I.  Layout and Design

Golf Course design includes considerably more than just hole routing. It includes contour layout, water feature design, clearing lines, green and bunker layout, bridges and paths, irrigation, seeding/planting, specifications for materials, and overall land planning. Careful considerations are always made for utilization of the existing topography.

An average 18 hole golf course has a routing of approximately 6,300-6,500 yards in length. Small courses run as low as 6,000 yards and championship courses up to 7,300 yards. The average course encompasses 150-175 acres, including clubhouse, parking and maintenance facilities. Courses are routed with a hole combination of par 3’s, 4’s, and 5’s. Each hole is sized to match its par, with 125-235 yards for an average par 3, 325-470 yards for par 4’s and 485-590 for par 5’s. Recommended Green surfaces are from 5,000 to 7,000 square feet of putting area.

Land surveying is accomplished by measuring horizontal distance, ignoring slope. Many tees, greens, and doglegs are staked with the use of right angle measurements. These can be established without a compass or transit by performing the three, four, five method.

When the project is completed, an “as built” drawing is made. This drawing includes drainage, irrigation, seeding, and construction features of the course.

II.  Clearing

Clearing is a very important function of golf course construction. Many projects require existing trees to be retained without obstruction of the roots. Some areas of the country have TCP (Tree Conservation Program) ordinances regulating the amount of trees that can be removed and the spec’s on replacement. A feller buncher is a common tool used to remove trees and branches. Removed material is commonly buried in non-playing areas as fill. Burning is allowed in some areas but the contractor must obtain a permit.

III.  Earthmoving

On most projects, the most efficient way to move soil is with a wheel scraper. With moves of 500 to 1,000 feet, a 12-15 CY scraper can typically move 800 to 1,000 CY/day of dry structural clay. Many projects utilize off road trucks for earthmoving. This method is referred to as “top loading”. The main factors for calculating earthmoving production are soil conditions, distance and cycle times. Soil volume is measured in three categories: bank, loose, and compacted. Careful consideration should be made with regard to over compaction of the soil. Low ground pressure “LGP” tracked equipment is used to minimize this compaction.

IV.  Finish Grading

Finish grading is generally done by a professional shaper. This person is trained to understand what the architect intends the feature to look like. The slopes of these features should be no more than 4:1, facilitating ease of future maintenance. A minimum slope of 2% is required to
provide adequate surface drainage. Pond banks can incorporate steeper slopes if other bank support materials are used. “Free board” is a commonly associated term in pond construction.

V. Drainage

Proper drainage is essential to provide a quality stand of turf. Slopes of 2-3% are recommended to sustain sufficient surface drainage. Relatively flat land, solid grass cover, or deep sandy soils contribute to low runoff conditions. Many areas that require drainage piping are greens, bunkers, and sand traps. Drain lines are installed at a minimum of 1% slope for proper movement of water. The sizing of these lines is determined by calculating the area to be drained.

VI. Green Construction

Green construction generally follows a specification developed by the USGA. The specification includes laying a 4” layer of gravel on the subgrade, then adding a 2” layer of choker sand and following up with a 12” layer of compacted root zone mix. The spec requires each layer to follow the contour of the finish green surface. The 2” layer of choker sand is specified to allow better rooting and prevent the root zone mix from entering the pea gravel drains under the green. Recommended choker sand should have a particle size of from 1 to 2 mm.

The root zone mix typically has a sand to peat moss ratio of 80/20. This ratio is a reflection of volume. The desired range of medium and course sand is 65-80%. Limestone is not recommended due to its ability to break down. When the mix is in place, the ideal water retention capacity at 40 cm should be between 12 and 25%.

Permeability for bent grass green should be from 14 to 17 inches/hour.

Many green specifications require that an impervious plastic barrier be placed around the green perimeter to prevent capillary movement between the greens mix and surrounding soils.

Many greens are being constructed with straight sand. This method has been called the “California” green construction method.

VII. Trap Construction

Traps and bunkers are constructed with a variety of shapes and contours. The recommended slope ratios discussed in finish grading can vary in trap construction. Steeper grades require extensive drainage and the banks must be covered by sod as opposed to seed. Trap sand is purchased by the ton as opposed to the cubic yard. The weight varies with moisture content in the sand. Bunker sand is typically installed at a depth of 6 to 8 inches.

VIII. Irrigation

Irrigation systems used in golf courses today range from full automatic computerized systems to manual quick coupling valve systems. The volume of water disbursed by irrigation heads is expressed in gallons per minute. Systems are most commonly piped with (PVC) polyvinyl chloride pipe, however, other material such as polyethylene is used. Pipe is supplied under specifications for class, which is the pressure rating, and schedule, which relates to the pipes wall thickness. The two types of piping connections used on golf courses are solvent weld PVC
or bell ring tite. Bell ring tite pipe requires concrete “thrust blocking” at all changes in direction of the pipe path.

The piping system is zoned by gate or ball valves. These valves have the lowest friction losses per like sizes of all valves made.

