

# **Golf Development Overview and Analysis**

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## **A Golf Construction Process Overview**

The planning, design, and construction, of a modern golf course is a much more involved process than most people outside the golf industry realize. In general, a golf project can be broken into the following phases. Each of these phases has many sub-phases and tasks that are required for the successful completion of the project.

- **Concept**
- **Feasibility**
- **Planning**
- **Design**
- **Construction**
- **Grow in**

### **Concept:**

In determining the concept for a new golf project the owner, usually with the help of consultants, will review the market in the locale of the proposed course.

**Types of golf projects are can be broken into categories such as:**

#### **Resort:**

Usually built as a feature to a hotel or similar lodging sometimes as a recreational option for guests and sometimes as the main theme of the site, i.e., where golf is the reason one would stay at the facility.

**Daily Fee:**

Privately owned but open to the public

**Municipal:**

Government owned and open to the public

**Private Equity Club:**

Owned by members usually as shares. Closed to the general public

**Private Non Equity Club:**

Owned by a business entity. Members pay an initiation fee and monthly dues to the ownership entity

**Semi Private :**

A mixture of Daily Fee and Private where the course is open to the public usually on a limited basis. Members enjoy special privileges.

Once the type of club and its market function is determined, the project will move into the feasibility stage.

**Feasibility:**

In determining the eventual viability of a golf course many factors are considered and a feasibility study is often commissioned. Some of the factors are as follows:

- **Site analysis**
- **Target market**
- **Consumer profile**
- **Historical performance of competing facilities**
- **Trends of market rounds played and price points**
- **Identification of competition**
- **Operating and fee structure**
- **Design Expenses**
- **Construction Expenses**
- **Operating Expenses**
- **Market share**
- **Cash Flow**
- **Planning Options**
- **Resource requirements**
- **Capital Investments**

**Planning:**

Planning may include the assemblage of a project team often consisting of consultants and design professionals. The initial planning will often consist of meetings of the team

to determine project issues from each of the disciplines. Responsibilities will be assigned usually by an owner or his representative. Some of the early issues include environmental impact, ingress/egress, coordination and availability of public utilities, the possible construction of private utilities, storm water discharge, flood control, wetland mitigation, permitting on a Local, State, and federal level, water availability, and governmental fees, potential tax assessments. The Golf Course Architect is often chosen during this period.

## **Design:**

The design team is usually led by the Golf Course Architect (GCA) and coordinated by an owner's representative who is often someone experience in golf and/or real estate development. Other members of the team would be a land planner, civil engineer, irrigation designer, landscape architect, environmental consultant, geotechnical consultant, water feature designer, electrical engineer, agronomist, surveyor, and legal counsel.

**Base map data** is compiled by the surveyor consisting of **boundaries, existing topography, and vegetation, along with structures, easements and right of ways.** Initially the GCA and the land planner will work together with the owner to develop the concept of the facility and what land will be set aside for what purpose. The GCA will propose a routing for the golf course and adjust according to the land planners needs. The level of adjustment varies from project to project with the objective to have the best most efficient facility possible while complying with the owner's priorities and wishes. In the case of a residential development the, land planner and GCA will coordinate the configuration of the lots, streets, parking, Club House site, maintenance facilities, easements, and road crossings. This initial plan will be sent to the technical designers i.e., civil engineer, environmental consultant, geotechnical engineer, for comment. The Civil engineer will review the plan for potential design problems, compliance with building codes, potential storm water collection systems. The environmental consultant will review for wetland, flora and fauna, erosion control, and potential hazardous waste issues. The geotechnical consultant will likely take soil samples to analyze for structural integrity and suitability for the various components of the project and produce a report for the team's use. The owner's representative will often bring this initial plan to the local permitting and planning commission for review and comment.

Once this portion of the design team is satisfied with the general concept; the GCA will begin designing in earnest. He will start with **the routing plan** which so far consists of golf hole centerlines and boundaries. Working with the existing contour lines on the topographic, map he will begin to draw the modifications that will needed to be made to meet his vision, (grading plan) Golf features may be sketched in such as greens, tees, bunkers, water features, walls, landscape areas, and cart path. **Drainage collection systems** will be added as this process takes place. Drainage collection often consists of a network of pipe and inlets dispersed throughout the golf course according to the GCA's

design needs, and the discharge requirements of the civil engineer. The civil engineer will assist in the sizing and routing of this system.

Upon completion of the Grading Plan the GCA will send it to the irrigation designer and water feature designer who will then coordinate their work. The electrical engineer will be involved during this phase once the electrical requirements and distribution points for the project are determined. The irrigation designer will design an automated sprinkler system that will provide water to the golf course efficiently based on the GCA's design. He will also allow for delivery of water to the water features if needed, as well as power, and to the landscape areas if applicable. The water feature designer will design according to the wishes of the GCA. The landscape architect will often work in synch with both during this phase.

The GCA will continue to prepare supporting plans and documents, including a clearing plan, a grassing plan, a staking plan, a cart path plan, greens, bunkers, tees details as well as any other detail or supporting plan he may deem necessary.

Up completion of his work, the GCA will consolidate the plans and specifications of the other designers with his and produce the "Project Manual" Which typically includes: Plans, specifications, a contract draft, general conditions of the contract, supplementary conditions to the contract, bidders instructions, amendments to the contract, bond forms, lien release forms, and other documents applicable to the construction of the project.

