Malleable Pea Rock As a Barnyard Footing

Utility and Therapeutic Benefits of a Common Landscaping Material

by Robert M. Bowker VMD, PhD

Most horses in the United States move over pasture during the warmer months and over varying degrees of partially-frozen terrain during the winter months, but a smaller percentage move on more barren, hard surfaces or even more rocky and mountainous terrains. In each of these instances, the horse responds to the particular environment as the foot and its enclosed structures must protect itself if the horse is to survive in the environment, regardless of how hostile or friendly it might be.

The ground surface on which a horse stands and moves is very important in contributing to the overall shape and "strength" of the horse's foot. On softer surfaces, the hoof wall doesn't wear as fast as it would if it was interacting with the more abrasive surfaces. Hence there is often need for human intervention with periodic trimming or rasping the wall and/or the solar surfaces or even with the application of shoes to protect the foot.

Much has been written about the actual care of horse's feet in many of these types of environments and the benefits that each of these surfaces have.

However, in all instances, the ground surfaces must support the weight of the horse with emphasis on that portion of the foot that makes ground contact. While this statement sounds perhaps like very common sense, it becomes very important for the health of the foot to be dependent upon a relationship between 1) the ground surface; 2) the area of the foot that is supporting the weight of the horse; and 3) the weight of the horse, of course.

If either the ground surface is inadequate to support the horse or the foot and hoof are too small for the horse or the weight of the horse is excessive for the foot, then the tissues within the foot are not likely to support the loads.

As a result, the tissues will gradually begin to break down under the excessive stress of the loads. Such scenarios will often result in lameness problems.

For example, a 1000-pound horse is generally considered to have approximately 60 percent of its weight distributed to the forelimbs with the remaining 40 percent of the weight being supported by the hind limbs.

If the weight is distributed equally to each forelimb then each forefoot will support approximately 300 lbs of weight when the horse is standing quietly with minimal movements and no saddle or rider present upon the horse. This load can and will change with the

Sometimes called pea gravel or pea stone, pea rock is a common landscaping material available in North America. It is an aggregate of small, smooth-edged, washed stones that were considered to be the size of peas, hence the name. They are a common additive to landscapes to facilitate drainage or for visual edging.

Pea rock is often recommended to use in horse pens and paddocks. However, its use is predicated by the need to mow in the area. The tiny stones can be very dangerous if picked up by a mower blade. Also, pea rock can act like tiny ball bearings beneath a human's feet if pebbles scatter onto a hard surface such as a concrete apron or driveway.

slightest of movements, such as when the horse shifts its weight or begins to turn its head to one side or the other or when the horse is saddled and a rider climbs aboard.

These subtle shifts in positioning will change the weight upon the feet and hence the stress loads imposed upon the hoof wall and the hoof tissues vary continuously throughout the day. Under conditions of a constant weight the approximate amount of the load that the tissues are supporting can be easily determined using basic mathematics and a little physics. If the surface area of the foot making contact with the ground was, for the purposes of discussion, one square foot, then the loads that the internal foot tissues would subjected to be approximately 300lbs/ft2.

Obviously, a horse's foot is much smaller in area than a square foot so the foot tissue loads are much higher than this hypothetical figure. With a foot area of half of this size the loads that the tissues are supporting are now increased to an impressive 300 lbs/ 0.5ft2.

