach designs a surface composed of delivered materials that meet criteria for the expected arena activity. Both approaches will work. The approach chosen often depends on local soil conditions and availability of locally mined raw materials. Most of the discussion that follows in this section relates to designed surfaces. When one works with the native soil as a primary component, the decision to use this material is a local one based on soil characteristics at the site. Soil is not the same throughout the country or even throughout the farm. For this discussion of arena footing materials, it is instructive to outline characteristics of suitable materials, which then allows evaluation of the suitability of local soil.

The range of particle sizes is the first key component for selecting footing materials. When footing is primarily composed of materials with one particle size, it cannot compact. In the extreme, this can be such a loose footing that it is unstable without much “purchase” for changes in direction or speed while riding. In contrast, when a widely graded material is used, many particle sizes are present (up to the maximum size you specify). With this wide distribution of particle sizes, the smallest particles fill the gaps between the larger particles

so that eventually the materials are effectively contained in a smaller volume, or compacted.

Aggregate particle shape is the second key component in footing material selection. Sharply angular materials (like manufactured sand or stone dust) are more prone to compaction than “subangular” particles. Sharply angular materials fit tightly together and have smaller void spaces between the particles than the less angular particles. Subangular particles have already had the sharpest corners broken off so they do not fit as tightly together and provide larger void spaces between particles. To help visualize this, picture a brick placed next to adjacent bricks. Visualize new bricks that are sharply angular placed tightly and evenly so that the spaces between adjoining surfaces are even and very narrow. Now visualize bricks worn over time into a subangular shape with broken corners. Placing these subangular bricks tightly against each other will leave more space between bricks. An arena surface that is composed of subangular particles will be relatively stable because the wide range of particles can nest together without rolling (round particles will roll), but will not compact because the rounded edges have voids between them that provide cushion. Manufactured particles fit together like pieces of a puzzle and have no air space and, therefore, no cushion.

Particles need some angularity to offer resistance to movement between them. Round particles would appear to offer the biggest void space between adjacent particles, thus being less compactable. But a footing primarily composed of round particles is not suitable since there is too little stability between particles. Picture a giant-scale footing composed of ball bearings or marbles. Beach and river sand have rounded particles through the wear of water action that has removed most angular corners. These

rounded particles only have stability near the shoreline where they are saturated with water. Subangular particles offer resistance to movement between particles without the rolling action found with rounded particles. The subangular particle shapes are typical of naturally occurring, mined materials. Naturally occurring sands have had the sharpest corners of their originally sharply angular particles broken off. These mined materials are more durable and provide better traction and stability due to their shape and are less prone to becoming dusty than manufactured materials. Crushed stone or gravel is manufactured and will be sharply angular until it erodes over time through use as the arena footing. This erosion of the sharpest corners of particles eventually makes them subangular, but the former corners leave fines that have potential to loft as dust. Not everyone lives within affordable delivery distance of mined sand, so understand and learn to manage what is available in your area.

Another aspect of particle shape relates to the fine particles within the footing matrix that are composed of silt or clay particles, depending on the gradation of sand that you choose. Within the finest particles of arena footing, clay's flat particle shape is more prone to becoming slippery when wet since these particles easily slide over each other compared to the more angular silt and sand particles. A footing mixture with a large portion of clay or silt particles will also be dusty when dry since these super-fine particles loft easily. In addition, the small clay particles easily "cement" the larger particles together by filling void spaces between them.

When compactable material is desired, such as for an arena base, stall floor base, or under a building foundation, use a widely graded, manufactured material that has angular particle sizes that range from very fine to the largest size you specify (usually

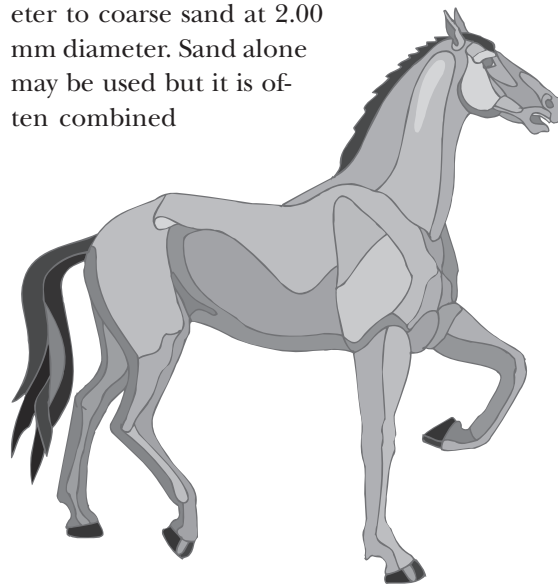
no larger than ¼ inch; any larger can bruise a horse's hoof). Crushed stone is the product most useful as a compactable base material.