Once all the documents are assembled they are submitted to the proper agencies for approvals and permitting. While this process is ongoing the GCA invites or advertises for qualified contractors to submit bids for the project.

The project can be bid in a number of ways, as a general contract, where one contractor is responsible for all the components of the project and performs the majority of the work with its own forces and some subcontractors. Or the owner can act as the general contractor and contracts each component with individual companies. Or a combination thereof.

The interested contractors respond to the GCA with a request for the project documents. The GCA schedules a pre bid conference at the site to answer questions and to lead a tour of the property. All of the design team is usually there and the minutes are recorded. Questions and answers from the meeting are sent in a written format to the prospective bidders and a time period is set to take additional written questions before the bid. There is usually a deadline for questions to allow the GCA time to publish the responses to all bidders. A date and time is set for the submission of bids.

### **There are different types of bids:**

#### **Lump Sum**

The contractor agrees to build the entire project for a single set price. This is rarely used because golf construction is an ongoing process combining art and engineering. The

nature of a lump sum contract is not well suited for the flexibility need to produce the best product possible.

### **Unit Price**

The works is defined in a “**Schedule of Values**” which is typically a spread sheet defining a series of tasks (**line Items**) to be completed, the unit of measurement, the estimated units of work, the unit price for each line item; with sub totals for each item, category, and a grand total, for all the work. This is the most common bid.

### **Cost Plus a Fee:**

The contractor works at the pleasure of the GCA and tracks costs for which he is reimbursed. He is also entitled to a set fee for the project regardless of costs; or a fee based on a percentage of the costs. This format is convenient for “fast track” projects where the work may start before final plans are complete.

### **Hourly:**

The contractor provides a list of rates for equipment and personnel that includes profit, overhead and taxes. And bills according to hours worked. This is a useful format for small projects where the owner may be doing some of the work in house and buying some or all of the materials.

Once the bids are received, the GCA and owner’s representative open and evaluate them. The bids are usually posted to a spread sheet for comparison. The GCA will likely conduct phone interviews for follow up and clarification with two or three of the most competitive bidders. Based on price, experience, and understanding of the project, the GCA and owner will select a contractor.

The final details of the contract will be negotiated and the final documents are prepared and executed.

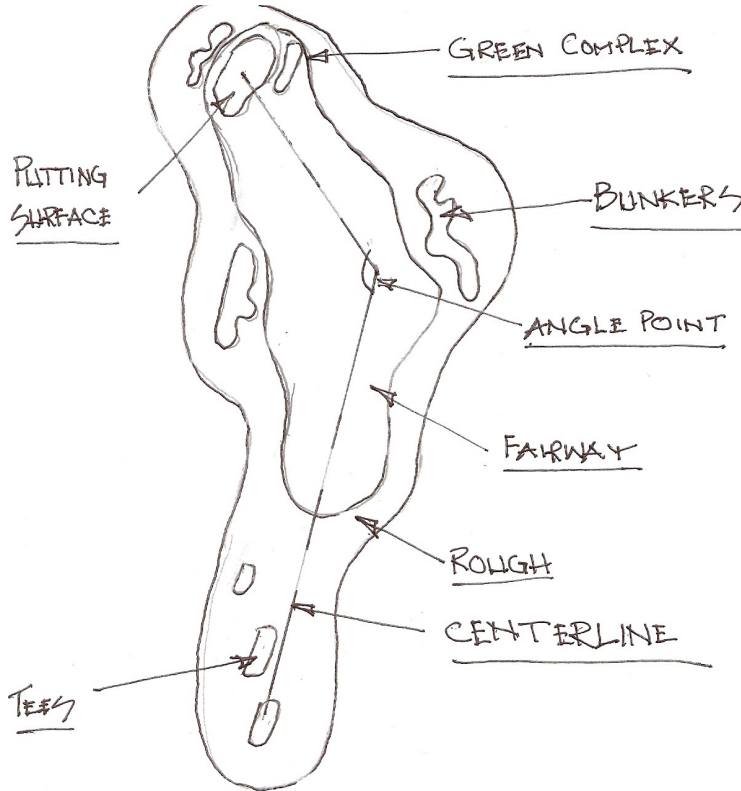
## **Definitions:**

### **The Game of Golf**

As defined by [Britannica Concise Encyclopedia](#):

Game in which a player using special clubs attempts to sink a small ball with as few strokes as possible into each of the 9 or 18 successive holes on an outdoor course. A hole includes (1) a teeing area, a clearing from which the ball is initially driven toward the actual hole, or cup; (2) a fairway, a long, closely mowed, and often angled lane; (3) a putting green, a smooth grassy area containing the hole; and (4) often one or more natural or artificial hazards (such as bunkers). Each hole has associated with it a par, or score standard, usually from par 3 to par 5. The origins of the game are difficult to ascertain, although evidence now suggests that early forms of golf were played in the Netherlands first and then in Scotland. Golf developed in Scotland — the courses were originally fields of grass that sheep had clipped short in their characteristic grazing style. Golf balls were originally made of wood; wood was replaced in the 17th century by boiled feathers stuffed in a leather cover, in the 19th century by gutta-percha, and in the 20th century by

hard rubber. Clubs, limited in number to 14, are known by the traditional names of "irons" (primarily for mid-range to short shots) and "woods" (primarily for longer shots); today irons are more likely made of stainless steel, and the heads of woods are usually made of metal such as steel or titanium.