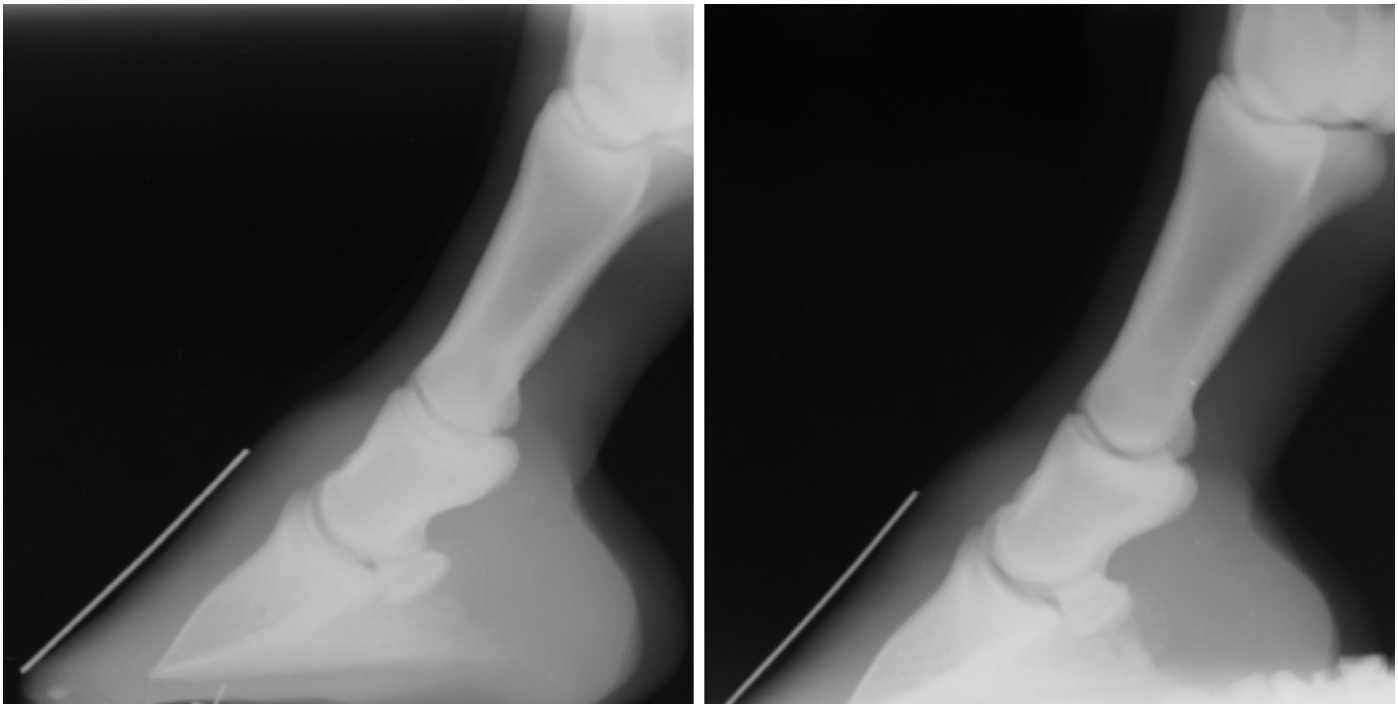
In biomechanical terms stress is defined as load per unit area. The previous example shows, therefore, that if two horses of equal weight have different sizes of feet, the stress on a small foot is greater, or approximately twice as much when compared to the larger one square foot area of contact.

This general trend will continue as the surface area of the foot gets smaller even though the horse's weight doesn't change.

Using certain trimming and shoeing techniques, the surface area involved in supporting this weight is shifted peripherally on the foot. The actual support area of the foot may be reduced even further when much of the solar surface (sole), frog and bars do not make contact with the ground.

Such "peripheral loading" can occur when the ground surface is very firm, dry, and hard, such as a dry, barren pasture or rocky environment or even when horses are housed for long time periods on cement or perhaps wooden flooring, or when the ground surface is frozen, as it commonly is in the northern United States in the winter months.

Top: Our barn showing extent of pea rock around two sides (3 inches deep) including overhang area (4 inches deep). Inset: High power magnification of small evenly shaped pea rock stone.



Radiograph of Chip (22-year-old Arab-cross gelding) showing foot position on cement block (left) and position of foot on pea rock (right). Angulation of coffin bone is higher as well as movement of navicular bone up the short pastern bone (less weight bearing).

Obviously there is a small range in the degree of hardness of these surfaces, but in general they are not very forgiving when the average horse stands on them for long time periods.

Generally in these instances there may be three to four "points of contact" when the solar surface is cleaned and then interacts with these surfaces. These points of contact have been discussed previously by many farriers, veterinarians and horse enthusiasts alike, as these areas represent a very small surface area, approaching three to four square inches of contact. This small area of contact can often be translated into many hundreds of pounds per square inch or more, depending upon the degree of hardness of the surface and whether or not there is any "forgiveness" when the horse is standing on such a surface.

An example that I use often when I speak to horse enthusiasts is that the small areas of contact are very similar to one in which a human wears high-heeled shoes in which the weight of the human is supported by a very small surface area! When these same people slip on their sneakers, they usually are much more comfortable, but may be less fashionably dressed, as the same loads are distributed over a much larger surface area.

Common pea rock, in my opinion, represents the equivalent of the "sneaker" ground surface in the horse world. It is a very firm but malleable surface that conforms to the entire underside of the sole, bars and frog of the foot with much less load being placed upon the hoof wall in the barefooted horse. This pattern of loading will provide enough support and, presumably, comfort for the horse during stance.

