

when designing cultural practices. It can tell a superintendent directly if he needs to be aggressive with an aerification program.

Adopting the 4-percent rule to design aerification programs is simple. First, the percentage of organic matter in the upper 2-inch surface of each green needs to be identified. To accomplish this, samples must be tested by a qualified laboratory. This test is determined in the lab by ignition, and the result is organic matter percentage by weight. The results of this test can tell superintendents exactly how much material, if any, to remove through cultural practices to achieve their desired organic matter percentage level. These actual numbers are something superintendents never had in the past.

DESIRED LEVELS

After the organic matter levels have been identified, it's important for superintendents to set a desired level of organic matter they'd like to achieve. Although Carrow's work identified 4 percent as the possible break point, a desired level should be set lower.

For example, using a level of 3.5 percent as a targeted value is probably a good option. The organic matter reduction formula example (see figure 1) can be used to calculate the amount of surface area removal/impacted needed. In the example, a fictitious 4.49 percent organic matter tested result value is used. This tested result (4.49 percent) is subtracted from the desired value (3.5 percent) to calculate the percentage amount above the desired level (0.99 percent). Then, calculating the surface area removal/impacted needed is determined by setting up a fraction. The example shows that to achieve the desired level, 22 percent of the surface area needs to be removed.

It's important to note all greens may or may not need this amount removed. On most golf courses, all greens don't have the same environmental growing conditions, and therefore, most likely have different percentages of organic matter. If a superintendent adopts the 4-percent guideline, it might be important to analyze each green individually. This can help identify individual green problems and might lead superintendents to consider the aerification needs of individual greens, instead of lumping them together as a whole.

AERIFICATION

Once the removal amount is known, it's possible to calculate how much aerification is needed. When the amount of removal is high, it might be desirable to achieve that level using multiple cultural practices. It's also important to take into consideration the health of the greens. Healthy greens can withstand much more impact than weaker greens during a single cultural practice. There's also a limit of maximum removal based on cultural practice equipment.

To calculate how much material should be removed by aerification, two factors are needed. First, to calculate the surface area removal/impacted, calculate the area of the tine-spacings used (see figure 2). For example, if the spacings on a machine are 2 inches by 2 inches, then 4 square inches would be impacted. Or, if 1-inch-by-1-inch spac-

Figure 1

Organic matter reduction formula

Organic matter tested result
 - Desired organic matter level
 = Amount above level

4.49% OM tested
 - 3.5% OM desired
 = 0.99% above level

Amount above level ÷ OM tested result
 = Amount of surface area removal/
 impacted (SARI) needed

0.99 ÷ 4.49 = 22% SARI Needed

Figure 2

Calculating surface area removal/impacted

Base the calculations on the area of one tine.

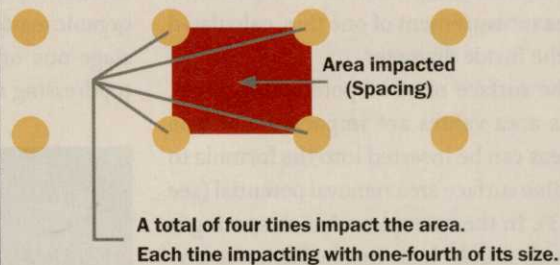


Figure 3

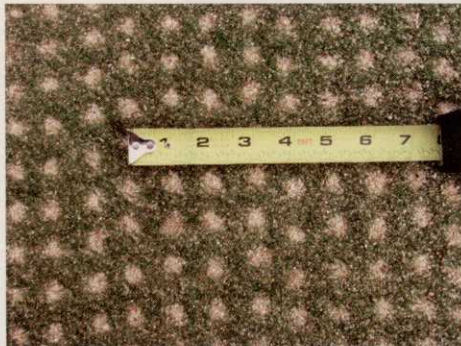
Surface area removal potential formula

ID area of one tine (area of a circle = $(3.14) \times (\text{radius})^2$) ÷
 Square inches from spacing used.

Example below uses 1-inch x 1-inch spacings, with
 an inside diameter tine measuring 0.40 inch

$(3.14) \times (0.20)^2 = 0.125$ square inch ÷
 spacings 1 inch x 1 inch = 1 square inch

0.125 square inch ÷ 1 square inch = 12.5% SARP



Close spacings offer the greatest surface removal potential.

ings were used, then one square inch would be impacted.

The second factor is determining the inside diameter of the tine used, or needed to be used, to reach the correct removal potential. With square spacings, four tines impact the area with one-fourth of each tine hitting the area. Therefore, the total area impacted is the area measurement of one tine, calculated using the inside diameter.

