

Design With Maintenance In Mind

A well-designed golf course can be maintained properly with available resources.

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Putting greens that have areas without positive surface drainage are more prone to a variety of issues, including winter injury and traffic damage.

Golf course architects are tasked with creating aesthetic layouts that provide an enjoyable experience for golfers. While some features may be more appealing than others, they sometimes can be detrimental to turf health or costly and difficult to maintain. Therefore, it is important to balance the design goals of a construction or renovation project with the long-term goals and budget of the golf course. This article provides some guidelines that should be considered to help optimize playing conditions and control long-term

maintenance costs when building or renovating a golf course.

GENERAL

Size: According to a USGA-funded survey of U.S. golf courses in 2015, the median maintained turf acreage for an 18-hole golf course was 95 acres (Gelernter and Stowell, 2017). In regions where water is scarce, there have been greater limitations on maintained turf acreage in an effort to reduce water use. All golf course maintenance inputs — including water, labor, fertilizers, and plant protectants — can

be reduced by decreasing the acreage of intensively maintained turf. For this reason, many golf facilities are converting irrigated turf areas to drought-tolerant turf or naturalized plantings to improve sustainability.

Drainage: Soil moisture — one of the most important factors in golf course maintenance — has been discussed since the inception of the USGA Green Section in 1920. If given the option, sandy soils that drain well are preferred over heavier soils that remain wet. Water can be added to dry turf, but removing excess water from a



Teeing grounds that are too small for the amount of play they receive will struggle to recover from peak use and can become an eyesore.

wet area is difficult. Golf courses with heavy soils or poor surface drainage hold excess water and often require supplemental drainage or sand top-dressing to provide quality playing conditions. Poorly draining golf courses may suffer from inferior playability, cart traffic and mowing issues, and increased turf stress.

PUTTING GREENS

Putting greens are the most important playing areas on a golf course. For good reason, putting greens receive

the most scrutiny and intensive maintenance. Location, design, and construction method have significant impacts on putting green maintenance and performance. Even the most experienced turf managers with almost unlimited resources can struggle to produce quality putting surfaces when these important factors are ignored.

Location: “Location, location, location,” is a common real estate mantra that also pertains to putting green complexes. Place a properly built and well-managed putting green

in a poor growing environment, and it will struggle or may even fail. Turfgrass plants maintained at mowing heights of one eighth of an inch or less need a lot of sun to produce enough energy to sustain growth and recover from traffic. Shaded turf plants have weaker roots, produce more succulent tissue, and are less competitive than shade-tolerant weeds. Shaded surfaces also remain wet longer than areas in full sun, increasing the risk of disease activity. Ideally, putting greens should be located in areas that receive a minimum of 10 hours of direct, non-filtered sunlight per day throughout the growing season. Southern and south-eastern exposures will receive more morning sunlight, which is most critical for turfgrass. If a putting green is located in an area shaded by trees for much of the day, selective pruning or tree removal will be necessary to improve the growing environment.

Like most golfers, turfgrass appreciates a light breeze during the heat of summer. A breeze of 2 or 3 mph provides a cooling effect that can reduce heat stress, lower soil temperatures, and help dry plant surfaces, thereby reducing the likelihood of disease. Keep in mind that trees create [natural windbreaks](#) capable of impacting wind velocity for a distance of two to five times the height of dense tree plantings on the windward side and up to 30 times the height of dense tree plantings on the downwind side. If a putting green is located in an area with limited air movement, there are several options for improving the growing environment. Dense stands of vegetation can be thinned out to allow for more air movement and oscillating fans can be installed to move air in stagnant environments.

Drainage: Many design factors impact putting green performance, but perhaps none is as important as drainage. Putting greens that shed surface water and drain well internally will be the most successful and easiest to maintain. When it comes to surface drainage, keep these important points in mind:

- Putting greens should have several outfalls to disperse water off putting surfaces.

- Avoid designs that concentrate surface water at primary access points.
- Putting surfaces should never have water-holding depressions.
- Ensure that surface water from surrounding areas does not flow onto a putting green.

New putting greens should be built with well-drained soils and an internal drainage system to remove excess water from the rootzone. The [USGA Recommendations for a Method of Putting Green Construction](#) provides science-based recommendations for selecting a successful rootzone mix based on soil porosity, saturated hydraulic conductivity, and other important characteristics. The Recommenda-

tions also stipulate the installation of a gravel layer and internal drainage system to remove excess water and help maintain optimal rootzone moisture. In the event that complete renovation is implausible in the short term, sand channel drainage and other systems have been successfully used to improve the drainage of soil-based putting greens with limited drainage capacity. No matter the construction method used, a well-drained rootzone along with a properly designed drainage system will help ensure long-term putting green performance and success.