*Typical Golf Hole Layout*

# Glossary

## **A:**

### **Aerator**

A device installed in ponds that adds oxygen to the water to reduce stagnation and unwanted algae growth.



*Floating Aerator*

### **Agronomist**

A consultant to the project who advises the project team on matters concerning fertility, plant selection, soil amendments, and maintenance practices.

## ***B:***

### **Bermuda Grass**

Bermuda grass is a popular turf plant used for golf and other recreational applications in the southern zone of the United States.

### **Bunker**

A strategically placed depression filled with sand. A difficult medium to play from, Bunkers enhance play by bringing in an element of strategy for the golfer to avoid landing in them.



*Sand Bunker*

## **C:**

### **Cart path**

An improved surface for golf carts to drive on during the course of play to provide an all weather surface and reduce wear and tear on the turf playing surface.



*Cart Path*

### **Central Controller**

Usually a desktop computer loaded with custom software that is connected to the Satellite Controllers and sometimes the Pump Station. The central controller allows the operator to program and monitor the irrigation system.



*Central Controller*

### **Centerline**

The ideal route of play of a particular hole as denoted by the GCA on the plans. Starting from the center of the back tee to the angle point if a Par 4, and then to the center of the green; or to both angle points if a Par 5 and then to the center of the green, Or to the center of the green if a Par 3.

### **Common Bermuda Grass**

Bermuda Grasses differentiated by its production of seed heads to self propagate





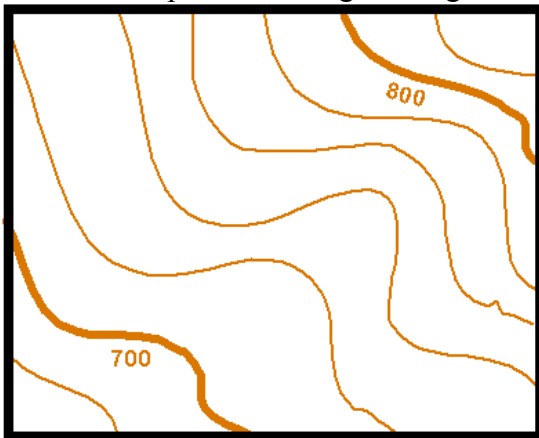
*Common Bermuda Seedhead*

**Construction Superintendent**

The person responsible for the construction personnel on the project. The Construction Superintendent typically works closely with the GCA, the Maintenance Superintendent and the Owner's representative.

**Contour Lines**

Lines on the plans denoting a change in elevation.



*Contour Line*

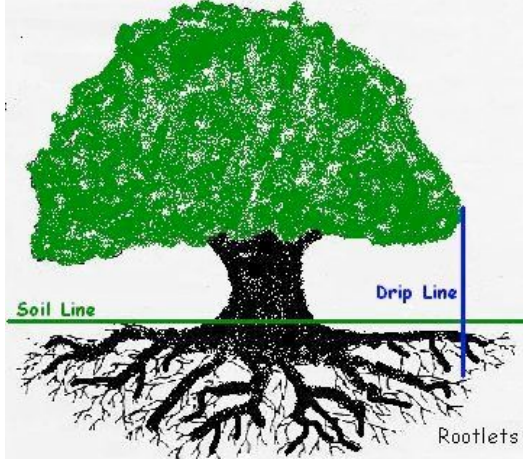
**Cut and Fill**

Cut and fill are terms used to Excavation (cut) and placement (fill) of earthen material according to the grading plans

# ***D:***

## **Drip Line**

An imaginary line directly below the outer edge of the canopy of a tree. Where rain water would reach the ground if the canopy were watertight.



*Drip Line*

# ***E:***

# ***F:***

## **Fairway**

A closely mown area on both sides of the centerline and the most desirable place to play from in terms of both playability and strategy



*Fairway*

**Final Grade or Grade**

Refers to the completion of excavating or the filling of earth per the GCA’s plans. As in, “the builder achieved final grade according to the plans.”

**Finish Equipment**

Smaller Equipment used in the final smoothing stages of construction. Includes machines and implements to till, pulverize, and smooth the final grade just before planting.



*Finish Equipment*

**Fittings**

The parts used to connect pipe together



*Fittings*

## **Fumigation**

The injection of a poisonous gas usually Methyl Bromide, into the soil and covered with a tarp for a period of 48 Hours to kill all vegetation and seed in the soil. The tarp is then removed and the gas is allowed to dissipate for an additional 48 hours before planting.



## ***G:***

### **Grade Percentage**

A slope expressed as a percentage. Example; A drop of 5 feet in a run of 100 feet would be a 5% Grade.