The electric or hydraulic valves used to control the sprinklers in the system are either piston or diaphragm type. Water pressure is required to open these valves.

Golf course pumping systems use either turbine or centrifugal pumps. Groups of pumps placed in parallel will increase flow by adding the capacity of each pump. Groups of pumps placed in series maintain the flow of one pump but increase the pressure by adding the pressure of each pump.

Irrigation control systems and their communication networks between centrals/field units are typically hydraulic, electric, phone modem, or radio waves. Valves are normally activated with 24 volts of power. Underground wire connections are made with Scotch-Lok, Pen-tite or DBY connectors. Electric systems require proper grounding to provide “Surge Protection” of electrical circuits.

IX. Fertilization

Fertilizer is made up of three basic elements: (N) Nitrogen, (P) Phosphorous, and (K) Potassium, or potash. Different amounts of each element are mixed to provide specific levels of plant growth in various stages. The pH (alkaline) level in the soil also should be maintained at approximately 6.5 by adding sulfur. A common type of sulfur used for decreasing the pH level is ammonium sulfate. Some liming material like dolomitic lime will also provide beneficial calcium and magnesium to the soil. Soils that show a high level of sodium can be brought in check by adding gypsum.

X. Seeding

Many types of grasses are used on golf courses and selection is based on climate, soil, maintenance practices, and cutting heights. Generally bents are used for fine turf in northern climates and bermudas in southern climates. Additional cultivators such as Meyer Zoysia have been developed for their tolerance to cold weather.

Seed mixtures represent seeds combined from different species and seed blends are seeds combined from like species.

When seed is blended, a lot number tag is attached to the bag representing a record of how much seed was mixed from one field of one variety. The percentage of crop seed shown is the amount of commercially grown seed in the mix other than the seed you purchased. If the bag is “blue tagged” you have a guarantee the varieties are as specified. “Interagency Certification” ensures the seed is the specified varieties and mixed under the supervision of a state agent. Pure live seed is the amount of seed in any given lot, which should germinate in relation to the percent purity.

Seeding rates vary; a typical rate for bent grass is 2 lbs./1000 square feet. Perennial Ryegrass is the fastest germinating grass on the market. Regardless of seed type or rates, continuous light moisture is required for proper germination. Straw mulch is typically applied at the rate of
1-1 ½ tons/acre to ensure the soil stays moist and minimize erosion. “Crimping” is a process of mulching newly seeded areas with straw. Another planting process is laying stolens as opposed to seed. Stolens are generally warm season grasses that already have grown a root structure. This process is called “sprigging.”

XI. Soil Structure

Clay, sand, and loamy soil are very desirable for golf course construction. Gravelly soils are not desirable because of the extensive soil modification required to provide proper plant/soil structure. Variables directly related to ideal soils are texture, pH, permeability, and organic matter. The main purpose of proper soil mix is to provide adequate air and water movement. The ability of the soil to hold the maximum amount of water in its pore spaces is called Field Capacity. Compaction increases the bulk density and reduces the permeability of the soil. Soil pH is again also affected by the soil type and structure. Clay soils generally require lime, increasing the pH. Maintaining ideal pH will improve the ability of plant roots to take in nutrients. pH readings range from 0 to 14.

XII. Regulations

OSHA administers the safety regulations of the building industry. The hazard communication part of their program requires posting of (MSDS) Material Safety Data Sheet information on every job site. The U.S. Army Corp of Engineers is responsible for controlling and permitting wetland disturbing activities under Section 404 of the Clean Water Act. Excavation on any site with ¼ acre or more of wetlands requires a National or local 404 grading permit. Wetlands are defined as swamps, marshes, mud flats, and similar areas. When dealing with natural lakes, consideration must be made for the lake’s eutrophication which is the natural aging process. During construction wetlands are protected by many construction methods but most often with silt fences and chain-linked backed super silt fences for NO impact areas.

Use of ground water and its protection falls under the (SDWA) Safe Drinking Water Act. Wells, their flow volume, and direct connections to piping are regulated by this agency to protect the quantity and quality of ground water supply. Drawing water from navigable waterways is permissible but a permit must be obtained.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) regulates the use of chemicals or soils or plant material. They say substances mixed or intended to artificially accelerate the drying of plant tissue are called desiccants.

XIII. Building, Structure & Cart Paths

Concrete paths or building floors typically require fiber mesh or rebar placed in concrete for strength. Rebar is numbered #3, #4, #5, etc. which is representative of 1/8” per number.

Wood bridges and bulkheads require a material specification to meet “2.5CCA.” Bolts and fasteners used must be galvanized coated or stainless steel.

Cart paths require soil compaction to 95% modified proctor. Common path materials used are concrete, asphalt and crushed rock.

XIV. Grow-In
Grow-in requires continuous applications of water to keep the soil and seed moist. High applications of nitrogen also speed plant growth. The first cutting should be delayed as long as possible as leaf height is directly proportioned to root depth. Grass can go dormant from moisture deficiency. Sunlight, standing water, and high temperature can cause scald to the turf. Compaction from traffic can also cause permanent damage to young turf.