Design: Design and construction principles for putting greens have evolved from the classical era of golf

course architecture. Modern putting greens tend to be larger in size and less severely contoured than their earlier counterparts. This makes sense considering increased traffic and expectations for faster green speeds. Architects are continuously challenged to design putting greens that offer the ideal balance of practicality and interest. The following are some general design guidelines that should be considered when rebuilding putting greens or building new putting green complexes:

- Large putting greens permit wider distribution of traffic and should experience less turf stress. Modern putting greens are usually designed to provide at least 6,000 square feet of surface area and should be larger



The number, size, and severity of bunkers can have a significant impact on golf course maintenance costs. Steep slopes and narrow capes make bunkers more difficult and costly to maintain.



A graduated rough system can help save resources while also creating a visually appealing landscape. Incorporating non-irrigated ornamental grasses in out-of-play areas is one way to reduce water use without slowing down pace of play.

when putting surfaces are more heavily contoured. Small putting greens should have limited contouring to provide adequate hole locations and sufficient access to the putting green.

- A general recommendation is to make at least 40 percent of a putting surface available for hole locations. This will make it easier to spread golfer foot traffic. Generally, areas for hole locations should not exceed slopes of 4 to 5 percent. Keep in mind that the appropriate slope for a

hole location largely depends on the desired green speed. Slopes of 3 percent or less are more practical when fast green speeds are expected.

- Be aware that steep or abrupt putting green contours will reduce the area available for hole locations and can be difficult and costly to maintain, especially at low heights of cut. The process of floating the final putting green surface can help soften overly abrupt contours, but it is important to evaluate all putting green contours

during subgrade construction when the architect has the greatest flexibility to make modifications. A good golf course architect will seek input from the golf course superintendent when creating putting surface features.

- Provide several large access points to a putting green. These areas should be wide and contoured to accommodate golfers and maintenance equipment. Confining traffic to a single, narrow access point will create turf stress on and around a

putting green and make it much more difficult to maintain high-quality playing conditions. Carefully consider traffic patterns when planning the size and placement of features such as bunkers or landscape plantings, and avoid funneling golfer traffic into confined areas.

- A putting green and its surrounds must provide adequate space for operating mowers, rollers, sprayers, and other maintenance equipment. Large aprons and collars and moderately sloped putting green surrounds can improve staff safety and efficiency. Designs should also take into account the type of equipment that will be used to maintain a putting green complex. Large putting greens with ample turning areas are helpful for facilities contemplating triplex mowing programs.

teeing area per 1,000 rounds played from a particular tee. Tees that experience particularly heavy traffic — e.g., Holes 1 and 10 — and par-3 tees should be even larger to disperse traffic and improve divot recovery.

Shape: Rectangular tees provide a classic look but are more difficult to mow. Designing tees with soft corners can allow for triplex mowing. Triplex mowing may be preferred at some facilities because it can increase efficiency.

Location: Sun exposure and air movement are equally important for maintaining healthy turfgrass on tee surfaces. Trees that are too close to tees can create difficult growing environments and interfere with play by limiting useable surface area. Before planting new trees, consider their impact on nearby tees. Also

points. For more information on building tees, read the USGA article "[Guidelines for Building Great Tees.](#)"

Tee Surrounds: Avoid steep banks — i.e., anything greater than 18 degrees or a 3-to-1 slope — around tees to allow ease of access for golfers and simplified maintenance. Establishing tee surrounds with drought-tolerant grasses or naturalized plantings can help reduce costs and improve sustainability.

FAIRWAYS AND ROUGHS

It is important to provide sufficiently wide fairways while recognizing that fairways require more resources to maintain than roughs. As a reference point, the average 18-hole golf course has 28 acres of fairways (Gelernter and Stowell, 2017). Superintendents and golf course architects should work together to create fairways that meet the intended design criteria while keeping maintenance costs under control.

Intermediate Rough: Maintaining a strip of intermediate rough between fairways and primary roughs is popular at some facilities. Keep in mind that this feature requires a separate mower and additional labor that diverts resources away from other playing surfaces. The USGA article "[A Waste of Time and Resources](#)" provides more information on this subject.

Turf Selection: Generally speaking, cool-season grasses should be planted north of the transition zone and warm-season grasses in southern regions. Trying to maintain a turfgrass species outside of its adapted range can be a challenge and usually requires additional maintenance inputs. The USGA has supported the development of improved cool- and warm-season grasses that can benefit golf facilities in a variety of climates. Consult with your local land-grant university, regional USGA agronomist, or the National Turfgrass Evaluation Program (NTEP) to select the grasses that will perform best at your site.

Graduated Rough System: Primary rough areas — i.e., those immediately adjacent fairways — often receive more water, fertilizers, plant protectants, and mowing than other



Tree roots, shade, and cart traffic are a deadly combination for turf.