### **Grass Farm**

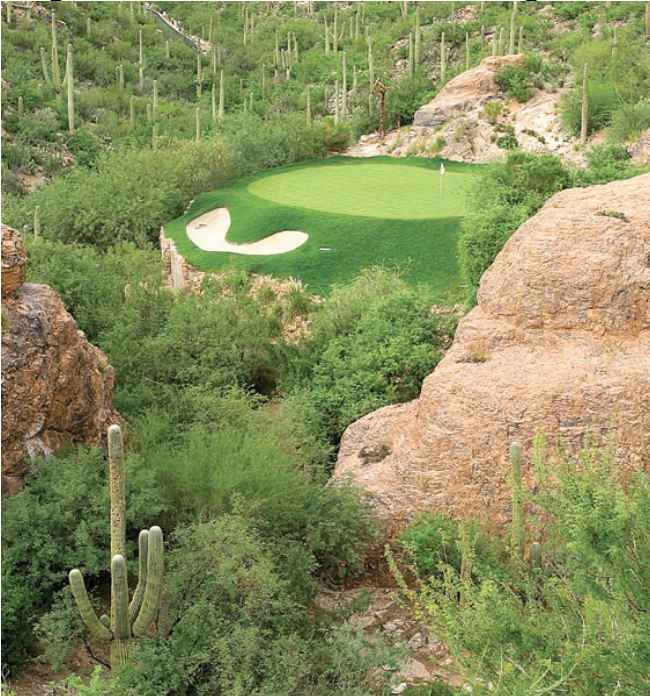
A grass farm is a large piece of land that has been sterilized and planted to desirable varieties for the purpose of harvest and sale to golf courses, landscapers, parks etc.



*Grass Farm*

### **Green**

A very closely mown area near the hole, specially constructed and maintained to allow the grass the maximum chance of thriving in the stressed environment.



*Green*

### **Green Complex**

The area including the Putting Surface and adjacent areas that may include contours, depressions and hazards such as Bunkers.



*Greens Complex*

### **Greensmix**

A specially blended soil, usually sand and peat. Sand, Peat, and a proposed Gravel is sent to a soils testing laboratory that specializes in testing golf course materials. The laboratory blends the Sand and Peat in different ratios and determines the best ratio as it relates to the performance specifications and the size of the proposed gravel.



*Greensmix being spread over gravel layer*

### **Greensmix Blender**

A specially designed and calibrated machine used to blend Greensmix to the recommendations approved by the laboratory.



*A Greensmix blender being loaded with Sand*

## ***H:***

### **Hazard**

A sand bunker or a water feature



*Bunkers, Water Feature, Retaining Wall*

### **Hybrid Bermuda Grass**

Bermuda Grasses differentiated from Common because it does not produce seedheads and must be propagated by cultivating parts of the plant. i.e., Sprigs or Stolons

## ***I:***

### **Imported Materials**

Materials not found naturally occurring onsite. Usually purchased and trucked to the site for special applications

### **Irrigation System**

An underground network of pipe, wire, sprinkler heads, and appropriate fittings usually connected to above ground satellite controllers which are connected to a central computer. The purpose of the irrigation system is to deliver water and in some cases nutrients to the golf course in controlled quantities for maximum efficiency and optimal plant growth.



*Golf Irrigation System*

## ***J:***

## ***K:***

## ***L:***



## ***M:***

### **Maintenance Superintendent**

The person responsible for the growth and care of the golf course.

### **Mass Excavation Equipment (Mass Ex)**

Heavy Construction Equipment used to move large quantities of earth. Used primarily by the builder in the early stages of a project to create general landforms and large water features per the GCA's plans. Examples of Mass Ex Equipment are Scrapers, Bulldozers, Loaders, Excavators, and Haul Vehicles.



*Mass Excavation Equipment at Work*

## ***N:***

### **Node**

A joint or bump on a stem (Rhizome or Stolon) where roots or leaves or branches originate.

## ***O:***

## ***P:***

### **Par**

The score that the GCA would expect an expert golfer to make on a particular hole. Also the score the GCA would expect and expert golfer to make upon completing of 18 holes. (also known as “par for the course”)

### **Putting Surface**

The actual closely mown area near the hole as determined by the plans. The Putting Surface is built in layers with specially produced imported materials.



*Putting Surface Under Construction*

## ***Q:***

## ***R:***

### **Rhizome**

A jointed stem from the underground portion of a Bermuda plant that is capable of producing roots or shoots at each node.



*Rhizome*

### **Rough**

Taller grass to the outside of the hole from the Fairway. To be avoided by the golfer as it is more difficult to play from.



*Rough Around Tees and Fairway*

## **S:**

### **Satellite Controller**

A switching station housed in a weather proof box on a pedestal strategically places around the course and connected to the irrigation system. The controller is connected to a limited number of valves. The controller decodes information it receives from the central controller and sends it to each individual valve under its control. Each controller can also be operated manually by maintenance personnel.



*Satellite Controller*

### **Shaper**

A lead bull dozer operator who specializes in artistic interpretation of the plans. A shaper works closely with the GCA to make adjustments to the grade and features in order to enhance the beauty and playability of the golf course.

### **Sod (Shingle or Slab)**

Mature grass grown at a sod farm and cut into rectangular pieces or rolls and shipped to the site to be laid by hand in the case of rectangular pieces or by machine in the case of rolls. The rectangular pieces are sometimes called shingles.