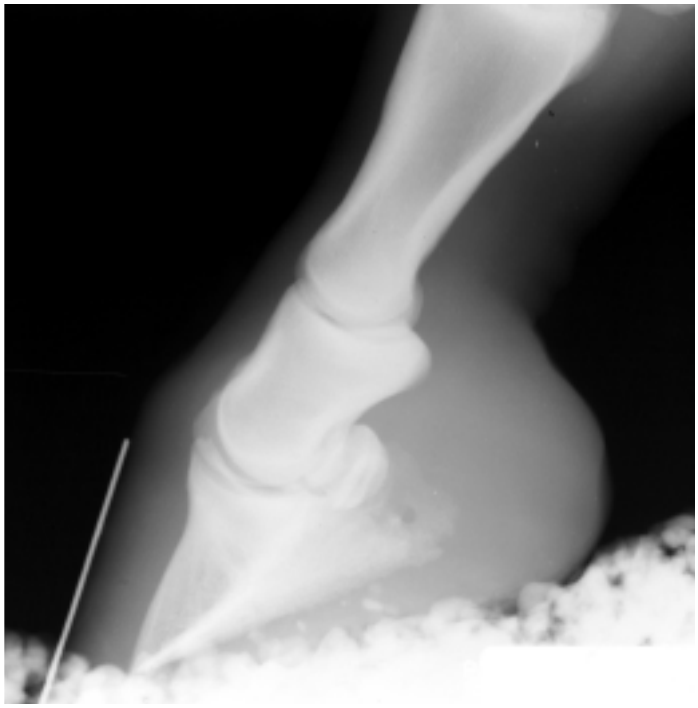
Pea rock neutralizes any of the imperfections of the solar surface of the foot as the small stones are moved by the loading forces to support the entire solar surface regardless of the condition of the underside of the foot.

Pea rock remains, for the most part, a malleable surface. It does not freeze and become a solid block of small stones, at least during the winters that we have here in Michigan, regardless of whether the climate is wet or dry or whether the pea rock is under several feet of snow. In other words, the small stones comprising the pea rock remain moveable among themselves to maintain foot support even though the remainder of the pasture is frozen solid.

During the spring, there is an added benefit to having pea rock in the barnyard as it drains very well so the horses have a relatively dry area on which to stand, even though the rest of the barnyard is three to five inches deep in mud.

In my personal experience we have a small group of eight backyard pleasure horses that are very typical of the horses common to Michigan. These horses vary in age from two years (two Belgian foals) to 24 years (one Quarter horse, one Tennessee Walker, one Arab cross, two Standardbreds and one Shetland pony).

At the time of writing, all horses in our group are barefoot. Four of the older horses were



originally shod when we obtained them several years ago; they have been barefoot for 3-8 years under these conditions of average pasture with a few hills and pea rock.

Their hoof care has been routine and regular as my farrier comes every five weeks, regardless of the condition of their feet or the weather, for trimming. Over the last few years only the hoof wall has been nipped off as we try to keep the toe shortened, but no sole or frog has been removed by my farrier on any of the horses.

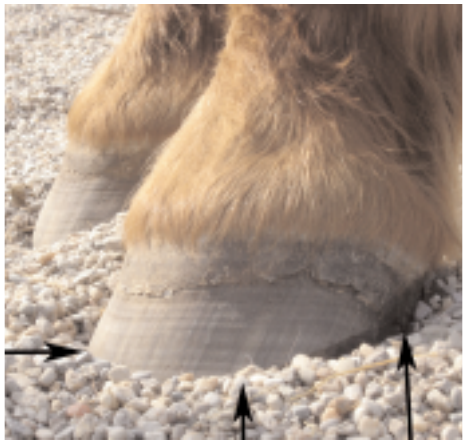
(This practice of regular farriery has at least provided me an opportunity to chat every five weeks for an hour or so with someone who is interested in the horse's feet. I have come to realize that working with horse's feet can sometimes be a lonely world!)

We have used pea rock for nearly ten years around our small barn, which has a border of pea rock on three sides. It extends outward to approximately 20 yards from the barn. This apron of pea rock will vary in depth between three to six inches in most of the areas but in certain places can be up to ten inches deep.