When a noncompactable but stable footing surface is desired, choose an evenly graded material so that the majority of particles are within a limited size range. Choose a material with subangular particle shape. Type of riding or driving activity will partially determine the stability needed in the arena surface. Evenly graded material will have a range of particle sizes, mostly in the middle range of suitable arena particle sizes, but it does not have the extremes that contain the fines (leading to dust and compaction) and large particles.

A feature that is becoming more important in footing material selection is the abrasiveness of the material on horse hooves. With a relatively nonabrasive material, such as wood products or shredded leather, horses may remain unshod if their primary riding area is in this type of footing. Conversely, sand, stonedust, and other sharply angular, aggregate materials can be abrasive to the hoof wall.

## Common Footing Materials

SAND is the common ingredient in many arena surfaces and ranges from fine sand at 0.05 mm diameter to coarse sand at 2.00 mm diameter. Sand alone may be used but it is often combined



with other particle sizes or other materials. Be careful to apply the proper depth of sand. With its deep, loose traction, sand deeper than 6 inches is stressful to horse tendons. Start with about 2 inches and add a ½ inch at a time as necessary. (Start with only 1½ inches for arenas used primarily for driving horses.) Newly laid sand contains air pockets that absorb shock and rebounds. However, despite its solid, inorganic nature, sand will erode and compact into an unsuitable surface over time.

Sand dries out fairly rapidly since it drains well, so frequent watering is essential. Some managers add a water-holding material, such as a wood product or commercial additive, to the sand footing material to hold water between watering events, hence reducing dust.

Certain specifications of sand are required for good footing material. Riding arena surfaces should contain cleaned and screened, medium to coarse, hard, sharp sand. Fine sand will break down more readily into small enough particles to be lofted as dust. "Cleaned" means the material has been washed of silt and clay, making the sand less compactable and less dusty. "Screened" means large, undesirable particles have been removed and a more uniform-sized

material remains that will be less prone to compaction. "Hard" is quartz sand, which will last up to 10 years. Obtained from a quarry, subangular sand has sharp particles, versus the rounded particles found in river sand. The subangular particles of naturally occurring, mined materials are old deposits of sand that have weathered from natural forces of water (typically) into particles that are still angular for stability as an arena surface. Manufactured

sand is very fine, crushed rock and is also angular, but not as hard as real sand. Angular sand provides better stability than rounded sand particles, which behave similar to millions of ball bearings underfoot.

Sand is often one of the cheapest materials to use for arena footing material, yet the hard, angular, washed sand that is most suitable as a riding surface is among the most expensive sands. “Waste” or “dead” sand contains considerable quantities of the silt and clay particles that are the by-product of “clean” sand and is unacceptable for good arena footing. Cleaned, washed sand alone is too loose for some riding disciplines that require sharp turns and stops, such as barrel racing and cutting. Wetted sand provides much more traction than dry sand, but frequent and abundant watering is needed and this is not realistic in some locations.

Allowing 5 to 10 percent fines (passing through a number 200 screen, which has 0.075 millimeter hole size) in the chosen sand product provides particles that help bind the larger sand particles. More fines than this will cause the sand mixture to become very dusty and slippery when wet. Providing 5 percent fines will allow some binding activity while decreasing dust potential; as the sand wears, the fine particle percentage will increase. For those arena surfaces designed to use native topsoil, 10 to 30 percent of the mixture may be “dirt” with the balance sand. Unfortunately, the fines in either of these mixtures will loft as dust if not managed for dust suppression (see Dust Management section of this bulletin). Fibers, natural or synthetic, may be used to bind loose sand with less risk of adding dustiness but of greater cost than the addition of fines or local soil. A combination sand-soil arena is popular with western riding events where high stability is needed for speed events so the footing can be kept moist and more compacted

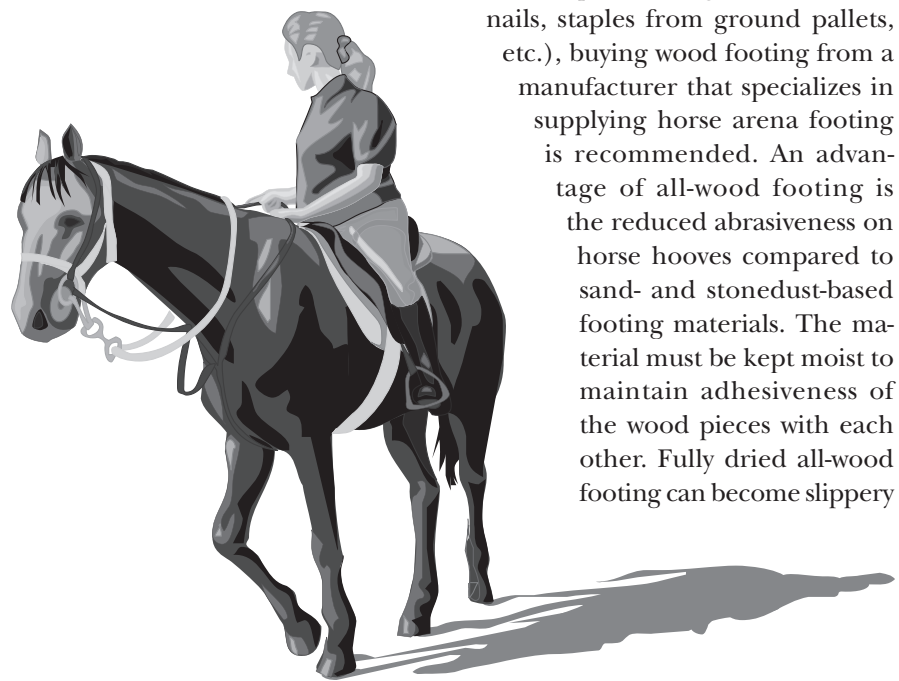
or harrowed into a loose mixture for sliding stops and cutting work.