*Sod on a pallet*

## **Sod Harvester**

A machine used at the grass farm to cut and stack sod for shipping



*Sod Harvester and Sod Loaded on a truck for shipment*

## **Soil Amendments**

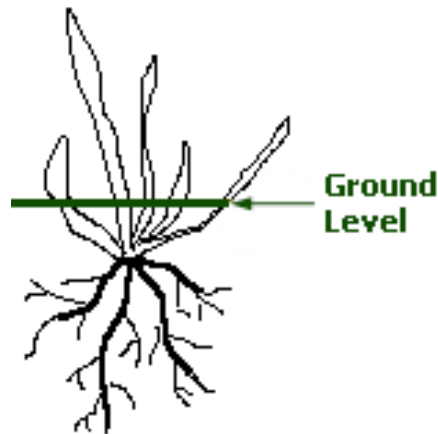
Fertilizers and other chemicals that are added to the soil

## **Solenoid**

A device that converts electrical energy into motion. In a sprinkler head, often referred to a solenoid valve, which is an integrated device containing an electromechanical solenoid which actuates the valve

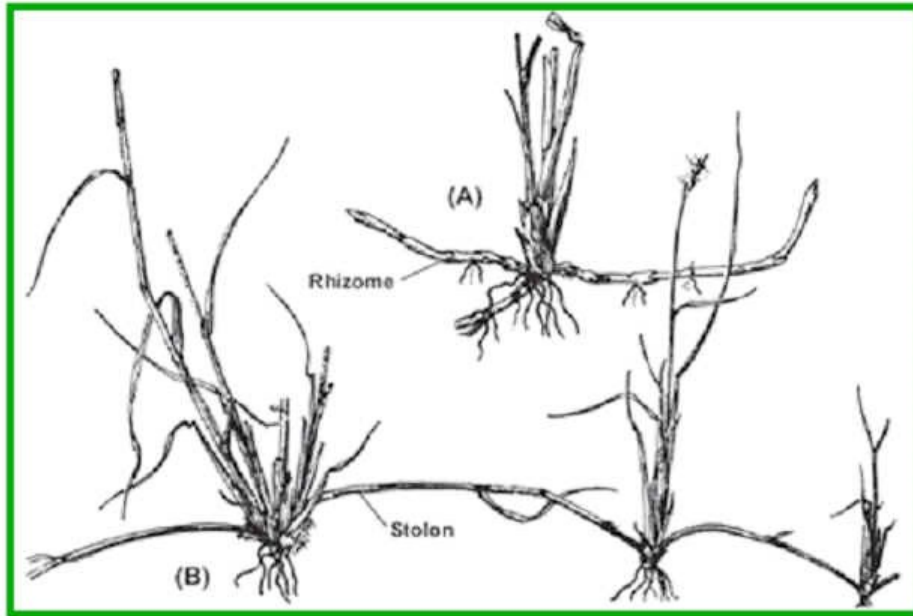
## **Sprig**

A Sprig is part of a Bermuda plant harvested for the purpose of propagating hybrid Bermuda varieties. A sprig is usually distinguished from stolons in that sprigs consist of stolons with roots and rhizomes; whereas stolons consist of above ground parts only. Sprigs are produced by shredding harvested sod or by sprig harvesters. Stolons are generally harvested with a vertical mower or a flail mower set close to the ground. Sprigs will tolerate slightly more environmental stress during planting and establishment because of the energy reserves in the roots and rhizomes. Harvested Sprigs are pressed into the ground typically by a special sprigging machine or sometimes spread by hand and then pressed into the ground with a disk like roller. Sometimes sprigs are simply



spread by hand and then hydro mulched.

*Sprig*



Adapted from Moser and Nelson - Structure and Morphology of Grasses

**Sprigging Machine**

A specially designed machine used to plant sprigs



*Sprigging Machine*



*Sprigging Machine in Action*

### **Sprinkler Head**

A set of gears, fittings, nozzles, a valve, and electrical solenoid, assembled in a plastic housing and connected to the irrigation delivery pipe. Its purpose is to deliver water to the golf course in a controlled and even manner.



*Sprinkler Head*

### **Stake**

A machined piece of pointed wood driven into the ground used to reference a location and having written information necessary for construction personnel to build the course. A stake will often have color coded plastic ribbon tied to it.



*Construction Stake*

**Stockpile**

Stored Material whether it be imported and piled onsite for later use or material obtained from the site such as topsoil set aside for later use.



*Stockpile*

**Stolon**

A jointed stem from the aboveground portion of a Bermuda plant that is capable of producing roots or shoots at each node.





*Stolons*

**Subsoil**

All soil below the Topsoil Layer. Usually somewhat sterile and void of nutrients, organic matter, or microbial activity

**Surveyor's Ribbon**

Plastic Colored Ribbon tied around stakes and trees, usually color coded. Used to provide information to construction personnel

***T:***

**Tee**

A closely mown area where a golfer starts play on a particular hole. But as closely mown as a green



*Tees with Markers*

**Topsoil**

The upper layer of soil containing microorganisms and organic matter. Considered the best soil for plants to grow in

**Turning point or Angle Point.**

A point in a fairway where the GCA's intended route of play as denoted by the centerline on the plans, turns. On Par a 4, the point where a player's first shot would ideally land. On a par 5 the points where a player's first and then second shot would ideally land. On a Par 3 there is no turning point as the player's first is expected to land on the green.