At the very peripheral zones the pea rock is gradually feathered to blend in with the surrounding pasture. Each year additional pea rock (20-25 cubic yards) is brought in to replenish as well as extend the pea rock area around the barn.

Over the years I have been, and continue to be, amazed at the horse's reaction to the surrounding pea rock (see figure 5). They appear to prefer to stand in the pea rock versus the sandy or pastured areas. When they are not grazing on the pasture they will all be standing in the pea rock during the

Another illustration of how a horse will "use" pea rock for comfort in standing and to self-adjust the position of the navicular bone. This is "Turk" (21 year-old Standardbred) on cement (left, above) and adopting a "toe down" stance in deep pea rock, above right. The same horse is shown below.



daytime rather than being out in the pastured area (approximately 2 acres near the barn). Some will argue that it is just the proximity of the barn but in another larger pasture which has an s-shaped shelter they will spend considerable time away from the shelter during the daylight hours standing and taking in the local environmental activities of the Michigan countryside.

While my interpretation is that the horses appear to be more "comfortable" on the pea rock rather than on other surfaces, I really do not know as we haven't communicated on that level as yet, but I have observed and documented a definite difference in the positioning and angulation of the foot when they are standing on the pea rock versus any other surface. (See Figure 5.)

A benefit to the pea rock that I did not initially anticipate was this loading of the foot during the painful condition of laminitis.

In the photographs one of our horses (a 12-year-old Tennessee Walker who was purchased six years ago) can be seen standing on two hard flat surfaces (each forefoot is on a one-inch thick cement block) followed by standing in the pea rock.

Please observe that on the hard surface, the frog is touching and bearing weight on the cement and that there is a slight angulation to the three bones of the digit between the fetlock joint and the hoof wall.

This position is commonly seen when a horse is standing on wooden blocks during a distal limb radiographic procedure as the digit has a slightly broken back axis to the alignment.

However, when the same horse stands on pea rock, the toe sinks deeper into the pea rock as the load of the foot is supported more on the solar surface and back portion of the frog, bars and sole. (See Figure 5.)All of our horses will stand like that for long time periods with little apparent shifting of the limbs.

We have had the advantage of being able to obtain radiographs of each of our horses while they are standing on the different surfaces around the barn: cement, wooden blocks, pasture and pea rock. One 2" x 8" x 16" cement block was placed under each forelimb and the horse stood on the blocks and routine radiographs were obtained. We used the usual foot markers: a thumb tack at the apex of the frog and a metallic wire along the dorsal hoof wall (see figures 3 and 4). In comparison however, the radiograph of the foot in the pea rock shows that the three bones of the digit become aligned into a nearly straight line when the horse stands on pea rock.

However, when the horses stood on the pea rock, the coffin bone's angulation is higher, often approaching eight to ten degrees as opposed to three to five degrees when they were standing on hard surfaces such as wood or cement (see radiographs).

Interestingly, the navicular bone appears to become a non-weightbearing structure during this time on pea rock as the navicular bone moves more proximally along the distal articulation of the middle phalanx (short pastern bone) than on the hard surfaces.

I believe that this position is a contributing factor to why the pea rock is more "comfortable' for the horse as, at the very least, the navicular bone becomes unloaded or is less of a weight bearing structure.

Finally, a benefit to the pea rock that I did not initially anticipate was this loading of the foot during the painful condition of laminitis. One of my horses is "Cushingoid" and he is definitely most comfortable when he is on the pea rock. When he was clinically lame, the white line gradually became stretched and hemorrhage occured at the toe.

During the winter months when the ground is frozen and the hoof wall extends beyond (lower than the sole from my anatomical point of view, but above the sole from a farrier's point of view), it was often difficult for him to walk around the barnyard.

However, when he reached the area covered in the pea rock, he appeared to become almost pain free as he would often run on the pea rock until he reached the frozen pasture, at which time, he would exhibit signs of considerable pain when walking.

Our observations were that he was telling us that he preferred to unload the hoof wall and load the sole to support his weight. I eventually listened to him and, as a result, my farrier and I have been trimming in a manner to unload the wall and load the solar surface to allow the hoof wall to heal.

Such a natural surface as the pea rock seems to encourage the healing of the horse's foot with laminitis and may be a clinically important tool for permitting a chronically affected hoof to heal as the condition lasts much longer than we acknowledge.

TO LEARN MORE
Visit Dr. Bowker's "Equine Foot Laboratory" web site at http://www.cvm.msu.edu/RESEARCH/efl