Other materials, such as wood and rubber, may be mixed with sand to overcome some difficulty encountered when using sand alone. Wood products added to sand footings will add moisture-holding capacity and improve traction while adding some cushioning. Rubber adds cushion to a sand footing and can prolong the useful life of the sand through decreased abrasion of sand particles on sand particles. While rubber can add some cushion to worn sand footing, for old, eroded sand the better long-term fix is to discard the failed surface material and replace with a new mixture. Rubber is a relatively expensive addition to a footing that has outlived its useful life and is best replaced.

WOOD PRODUCTS may be used as the primary footing material or mixed with other footing materials. Wood chips or coarse sawdust will provide some cushioning and moisture-holding capacity to an all-inorganic footing (sand, stonedust). Wood products are quite variable, not only from location to location around the country, but even from load to load at the same wood mill. Any wood prod-

uct will eventually decompose since it is organic, and smaller and softer wood products will break down into smaller particles that will eventually lead to compacted footing. Expect to add more wood product every couple of years as the older wood decomposes. Eventually, some footing may have to be removed to maintain an appropriate depth.

Manufactured wood products may be used as the predominant footing component. All-wood footing offers cushioning in a material with fibers that interlace for traction. Wood footing materials contain pieces that are larger and more durable than wood chips or sawdust and require little maintenance when installed correctly. Wood footing has ½- to 1-inch slender pieces, or wood “fiber” mixed with some finer wood for knitting the wood footing to the base material. All-wood footing is often installed on a 1-inch layer of wetted, washed, angular sand to further tie the wood pieces into the highly compacted base surface. Hardwood pieces will last longer than softwood products. Do NOT use walnut and black cherry hardwood products as they are highly toxic to horses. For this reason and for quality control in eliminating contaminants in the shipment (large wood chunks, nails, staples from ground pallets, etc.), buying wood footing from a manufacturer that specializes in supplying horse arena footing is recommended. An advantage of all-wood footing is the reduced abrasiveness on horse hooves compared to sand- and stonedust-based footing materials. The material must be kept moist to maintain adhesiveness of the wood pieces with each other. Fully dried all-wood footing can become slippery



as the wood becomes more brittle and does not as effectively interlace for stability. In contrast, all-wood footing with large pieces (for example, chunk bark or wood greater than 1 square inch, not slender) becomes slippery when overly wet.

RUBBER from recycled shoes or tires can be ground or shredded into small particles. Rubber source may vary so use products from a horse footing material supplier. Be sure to get a guarantee that the shredded product will not contain metal (from steel-belted tires) or other foreign materials or thoroughly check the load upon delivery. Ground rubber is usually mixed with sand or other surface material to minimize compaction and add some cushion into the surface. Rubber product won't degrade like wood but will break down into smaller pieces through grinding against sand and horse hooves. Its ability to darken an outdoor arena surface color reduces glare and helps thaw the surface faster during winter by absorbing more solar radiation. Pure

rubber tends to be too bouncy and the black color provides significant heat on outdoor arena users. Indoor arena users may notice the rubber odor. Most horses are not prone to eat it should they have free access to the arena footing. Rubber pieces float and with heavy rainfall can separate out of the footing material mixture (Figure 2). Simply reincorporate with surface conditioning equipment. Rubber is added to a sand or stonedust footing at the rate of 1 to 2 pounds of rubber per square foot. Crumb-shaped rubber pieces are suitable to reduce compaction in a sand-dirt or stonedust mixture. Flat rubber pieces (or fibers) will help knit together an all-sand, clean footing that needs more stability. The rubber fibers essentially knit together the entire depth of footing profile to create a material that does not shift as readily as pure sand.