In the surface removal potential formula, various area values are impacted and tine size areas can be inserted into the formula to determine surface area removal potential (see figure 3). In the example, a 1-inch spacing is used with a 0.40-inch inside diameter tine measurement. This equates to a 12.5-percent surface area impacted potential. Remembering the previous test example, it would take two aerification events using the example set-up to lower the organic matter 22 percent.

TOPDRESSING

Sand topdressing also is an important part of managing organic matter build-up. Topdressing sand filters into stage one organic matter, with the end result having a diluting effect on the material. The dilution of this organic matter helps keep porosity levels sufficient for proper greens performance.

Diluting organic matter through sand topdressing is just as important as aerification or dethatching.

How much topdressing is needed to help keep the organic matter content below the 4-percent threshold? Some have suggested applying sand at a rate of about 50 cubic feet per 1,000 square feet per year. This said, there are two important factors that should be thrown into the equation before considering 50 cubic feet of sand per thousand as the all-important amount.

First is the length of the growing season. Some parts of the country have a growing season as short as three to four months, and other parts have a 12-month growing season. Should both these areas of the country be on a 50-cubic-feet-per-1,000-square-foot rule?

Secondly, and maybe more importantly to a topdressing program, is the plant growth rate. Remembering the most important fundamental aspect about topdressing, applications should be directly proportional to the plant's growth. The plant's growth directly influences the amount of stage one organic matter produced. Therefore, to dilute stage one organic matter with best results, topdressing volumes and frequencies should

be increased as the growth rate increases. The same applies to the plant when growth decreases – topdressing volumes and frequencies should be decreased.

Topdressing has become more of a calendar cultural practice recently, instead of a true agronomic cultural practice.

BOTH ARE KEY

Even though sand-based greens have been around for many years, it seems we're still trying to understand the complexities of managing them, especially regarding organic matter. When it comes to core aerification and topdressing, neither is more important than the other. However, one thing is certain: The net effect of both practices combined will give superintendents the best potential for managing organic matter build-up and maintaining successful greens performance. **GCI**

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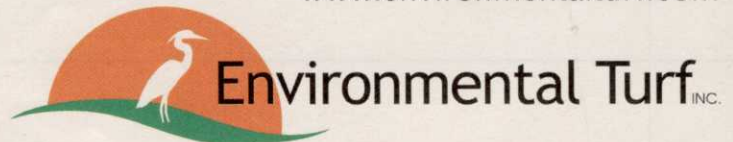
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a necessary evil

Although some don't like them, cart paths help generate revenue

Jeff Osterfeld, owner of the Golf Club at Stonelick Hills, prefers long, broad curves in cart paths. Photo: Golf Club at Stonelick Hills

BY T.R. MASSEY

If a strip of concrete on the golf course has changed the game forever, blame Henry Ford.

The invention of the car and America's love affair with vehicles is the genesis of modern cart paths on golf courses. In the mid-1940s, three decades after Ford made a car affordable for most Americans, an enterprising entrepreneur built a small golf cart so golfers with disabilities could move throughout a golf course.

At the time, cart paths didn't exist. A purist would say it's a travesty to pave a small road through a pastoral field designed for a game of walking, and carts aren't needed because carrying a bag is a caddie's job. But golfers saw the golf cart and loved its convenience, and owners and golf professionals saw a way to make more money in addition to green fees.

Generally, the prevailing notion is that younger people ride and older people walk because of the way they were introduced to the game. At one time, golf carts were a luxury only for the rich. Now, carts are as common as drivers, tees and balls, and so are the paved pathways on which they're driven.

The golf industry has evolved into one in which motorized transportation is the rule, says Mike Benkusky, a Chicago-area golf course architect.

"Today, whether good or bad, people expect

a cart to be part of a round," he says. "That's starting to become the rule – \$50 includes a cart."

CONCRETE OR ASPHALT?

Cart paths are installed as a course is being constructed, or if an older course is being remodeled, they're installed as part of the project. Once the decision is made to have cart paths, a material must be chosen. Asphalt generally is cheaper than concrete, although rising oil costs have caused asphalt costs to increase during the past two years. Concrete generally lasts longer and requires less maintenance than asphalt.

Matt Rownd and his father operate The Cart Path Co. in Atlanta. He works with concrete and says it's better than asphalt.

"Many times you can replace a panel or two [of concrete] in-house," he says. "You could do it with one or two guys. Asphalt requires a special expertise. Also, concrete can be buried [when it's being disposed of], but not asphalt."