***U:***

***V:***

**Valve**

A switching mechanism installed on the irrigation system to stop water or allow it to pass. Can be on the pipe itself or inside a sprinkler head



*Head Cross Section Showing internal and Solenoid (upper left with wires)*



*Gate Valves for pipe*

***W:***  
**Water Feature**

A manmade or enhanced natural feature that contains water. Often a water feature has a pumping system to circulate water. Examples include Waterfalls, Creeks, Ponds, Fountains. Modern pond construction often includes the installation of aerators to keep stagnation to a minimum



*Improved Water Feature*

**X:**

**Y:**

**Z:**

## **Construction:**

### The Construction Contract

The Construction Contract is the written agreement between the owner and builder defining the scope of the work and the terms under which it will be completed. The agreement is supported by other documents. The collection of contract and supporting documents, is commonly defined as the Project Manual or Contract Documents

Depending on the type of bid received, the main part of the contract is usually “the Agreement”.”

### **The “Contract Documents” consisted of:**

- The Agreement
- The General Conditions of the Agreement
- The Permits
- Exhibits to the Agreement
- The Drawings
- The Specifications
- Addenda issued prior to the execution of the Agreement

**The Agreement** describes the Terms of Payment, The Scope of the Work, The allotted time, The Price of the work, and other elements specific to the project.

**The General Conditions** are essentially the rules of the job; they are more general in nature and can often be applied to any similar project. A main function of the general conditions is to provide direction for what to do in anticipated situations that may arise on the project. Other Items may include Order of Precedence, Change Order Procedure, Responsibilities, Definitions, Insurance Requirements, and Work by Others.

**The Permits** are written permissions from local, state, or federal authorities as applicable to the project

**Exhibits** are labeled, additional, documents that further define specific parts of the Contract Documents

**The Drawings** are the plans, sometimes described as blue prints, which define through the use of graphic representations, the work to be completed. These graphics often have notes written on them defining dimensions and other specific information clarifying their meaning.

**The Specifications** define each part of the work as well as specific materials, techniques required by the GCA. Also, expected results, standards and testing methods. In the case of Fiddler’s the builder’s proposal form are included.

**Addenda** are changes to the contract documents agreed to by the owner and builder before the contract documents are executed.

### **The Construction Process**

A preconstruction meeting usually takes place before the start of the project. The project team assembles to discuss the process, timing, current issues, and issues that may arise during construction. A scheduling meeting often occurs with input from all the team members into a master Critical Path Method schedule.

The Critical Path Method (CPM) is a standard way of scheduling construction projects where all tasks are linked together usually with the aid of scheduling software. The CPM

schedule aids the project team in accurately tracking the progress of the work, seeing the effects of delays in portions of the work, and monitoring the project finish date.

## **Subcontractors**

The builder does not always use all of his own forces to build a golf course. A builder will sometimes hire other contractors to do parts of the work. These contractors are called Subcontractors. They are often specialists in a particular skill. Typical subcontractors for a golf construction project might include Cart Path sub, Retaining Wall sub, Water Feature sub, Grassing sub.

## **Construction Categories**

A typical golf construction project involves hundreds of measurable tasks that are broken down into the following categories:

- **Mobilization**
- **Initial Staking**
- **Erosion Control**
- **Clearing**
- **Topsoil Removal**
- **Mass Excavation**
- **Shaping**
- **Drainage**
- **Irrigation**
- **Topsoil Replacement**
- **Greens Construction**
- **Tee Construction**
- **Bunker Construction**
- **Cart Path Construction**
- **Water Features**
- **Bridges**
- **Retaining Walls**
- **Landscaping**
- **Finish Work**
- **Fumigation**
- **Sodding**
- **Sprigging**
- **Seeding**
- **Demobilization**

## **Mobilization**

Mobilization consists of the initial movement of equipment, materials, and personnel to the project. It also includes the procurement of a Performance and Payment Bond, establishment of employee housing, construction offices, staging area, temporary utilities, sanitary facilities, construction entrance, permits, setting up of local supplier accounts for fuel, expendable supplies, etc.

## **Initial Staking**

The staking plan usually consists of a centerline and boundary plan. A line is drawn from the center of the tee to the turning point (or points of the hole) to the center of the green. Additional staking will occur to direct and control the progress of the work throughout the construction process.

## **Erosion Control**

The environmental consultant will have produced a Storm Water Pollution Prevention Plan (**SWPPP**) that is the first task to be implemented on any project. The purpose of the plan is to define methods for the specific site to prevent silt contaminants from escaping the site into any waterways. It is federally mandated and usually locally administered and enforced. The erosion control plan will often include provisions for dust control. The contractor implements the plan using the prescribed methods, conducts regular inspections and repairs, and documents all the activities relative to the plan.

Typical methods of erosion control include:

### **Silt Fence**

A porous filter fabric attached to stakes, partially buried, and placed wherever water run off is flowing toward a waterway or exiting the construction site. The fabric allows water to pass though while collecting the silt particles for disposal or reincorporation into the work.

### **Check Dams**

Rocky rubble staked in a drainage channel bed to slow the flow and allow the silt particles to drop out of suspension. Functions like a silt fence but can handle much heavier and concentrated flows.

### **Waddles**

Tube shaped barriers that are installed perpendicularly to exposed slopes to slow water and collect silt.

### **Silt Detention Ponds**

Dry ponds that are constructed in strategic locations throughout the site to collect and hold water until the particles settle to the bottom and the clean water can be released through a structure near the water surface.