STONEDUST remains in the "common" footing material category but may really belong in the "challenging" category due the high level

of management needed to maintain suitable arena conditions. Stonedust provides good stability, drains well, and can be an attractive surface if kept watered and harrowed. It can be a very suitable footing material when kept damp. It will be almost as hard as concrete if allowed to compact and dry. Stonedust is extremely dusty if not kept constantly moist throughout the entire depth of footing. Stonedust is a very cheap material, which enhances its attractiveness, but frequent, diligent management will be needed to control dust in an indoor arena environment or for outdoor arenas outside of the rainy season.

For footing material, the stonedust (also known as blue stone, rockdust, limestone screenings, decomposed granite, or white stone) should contain a narrow range of grade sizes so that it does not compact easily. Stonedust is a finer version of the road base material used in arena base preparation. If the stonedust in your area is well graded and is suitable as a compacted base material, it will be difficult to keep loose as a footing material. In contrast, when stonedust is not compactable, it can make a suitable arena footing material.

Stonedust mixed with rubber will provide a less compactable footing than stonedust alone while keeping the high-stability stonedust offers for quick changes in direction and speeds, such as jump takeoff and landing activity.

## Challenging Footing Materials

TOPSOIL is hard to define due to differences in local soil types, but the properties that make it useful in growing crops or gardens make it unsuitable for arena footing. Topsoil is not recommended since it is a widely graded material and therefore tends to compact. Topsoil is a mixture of clay, silt, sand, and organic material that provides too many fine particles, leading to dust problems when dried.

**Figure 2. Rubber pieces can float to the top of a footing mixture after large rainfall events. The rubber will have to be mixed back into this stonedust mixture with surface conditioning equipment.**



Organic material breaks down further over time, adding to the dust problem. Topsoil with a large clay portion will be slippery when wet and hard when dried. Not all topsoils drain well so they require more time than the surface materials discussed above to become suitable for riding after a drenching rain. Dirt arenas continue to be successfully used when the native soil contains large quantities of sand particles (more than 50 percent) or is mixed with sand (see Sand section).

**STALL WASTE** (manure and bedding mixture) can be used as an arena footing for the very short term and is admittedly a cheap material. It will be dusty since it is almost entirely organic material that breaks down rapidly into small particles that lead to compaction. Filth of lofted dust and potential for attracting flies can be concerns, as are issues of sanitation should a person fall into it. Odor is unpleasant if the stall waste contains large amounts of manure. Ammonia gas given off by the decomposing urine and feces is not healthy for the horse respiratory system. On outdoor arenas, stall waste is slippery

when wet. Even on indoor arenas, when kept wet enough to dampen the dust, the stall waste surface tends to be slippery. It will need to be replaced at least annually.

### Locally Available Materials

Arena footings composed of shredded leather, industrial by-products, and mine waste have all been used and may be cheap local sources of footing materials. Match the good footing criteria presented above to the properties of the local material to help determine how desirable the material will be.

### A Footing Recipe to Try

This sand and wood product combination has been used successfully at The Pennsylvania State University and in many private arenas. Recipe for 1,000 square feet of arena surface:

**Sand** at 100 lb/ft<sup>3</sup> density

12 tons for 3 inches deep

8 tons for 2 inches deep

**Sawdust** at 15 lb/ft<sup>3</sup> density

1¼ tons (or 6 yards) for  
2 inches deep

½ to ¾ ton (or 3 yards) for  
1 inch deep

[a "yard" is a cubic yard or 27 ft<sup>3</sup>]

### Characterizing Footing Materials

Table 1 presents characteristics of several common footing materials. The characteristics represent those selected specifically for good arena footing (e.g., dust potential). You can see why wood products would be added to a footing to increase moisture-holding capacity and why rubber pieces or sand would be added to reduce compaction. Figure 3 (page 8) offers a look at the footing particle size distributions that were found in six indoor riding arenas located at commercial boarding facilities in central Pennsylvania. (Particle size distribution determines the various ranges of particle diameters in a composite material such as arena footing.)

**Table 1. Characteristics of riding arena footing materials.**

| Material                   | Primary use                                        | Cushion or compaction resistance | Traction improved | Dust | Drainage | Water retention | Slippery when wet | Freezing potential | Durability | Abrasive | Maintenance | Cost |
|----------------------------|----------------------------------------------------|----------------------------------|-------------------|------|----------|-----------------|-------------------|--------------------|------------|----------|-------------|------|
| Sand                       | Footing                                            | H                                | M                 | L    | H        | L               | N                 | L                  | H          | H        | L           | M    |
| Wood products <sup>1</sup> | Footing or additive to increase moisture retention | H                                | M                 | V    | M        | H               | V                 | V                  | M          | L        | M           | L-M  |
| Stone dust                 | Footing or compacted for base                      | M                                | H                 | H    | H        | L               | N                 | L                  | H          | H        | M           | L-M  |
| Rubber pieces <sup>1</sup> | Additive to reduce compaction                      | H                                | M                 | L    | H        | L               | N?                | L                  | M          | L        | L           | H    |
| Soil (not sandy)           | Compacted as base                                  | L                                | V                 | V    | V        | V               | Y                 | H                  | L          | M        | H           | L    |
| Stall waste                | Footing                                            | M                                | L                 | H    | L        | H               | Y                 | V                  | L          | L        | H           | L    |