Rownd says a proper concrete mix matching a course's freeze/thaw climate and the concrete's use must be considered. More concrete per square inch is necessary if heavier equipment will use the path. Another part of the equation is whether to use fiber mesh in the concrete or steel rebar, which is more

expensive. The end use can dictate sturdier reinforcements.

With all concrete cracks – every eight or 10 feet of a cart path – a control joint must be cut in. This means the concrete cracks where you want it to.

"You'll never see it because it's recessed in the concrete about an inch or inch-and-a-half [down from the surface]," Rownd says.

Expansion joints are another must. These allow the concrete to expand and contract depending on the temperature without breaking or cracking. The standard interval is 80 feet.

Another important aspect to remember when installing concrete paths is that concrete attains its designed strength in 28 days after it's poured, so driving on it before then isn't recommended.

"Don't run anything on them until 28 days have passed," Rownd says. "That's when you can count on it and when warranty issues can be backed up."

Concrete can be different colors and have different finishes, from the pitted, coastal look to a broom finish or an exposed aggregate. Asphalt always is black.

Many courses have asphalt cart paths, and if the base is laid well, they work quite well. Clay Dubose, the general manager and golf course superintendent at Tradition Golf Club in Myrtle Beach, S.C., says his asphalt pathways

are preserved because he runs a vibratory root plow alongside them each year, preventing roots from growing under the paths that can damage them.

"It's a fairly small amount of our budget to maintain them, except when you have to replace them," he says. "A couple of years ago, we cut out some old paths, removed the roots and put a new base in. It was about \$30,000."

A typical 7,000-yard course will need about 25,000 lineal feet for wall-to-wall paths,

Benkusky says. The cost per yard of concrete or asphalt varies throughout the country, but the range is anywhere from \$200,000 to more than \$1 million. More width (eight to 10 feet is required for two carts to pass without having to drive off the pavement) and curbing add to the cost.

"It's a significant part of a golf course construction fee," Benkusky says. "Irrigation, greens construction and cart paths are the most expensive."

PUT IT HERE

General guidelines exist for cart path location. Cart paths generally are placed down the right side of a fairway, if possible, because most golfers slice, and it's better to have a path on a high side of a hole so golfers can see the location of their balls. Paths are placed on the outside of a dogleg so players don't have to look at the path in their line of sight. Additionally, it's unwise to place a path between a landing area and a hazard, especially water, because bad bounces are unfair and can ruin a round.

"You look and try to run paths to provide access on and off fairways," Benkusky says. "Put paths closer to landing areas. You don't want to put a path across a fairway unless completely necessary."

Benkusky says topography dictates the design and strategy of a hole in many cases, which trickles down to the placement of cart paths, i.e., one can't put a bunker where a path needs to go or vice versa.



Larry Canini, owner of Clover Valley Golf Club (pictured at top) has liability insurance to help protect him from lawsuits involving cart paths. Photo: Clover Valley Golf Club

At TPC Craig Ranch (pictured above), golf course superintendent Mark Johnson requested \$50,000 in his budget for cart path repairs. Photo: TPC Craig Ranch

Cart paths usually consist of asphalt (left) or concrete, which is more expensive. Photo: Jeff Brauer

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TPC Craig Ranch in McKinney, Texas, has 7.5 miles of cart path. Photo: TPC Craig Ranch

“You try to find the main access points from the cart path,” he says. “You don’t want a cart path behind the bunker to the green.”

Golf course architect P.B. Dye remembers listening to his famous father address a group of golf course superintendents during the mid-1960s.

“His advice was to bring cart paths to the high side of every green and build a lip on them so golfers have to park and get out,” he says. “Then, they won’t remember they three-putted because all they’ll be thinking about is walking up a hill to get back to the cart.”

Dye says he operates under the general philosophy of building paths close to the level

of the tee and on the outside of the hole.

“You know where the best place for a cart path is?” he says. “The middle of the fairway. No one ever hits it there.”

Aside from location, cart paths need enough slope so they don’t retain water. Rownd says safety curbs can be used to direct water to keep it from eroding natural features, but that’s more expensive.

“You have to direct water to go somewhere,” he says. “Especially in Texas, Florida and other places in the South where there aren’t many terrain changes. You have to have at least a 2-percent slope to break the surface tension of the water on concrete. You have to direct it, and if you don’t have 2 percent, water won’t move.”