### **Diversion Berms**

Earthen berms that collect flowing dirty water and direct it to detention ponds. The berms are usually lined with erosion control blankets and seeded.

### **Erosion Control Blankets**

A blanket usually made primarily of straw woven into a biodegradable plastic mesh. The blanket is staked to seeded ground to provide soil stability while the plant grows.

### **Temporary Seeding**

A fast growing seed is often used to establish vegetative coverage on areas that will not have active construction activity for extended periods. Often applied with Hydromulch.

### **Hydromulch**

An emulsion of shredded paper or wood fibers often mixed with seed, fertilizer, water, and an eco friendly chemical binder that is sprayed from a **machine** specially designed for this application. The mulch dries and forms a crust that helps prevent erosion and provides an enhanced growing medium for rapid seed growth.

### **Best Practices**

Consists of educating personnel in methods of construction that, combined with the implementation of other measures described in the SWPPP, eliminate storm water pollution.

## **Clearing and Grubbing**

After the centerline is staked the builder will flag the proposed clearing line as shown on the plane by measuring the appropriate distance from the centerline stakes. The line will be denoted by tying colored plastic surveyors ribbon around trees along the line. The GCA will then walk the lines making adjustments and designating any other trees of interest he may want to save. The builder will then clear the trees designated for removal. The builder will also remove small trees and brush in and around the remaining trees at the GCA's direction. The last phase of the clearing process is grubbing which consists of using rake like implements mounted on equipment to remove roots, debris or other obvious deleterious matter from the topsoil.

## **Topsoil Removal**

After grubbing any available topsoil is removed and stockpiled for later use. This is accomplished with heavy equipment including Scrapers, Bulldozers, Loaders, and Haul Vehicles.

## **Grade Staking**

Reference points will be established using Stakes and Ribbon denoting the locations of specific features of the golf course as taken from the plans. The ribbon is colored coded



to identify the type of information that is written on the stake. Equipment operators will use that information to do the initial grading of the golf course.

### **Mass Excavation**

The moving of large quantities of earth by the builder in the early stages of a project to create general landforms and large water features per the GCA's plans

### **Shaping**

Shaping is a key component of the golf construction process. The shaper is charged with creating the GCA's artistic vision and is knowledgeable in construction principals as well as aesthetics. Shaping consists of making the final grade and adjustments to fit the land and the GCA's concept. When a shaper's work is complete the golf course the form of the golf course is very close to its final grassing grade. A shaper typically uses a bulldozer and sometimes is supported by other members of the crew who do things like bring or haul away fill, stake, and grade check.

### **Drainage**

Drainage is often installed after shaping although in cases of extreme fills, some pipe may be installed in advance. Drainage consists of pipe, fittings, discharge structures, and collection basins (inlets) Drainage is usually engineered to accommodate certain flows as desired by the GCA. The GCA designates collection points where inlets should be installed. The engineer recommends the sizing of the inlets and pipe that will be installed. He also routes and assigns grade to the pipe through the golf course according to the design and wishes of the GCA

### **Irrigation**

Once drainage is installed the irrigation system is staked. Irrigation staking usually consists of marking Sprinkler head locations and then marking pipe routing in order to connect the pipe and wire to the heads. Once a section of the golf course is staked Mainline is installed in trenches. Smaller pipe called Laterals are then connected to the main line. It is to the laterals that the Sprinkler heads are connected. For the most part the pipe is made of Polyvinylchloride (PVC) Control wire is then laid in the same trenches as the pipe and run to the Satellite Controllers. Signals from the controller to the solenoid in the head open and close the valve, thus allowing water to flow or stop accordingly. The Satellite Controllers are connected to the Central Controller by shielded Communication Wire which is also installed in trenches. The irrigation is fed by a Pumpstation usually set up near a body of water on or near the golf course. The Pumpstation is often integrated with the central controller to achieve maximum efficiency and monitoring. Stub outs of pipe and wire are also run into designated landscape areas for future use at this time.

### **Topsoil Replacement**

After irrigation is installed, stockpiled Topsoil is brought back onto the golf course and spread in an even layer over all areas to be planted with the exception of greens and tees which will be covered with a specially blended material.

## Greens Construction

Greens construction can occur during or after the respreading of Topsoil. Green Construction is an important and involved process. The materials consist of Solid Drain Pipe, Perforated Drain Pipe, Fittings, Gravel, a Plastic Interface Barrier Material, and a specially blended Growing Medium usually referred to as Greensmix.

A green is built in several layers. The contractor begins by determining the total depth of all the layers as determined but the plans and specifications. Once determined, the contractor will shape the green site to the proposed grades allowing for the eventual addition layers toy bring the putting surface to the final grade. The surface at this point is called the “Subgrade.”

The Solid and Perforated drain pipe is usually made of High Density Poethylene (HDPE) The only difference between the two is that the Perforated Pipe has small slits in it to allow water in. Perforated Pipe is laid in trench and surrounded by gravel. Both types of pipe are connected by fittings manufactured for the purpose.