L = Low, M = Medium, H = High, V = Variable, Y = Yes, N = No

1. Potential contaminants are diminished when materials are purchased from a specialty horse footing material supplier.

Note that the two “sand” arenas were very different in their particle size distribution. This emphasizes why you should be specific as to the desired type of sand (or any other material) in an arena footing. Some materials are sold with a particle size distribution analysis. It is important to keep the fines, or those particles below 0.1 millimeter in

diameter, to a minimum in the mixture. Dust is caused by clay and silt particles, which are 0.001 to 0.005 millimeter in diameter, and should be kept below 5 percent of the mixture. Fine and very fine sands, which are 0.05 to 0.25 millimeter in diameter, also contribute to dust when allowed to dry. The more fines, the more dust potential.

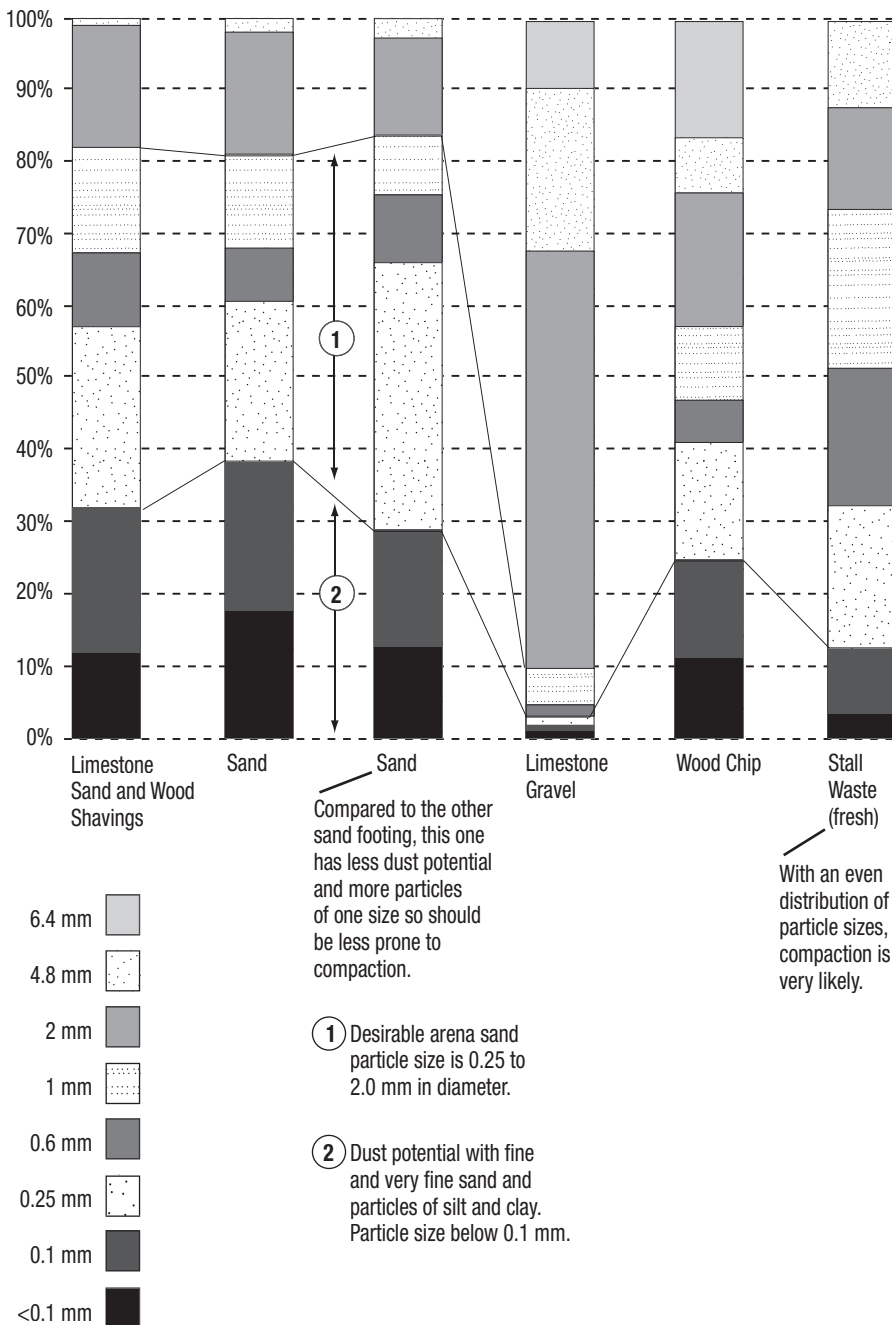
## Dust Management

Riding arenas, particularly indoor arenas, are plagued with dust problems. Dust causes eye and nose irritations and contributes to respiratory damage in both horse and rider. It is estimated that an idle horse inhales 16 gallons of air per minute and during strenuous exercise can inhale up to 600 gallons per minute. Minimizing the amount of dust in this air should be a primary goal in footing material choice and subsequent management. In addition to horse and handler respiratory irritation, dust coats any structure and equipment near the arena. Dust rises from the surface when a large percentage of fines break loose and float into the air. Naturally, lightweight particles are more prone to suspension than heavier particles. Decrease lightweight particles in three ways:

**1. Eliminate fine particles** such as silt, clay, or fine sand in the footing mixture by careful footing material selection. Even coarse materials such as sand and wood products will break down over time into many fine particles, so maintenance is critical to reduce dust. In some footing mixtures, 10 to 30 percent of these materials are deliberately added for stability and water-holding capacity but realize the implications for more diligent management for dust suppression. Generally, if more than 5 percent of material passes a 200-sieve screen, the footing material will have a tendency to be too dusty. With a high percentage of fines, the arena footing material should be partially or wholly replaced. Remove manure deposited on the arena surface before it gets mixed in. Manure will break down into fine particles, contributing to the dust problem.

**2. Moisten particles** to increase their weight with simple, cheap, environmentally friendly water. With no rain occurring in indoor arenas, the facility manager must be in charge

**Figure 3. Particle size distributions of six indoor riding arena footing materials. Minimizing the amount of fine material will decrease dust potential.**





of moisture control. Moisture retention and evaporation is site and season dependent, so weekly checks on moisture level are important. Materials that can hold more water will increase the time between watering events (more about watering in the next section of this bulletin).