TEERING GROUNDS

Teeing grounds are focal points on a golf course. As the starting point for each hole, they experience heavy traffic, and some require constant divot repair. Tee alignment towards the landing area is an important design feature but has little impact on sustainability. Other factors that should be considered include size, shape, location, drainage, and maintenance in surrounding areas.

Size: A general rule of thumb is to provide at least 100 square feet of

consider pruning or removing existing trees that are causing turf issues. If pruning or removing problem trees is not possible, it may become necessary to relocate the affected tee complex.

Drainage: Build tees with at least 6 inches of well-draining rootzone mix. Tee surfaces should have a slope of at least 0.5 to 1 percent to maintain adequate surface drainage while still providing a level playing surface. Whenever possible, avoid draining surface water toward entry and exit

types of roughs. Designs that allow for secondary roughs or naturalized roughs in out-of-play areas can help reduce the resources devoted to rough maintenance. It is important to consider pace of play when implementing a graduated rough system. Secondary and naturalized roughs are best suited for low-play areas. Mowing secondary roughs or naturalized areas may only occur occasionally, so communicate to golfers the seasonal differences in playability and aesthetics in these areas. The USGA article "[Beyond the Primary](#)" further discusses graduated roughs.

BUNKERS

Bunkers can require [intensive maintenance](#), including frequent raking, edging, and hand trimming. There is no doubt that bunkers can be appealing design features, but their associated maintenance costs are high. Superintendents and architects should work together to create bunkers that are appropriate for the facility's golfers, design goals, and maintenance budget. Designs that allow for mechanical maintenance in and around bunkers will help improve efficiency.

Flashed Faces: Flashed sand faces can be quite costly to maintain because they are prone to washouts during heavy rainfall. Sand faces with slopes less than 25 percent are less vulnerable to washouts and can be easier to maintain. Also, liners can be installed on bunker faces to help hold sand in place, reducing washouts and sand contamination. Installing liners is an additional cost, but they can greatly reduce long-term maintenance costs and improve golfer satisfaction.

Grass Banks: Steep grass banks around bunkers can be very expensive to maintain. They often require hand mowing and edging, which can be time consuming. Water management on steep grass faces can also be extremely challenging. Avoiding narrow capes and steep slopes in grass bunker faces will facilitate maintenance and improve entry and exit for golfers.

Drainage: Avoid allowing surface drainage from surrounding areas to enter bunkers by using berms, swales, and interceptor drains to deflect or capture water. This helps limit washouts and sand contamination. Also, avoid directing subsurface drainage into bunkers. Subsurface drain lines

should be included in bunkers to prevent standing water from accumulating, reduce washouts, and maintain desirable sand moisture.

TREES AND LANDSCAPING

When planting new trees, utilize native species that are adapted for the site and climate. Always consider a tree's mature size and form during the selection process. Avoid tree species that are prone to storm damage, have inherent pest problems, or are prolific rooters. Trees that produce significant amounts of debris — e.g., sticks, fruits, nuts, bark, and other debris — are best used away from in-play areas. The USGA article "[A Guide for Selecting and Planting Golf Course Trees](#)" offers further insight.

Size and Location: Avoid tree plantings that create morning shade on playing surfaces or block air movement; they can weaken turf and increase the likelihood of disease. Tree roots can also extend well beyond a tree's drip line and impact playing areas. Competition from tree roots increases the need for irrigation and fertilizer to maintain healthy turf. Surface roots can also damage maintenance equipment and



Do not plant trees with shallow surface roots near maintained turf, cart paths, or any areas that receive regular play.



Landscape beds — especially when planted with annuals — can be expensive features to maintain.

cart paths and create playability issues. Therefore, it is best to avoid planting potentially large trees any closer than 75 feet from putting greens or teeing grounds. Tree canopies should also never impact sightlines from a tee to a fairway or putting green.

Limit tree planting in high-traffic areas. The combination of traffic, shade, and root competition can cause considerable turf thinning. Trees can also funnel traffic into small areas, causing further problems.

Aesthetics: Ornamental plantings, when used effectively, can enhance golf course aesthetics. However, they are costly to maintain properly and for that reason their use should be limited. Make sure to consider the cost per

square foot for maintenance when planning ornamental plantings to avoid diverting excessive resources away from playing areas.

SUMMARY

A well-designed golf course with prominent features can be a beautiful thing. However, if the resources necessary for maintaining its features are lacking, even a well-designed golf course can end up a far cry from its original intent. With ever-increasing scrutiny on resource management, the factors listed in this article should be considered when building or renovating a golf course. The golf course architect and superintendent should work closely together throughout any construction

or renovation project. Communication and collaboration are key to ensuring that facility goals are met and that the architect's design can be maintained with available resources.

REFERENCE

Gelernter, Wendy, and Larry Stowell. "National Trends in Land Use and Environmental Practices on U.S. Golf Courses, Part I." *GCM Magazine*. April 2017: 72-82. Print.

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