Greensmix and Gravel:

Gravel is a fine stone of a size determined by a special soils testing laboratory to have characteristics compatible with the Greensmix. The Greensmix and gravel must function together to produce a successful growing medium for putting surfaces. A detailed explanation can be found in the attached document titled “**USGA Recommendations for a Method of Putting Green Construction**”

The Plastic Interface is a thick piece of plastic installed around the perimeter of the green subgrade to prevent water from wicking out of the greensmix into the surrounding soil.

Once the putting surface is shape to the subgrade stage, solid pipe is installed from the edge of the putting surface to act as discharge lines. Perforated pipe is installed in trenches and back filled with approved gravel. The plastic interface is installed and a four inch layer of the same gravel is then spread over the entire subgrade. The final layer of greensmix, usually 12” is then spread over the gravel bringing the entire putting surface to final grade.



## *Green Subgrade*



*Trenches for perforated Pipe*



*Gravel Layer*

## **Tee Construction**

Tee construction is often underway the same time as greens construction. Tees are built in a similar manner to greens often with the perforated drains installed and four to six inches of greens mix.

## **Bunker Construction**

Bunkers are also constructed about the same time as Tees and Greens. Bunkers also have perforated drains in the subgrade and are typically filled with four to six inches of approved imported sand.

## **Water Features**

Water features includes digging dredge and/or lining of ponds, building of man made creeks or water falls. Water feature construction is on going during the process. Once the mass excavation is done in an area of a water feature the builder will begin the necessary piping and improvements per the plans.

## **Cart Path Construction**

Cart path construction begins as Greens Tees and bunkers are completed. Cart path in the Florida area is usually made of concrete, is typically 8 to 12 feet wide and 4" thick. Curb is often added in strategic locations to minimize cart traffic damage. Sections of the path are typically left out to provide access for sprigging equipment.

## **Landscaping**

Landscaping is typically installed on the perimeter of the golf holes. The landscape architect directs final placement of the plants. Landscape construction is usually one of the last processes in the project. Sometimes continuing even after grassing.

## **Bridges**

Bridges if needed can be constructed at any time after mass excavation is completed in the appropriate areas. Bridges are most often built to provide cart and maintenance equipment access and are usually connected to the cart path. If access allows, they can even be constructed after grassing. Bridges can be built of many different materials. Wood is a common material. Masonry is also popular.

## **Retaining Walls**

Retaining walls are built at the appropriate time in relation to a particular portion of the work. Their function is usually to hold back earth in areas of high erosion, steep slope and lake edges if the GCA deems them necessary to the design.

## **Finish Work**

When the Irrigation, Greens, Tee, Cart Path and other elements are built, Finish Work begins. Finish work consists of the final grading tilling and smoothing of all areas to be grassed. Soil amendments are added at this time. The soil is worked smoothed and raked free of debris. Water is often incorporated into the soils at this time to give the sprigs the maximum chance of survival.

## **Fumigation**

Fumigation of the greens occurs during finish work. The hot gas method was used where a tarp is laid on the area to be fumigated and Methyl Bromide Gas is injected under the tarp.

## **Sodding**

As areas of the golf course are finished, the contractor orders sod to be delivered. Sod is mature grass cut into rectangular shapes or rolls and placed on palettes and loaded on truck for delivery to the golf course. The Sod is grown commercially on a sod farm usually relatively near the project site. When the palletized sod arrives at the site it is unloaded from the trucks and inspected for suitability. The sod is accepted or rejected at this time. Rejected sod is usually loaded back onto the truck for return to the farm. Accepted sod is taken, often by forklift, to the area of the golf course scheduled for planting that day. The sod is laid as quickly as possible, by hand if in rectangular slabs, or by machine if in rolls. Once the sod is laid it is immediately watered heavily to insure maximum potential for survival.

## **Sprigging**

Once the sod is laid in key areas, sprigs are brought in from the farm to complete the planting. The sprigs are installed by two methods. One method is from a specially designed sprigging machine, sprigs are loaded into a hopper on the machine and from there the sprigs are agitated and dropped onto conveyor which distributes the sprigs evenly on the ground to be planted. A series of disklike steel wheels press the sprigs a few inches into the ground. The second method of sprigging is to distribute the sprigs on the ground and then cut them in with a tractor mounted, or walk behind machine. This method is used when the area to be sprigged is too small to maneuver the sprigging machines in. It is also used on Tee surfaces and greens to minimize damage. The Sprigs are then watered heavily.

## **Seeding**

Seeding if required would be done after the sprigging. Fiddler's Creek did not seed.

## **Demobilization**

At the completion of the project, the Builder cleans up any refuse and leftover material, removes temporary office and sanitary facilities, and trucks his equipment from the site. This is the last step in the completion of the construction process.

## **Growin**

As holes are planted out by the builder the maintenance superintendent and his staff assumes responsibility for the care of the newly planted material. This process includes heavy watering for the first 10 days to two weeks. The water is necessary to help the plant produce new growth. This first new growth appears within days at the nodes of the sprigs and in the form of Rhizomes rooting in the ground from the sod. As the sprigs grow and the water is cut back the maintenance staff will apply fertilizer and other

nutrients to continue to stimulate growth. As the grass grows, mowings will begin. Mowing during growth helps the plant to spread laterally and fill in exposed areas of earth. Well maintained sprigged ground in Florida can usually achieve satisfactory coverage in 90 to 120 days. Sod seams, if carefully installed, will be knitted together and no longer noticeable in about 8 to 12 weeks.