**3. Provide an additive** to bind particles together. Many arena surface additives are available. Moisture retainers can be used or the surface amended to capture and hold more moisture on a dry site. Wood chips and other organic materials retain moisture well and can be a first line of defense. Synthetic or natural (e.g., coconut) fibers can be used to intertwine with footing particles to bind the materials together. Crystals and gels, some resembling cat litter, can absorb relatively large quantities of water and then release that moisture into the surrounding footing material as it dries out. Water additives can slow evaporation, increase moisture penetration, or encourage microbes to grow on footing materials for their moisture and binding activity. Peat moss holds considerable water and, when kept constantly damp, is effective at binding a footing mixture. Once peat moss dries it no longer has binding ability and becomes loose and potentially slippery. Fully dried peat moss is hydrophobic and takes considerable effort to rewet.

Oil-based products (such as palm, coconut, mineral, and soybean oil) can weigh down or glue together fine particles—similar to the effects of water application. The first application of oil is used to coat all the footing particles to increase their weight. Subsequent annual or biennial application of oil is of much reduced quantity to coat newly formed particles that have abraded off the original footing particles. The plant-derived oils may become rancid over time. Application of used motor oil is an environmental hazard. Costing more but lasting longer, pharmaceutical-grade petroleum coatings are a

good option for dust suppression and adding stability to a loose surface. Petroleum coating has characteristics similar to Vaseline™ and lasts about 10 years between applications, is UV-resistant, and will not become rancid. Wax coating is even more expensive than petroleum coating but lasts even longer for dust suppression on durable footing materials.

Salt mixed into the footing material is a common dust-suppression technique. The salt holds moisture in the footing and can draw moisture out of the air and into the footing material. The salt releases moisture slowly over time between watering events. It is added to a moist footing so it can absorb water for later release. Salt application rate is 20 to 50 pounds per 1,000 square feet of arena surface area. With watering or rainfall the salt dissolves and leaches out of the footing and needs to be replenished. Salt replenishment is necessary about every 6 months and although lower in cost for initial application, the frequent replenishments eventually make it comparable in cost to petroleum coatings that last much longer.

Calcium chloride ( $\text{CaCl}_2$ ) and magnesium chloride ( $\text{MgCl}_2$ ) are most commonly used since they are less expensive and more effective for moisture holding versus table salt sodium chloride ( $\text{NaCl}$ ). The effectiveness relates to calcium chloride and magnesium chloride having three available ions for binding water molecules while sodium chloride has only two ions. Salt application as a moisture-retention additive dries out hooves, and being a salt, it is corrosive to metal such as indoor arena siding and structural supports when lofted with the dust. Arena managers typically wipe salt from horse hooves, sole, and lower legs once finished using the arena. These salts are effectively and commonly used to reduce the freezing temperature of the footing material during cold weather in northern climates.