Though it might look appealing, putting
(continued on page 70)

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Reducing damage from golf carts

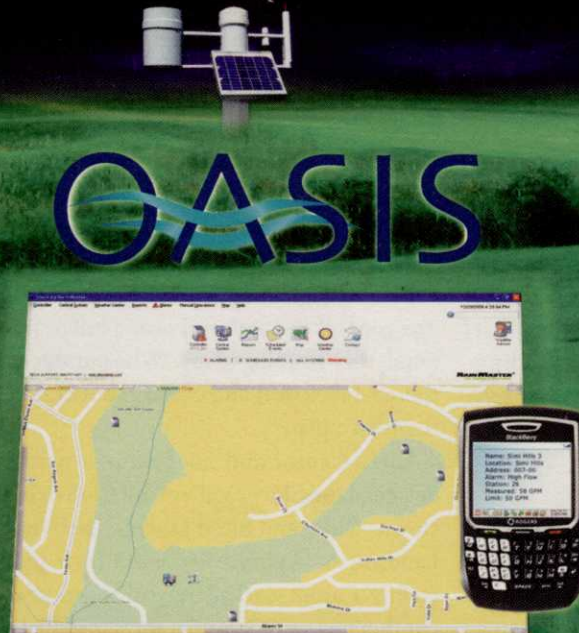
No matter how much golf purists dislike golf cart paths, they're here to stay. Cart paths are the route for owners to collect fees and save a course's flora from damage, especially during wet or cold weather. Mark Johnson, golf course superintendent of TPC Craig Ranch in McKinney, Texas, says he uses rocks around the curves of the course to help prevent the grass from wear.

"The wear around the edges is the biggest headache," Johnson says.

According to the U.S. Golf Association, golf carts damage grass and compact the soil. To reduce the damage, managers should establish cart policies. The USGA recommends:

- Encouraging golfers to spread cart traffic over a wider area and avoid turning and driving over the same areas repeatedly.
- Varying the entry and exit points along the cart paths each day to spread traffic and wear more evenly.
- Keeping all vehicles at least 30 feet from the edges of tees and greens to avoid damaging sensitive turf areas.
- Never allowing carts to be taken across excessively wet areas.
- Encouraging golfers to always share a cart.
- Encouraging golfers to use the 90-degree rule by exiting the path and driving to the first ball, then to the next ball, and then returning to the path.
- Restricting carts to the path on all par-3 holes.
- Proposing a "walkers-only day" one time per week when no golf carts are allowed on the course.
- Considering closing one additional hole to cart traffic on each nine on a weekly rotation. This allows the turf to recover from damage and gives the maintenance staff time for extra aeration and other procedures to stimulate turf recovery. GCI

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Cart paths generally are placed on the right side of a fairway - as shown on the Palmer Course at Oglebay in West Virginia - because most golfers slice. Photo: T.R. Massey



(continued from page 68)

curves in cart paths is a poor idea, says Jeff Osterfeld, owner, operator and designer of the Golf Club at Stonelick Hills in Batavia, Ohio.

"They cut off every inside corner, no matter how soft or subtle the curve," says Osterfeld, who's the founder of the Penn Station East Coast Subs chain. "Then you're sodding and seeding all the time. I would do longer, broader curves if I did it again."

LIABILITY

Cart paths aren't without a bit of controversy, though. It seems no one wants to take responsibility for their placement.

"The problem is everyone gets sued over the damn things," Dye says. "In my contract, I say everything I do is approved by the owner."

Some architects will consult about cart path placement but won't include it on the final layout.

"I'll look at how the circulation is going to affect the golf course and look at it to provide easy access so the pace of play keeps up," Benkusky says. "From there, you work with the contractor and owner. We don't like to say, 'This is where you put the path.' An engineer can do that work. It's such a liability. Someone goes off the path and over a hill or into a pond, they're going to say, 'Who put this path there?' I look at it and consult, but don't put them on a plan."

Larry Canini and his business partners designed the Clover Valley Golf Club in Johnstown, Ohio, and hired Lincoln, Neb.-based Landscapes Unlimited to build their public facility. Canini marked the paths, Landscapes cut them in, and Canini's crews installed the gravel base then subcontracted the asphalt installation. But early on he realized that he'd bear final responsibility for the cart path placements.

"Obviously, you have liability insurance,"

he says.

Michael Geiser, a partner with the Columbus-based law firm The Plymale Partnership, says cart path liability fears make him crazy.

"I've never had anyone call and want to sue because of it," he says. "It's conceivable there would be some liability if a golf course or path was designed in such a manner that it was foreseeable a customer would be injured. But when you think about the circumstances that would be necessary, it's laughable. The only thing I could think of is a cart path on a hill that's so steep it's probable the cart would tip."

Geiser says people take responsibility for themselves when they play golf, whether they know it or not.

"We assume the risk of injury when we play golf," he says. "It's standard law if you're participating in a sport and are injured, you've assumed the risk of injury. You're engaging in an activity that's known to be hazardous."

Geiser says wording of the contract golfers