## Water Use and Techniques

Watering the footing material reduces dust levels and can put some stability back into loose, sandy, or wood-based footing. Frequent, deep watering will be part of normal arena maintenance, so planning ahead to make it a less arduous task will have long-term benefits. The objective is to keep the material moist all the way through and to have uniform water application over the surface. When an arena is not kept uniformly moist, the loose, dry areas are less stable than the well-watered spots so that horses lose confidence in what kind of conditions will be underfoot as they travel between slippery and suitable conditions.

Water the arena to keep the footing evenly moist to a 3-inch depth. Once the arena is at the moisture level that is suitable for your purpose, use a garden supply store soil-moisture meter to determine that moisture content and strive to achieve that moisture on subsequent waterings. Water an arena as you would a garden. It does not need to be flooded nor does just wetting the top fraction of an inch do any good. Give it a good watering with plenty of water in frequent, short periods. This will allow water absorption into the footing material(s) between waterings. In fact, wait about four hours or overnight before using the arena again to allow moisture to soak in. Once the correct moisture is achieved, subsequent waterings will only be needed to remoisten the top-most surface that will be drying faster than the footing underneath. Watering schedule will naturally depend on season (air temperature), wind, and sun exposure of outdoor arenas, and the indoor arena air temperature and moisture level. Watering when the arena surface begins to show signs of dustiness will preserve moisture in the underlying layer. Check the moisture level weekly and more often when drying conditions prevail, such as during

times of combined low humidity, high temperature, or greater wind speed over the arena surface. On outdoor arenas, direct sunlight dries the top footing layer on a daily basis.

Watering systems include those requiring continuous or frequent human involvement for proper application of the water and those systems that are automated and once installed or setup require little human attention during the watering event. Watering that requires a high level of human involvement includes hand-held spray nozzles, garden sprinklers, and tractor-mounted sprayers (Figure 4). More automated systems include ceiling- or post-mounted spray nozzles and self-traveling irrigation.

Hand-held hose watering takes considerable time and is variable in uniformity of moisture addition. The benefit is that the person watering can treat wet or dry patches of arena surface with more or less water. Garden sprinklers can be set out for timed operation and moved to cover the entire arena surface over time. This allows other activities to be performed by the operator during watering but is likely to be less uniform in coverage than the hand-held technique. Puddles are common when a sprinkler stays in one area too long. Tractor- or pickup-mounted watering can be done in concert with surface conditioning (Figure 5). A frost-proof hydrant should be located near the arena to supply hose or sprinkler-applied water. A hydrant is a convenient tap for filling a water tank that is pulled by truck or tractor through the arena.

Automated arena watering is provided by a permanently installed sprinkler system located along the perimeter of an outdoor arena, throughout the roof framing of indoor arenas, or by mechanized field-watering equipment in both indoor and outdoor arenas. Width of arena and available water source are important factors in determining which type of system will be most effective.

**Figure 4. A tractor- or pickup-mounted water spray tank is a way to partially automate wetting arena surface materials.**



Horticultural or agricultural-grade sprinkler systems (gear-driven rotors or impact heads) are suitable for providing fairly even watering of the arena surface. Ceiling-mounted sprayers (indoor arena) produce a mist of water and good, uniform coverage with proper design. Frost-proof installations are needed under freezing conditions. Landscape sprinklers can be installed around an outdoor arena perimeter to reach the entire surface with water (Figure 6). Indoor or outdoor sprinklers are spaced based on anticipated coverage pattern of the particular spray nozzle. Side-mounted sprinklers require substantial flow rates to spray water distances greater than 50 feet. Greater spray distances provide uneven water application with strips of dry surface between adjacent wetted circles or half-circles. For indoor arenas, the side-mounted sprinklers' uneven water distribution results in too much water applied in some areas, which is a problem since the indoor arena base is not constructed to shed water. The sprinklers may be activated as needed or controlled by a timer.

Arena surface materials may be wetted by mechanized field-watering equipment. A flexible hose traveling system is an effective option for sites with larger arenas or with low-volume water sources. One disadvantage is that the traveling hose has to be set up each time it is used. Once set up, it operates unattended with an automatic shut-off once the sprinkler cart on the traveling hose arrives back at the hose reel. Advantages include more even water distribution than with perimeter-mounted sprinklers and potential to double its usefulness by watering both indoor and outdoor arenas. Installation and maintenance costs of automatic systems are the highest of the footing watering options, but labor is significantly reduced.

Winter watering is a challenge in freezing climates. Too much water and the footing is frozen hard; too little water and dust prevails. This is a particular challenge for indoor arenas where rider expectations are that the surface will be usable year-round. Managers may opt to reduce water additions to the indoor arena as freezing weather approaches. The advantage

**Figure 5. Large amounts of water may be necessary to keep outdoor arena surface dust under control. To more fully suppress dust, more than just the top surface layer needs to be wetted.**



of having a footing material that does not compact is even more important when freezing is possible. Excess water can pass through a well-drained material, such as sand, and not bind particles together into a solid mass. Many indoor arena managers use salt to lower the footing's freezing point during the winter and discontinue its use during warmer weather.

## Surface Maintenance

Horse traffic patterns during arena use will cause the footing material to become uneven. The high-traffic path along the arena rail will take the most abuse. Depending on the riding discipline, high-traffic areas are also located along the arena diagonals, near barrels or poles, and the centerline. The footing within the high-traffic area will be thrown out of the path by hoof action, while any remaining footing will be more compacted where it is most needed. It is not uncommon for the footing material to be almost entirely gone from the high-traffic area with the horses working off the base material. This is very undesirable; footing is

supposed to provide a cushion above the highly compacted base material. Horse hooves contacting the base will cause permanent ruts in the base that are expensive to repair. Footing near jumps also compacts. Surprisingly, the position where riding instructors stand is among the most compacted footing in an arena.

Uneven footing and compacted areas at the rail and elsewhere are resolved with a dragging device to redistribute or break up the footing material (Figure 7, page 12). Dragging should be done even before traffic patterns begin to be detected. Plan to drag the arena at least once per week even for arenas that are lightly used for riding (three times a week or more). Arenas under heavily scheduled use will need the surface dragged once or more daily. Once a deep path of disturbed footing is established, it is difficult to alleviate. Ruts along the rail are common, but frequent redistribution of the footing will keep the rut from becoming chronic. Accumulation of footing at the fence line of an outdoor arena can slow surface water drainage. To make the dragging less time consuming, use appropriate equipment that is easy to hook up and adjust to conditions.

Several options for dragging arena footing back into position are available. A tractor-pulled chain-link fence section (with added weight) or light harrow is adequate for loose footing such as wood products. Dragging devices that cannot be lifted will drag

**Figure 6. Horticultural-type sprinklers can be used in indoor and outdoor arenas to automate the surface-watering process.**



**Figure 7. Equipment will be needed for frequent conditioning of the riding surface to redistribute footing for an even coverage of the base material and, in some cases, to loosen compacted surface materials.**



footing material out of the arena gate as it exits unless it is stowed prior to exit. Finer but heavier footing materials, such as sand and stonedust, will need a harrow with short tines. The tines are dull spikes that are flat on the bottom. Adjustable tines are highly recommended so they may be set to redistribute and loosen the entire depth of footing while not disturbing the base material. Adjustment of harrow tines is a real advantage in surface conditioning to match desired conditions, depth of footing as it wears and compacts, and for use in more with one arena footing material. Make sure the tines are set or purchased short enough so that they do not penetrate the underlying base material. The base is an expensive part of the arena construction and costly to repair if it is accidentally dredged up into the footing material. Heavier harrows benefit from a three-point tractor hitch arrangement to raise and lower the device for entry and exit from the arena.

## Summary

With no common recipe for successful riding arena surface material, understanding the physical principles that one is trying to achieve with the footing can lead to better selection of materials. Once installed, learn to manage the footing materials since each material and mixture of materials will have advantages and shortcomings. Footing will change over time, thus be adaptable and manage the footing material accordingly. Understand the principles of surface maintenance and indication of when footing material needs to be amended or replaced. Footings with sand as a major component are usually successful. Choose hard, angular, washed sand for stability with loose footing composition. The addition of up to 5 percent fines will help bind sand together but with increased need for management of dust. Good footing requires regular, consistent management in dust control and surface finishing.

## Additional Resources

*All-Weather Surfaces for Horses* 1994. Ray Lodge and Susan Shanks. J.A. Allen, London.

*The Equine Arena Handbook, Developing a User Friendly Facility* 1999. Robert Malmgren. Alpine Publications, Loveland, Colo.

*Horse Stable and Riding Arena Design* 2006. Eileen Fabian Wheeler. Blackwell Publishing, Ames, Iowa, and London, U.K.

[www.blackwellprofessional.com](http://www.blackwellprofessional.com)

*UnderFoot: The USDF Guide to Dressage Arena Construction, Maintenance and Repair* 2000. U.S. Dressage Federation, 7700 A Street, Box 6669, Lincoln, Nebr. [www.usdf.org](http://www.usdf.org)

## Acknowledgments

Appreciation to two reviewers who made significant improvements to the original bulletin *Horse Facilities 6: Riding Arena Footing Materials*:

Patricia Comerford, instructor, equine programs

Albert Jarrett, professor, soil and water engineering

When this bulletin was included and expanded into a chapter in *Horse Stable and Riding Arena Design* (Blackwell Publishing), an additional reviewer offered valuable contributions from her experiences providing footing materials: Emlyn Whitin, vice president, Stancils, Inc., Perryville, Md.