THE FUTURE OF GOLF COURSE ARCHITECTURE IN AMERICA

by

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(Under the Direction of Scott Weinberg)

ABSTRACT

Throughout its history in this country the game of golf has undergone constant change. These changes have come in the way of technological breakthroughs, both in maintenance practices as well as in the equipment with which the game is played. Changes have also occurred in the social fabric of the patrons that golf serves. Thirdly, the increasing environmental awareness of the public has lead to many changes in the practices of golf courses and the way they are designed. This thesis will examine those changes and the architectural reactions that followed. The future of golf course architecture is dependant upon these technological, social, and architectural trends with good design being accomplished through a complete integration of these factors to create courses that are maintainable, playable and aesthetically appealing.

INDEX WORDS: Golf Course Architecture, Golf Technology

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by

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DEDICATION

To my best friend and father, Ronnie Miller. For introducing me to the greatest game there is. If not for you, these dreams I pursue would have never been revealed.

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I would like to thank Professors Scott Weinberg, Bruce Ferguson, and Keith Karnok for making my exploration into golf course architecture possible at The University of Georgia. Thanks also to Glenn Boorman for his participation in this process and lending his expertise as a member of the golf industry.

I would also like to show my appreciation to my wife, Emily. If not for her constant support, I would not have been able to achieve this, and every goal that I have.

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Chapter 1

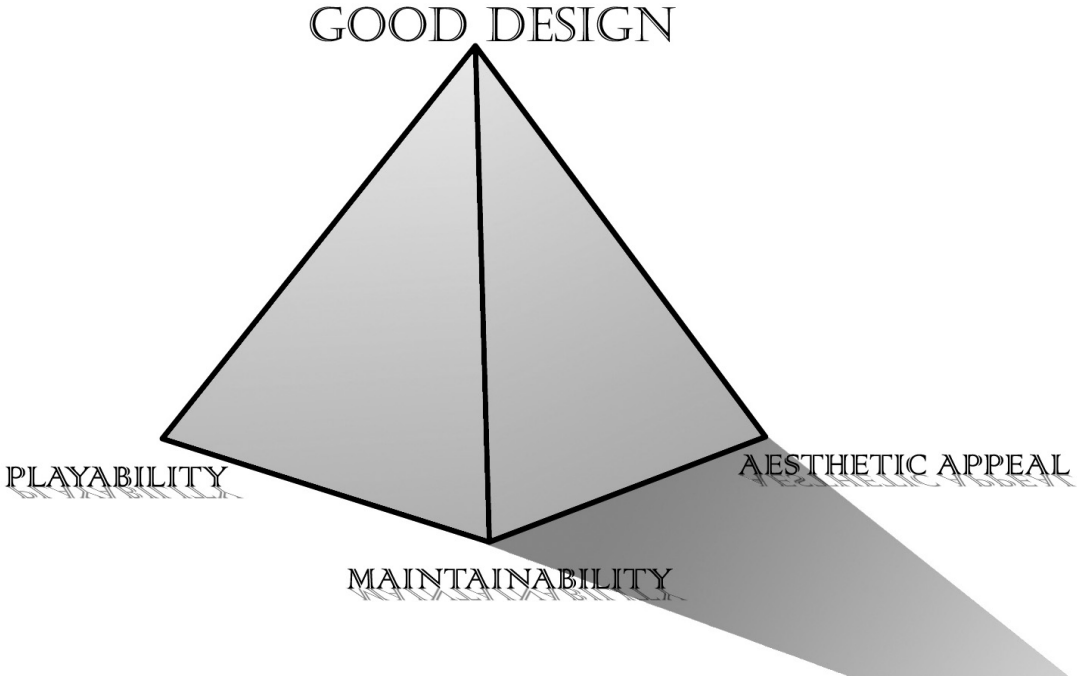
Purpose of Study

The year is 1786 and The South Carolina Golf Club has called its first meeting to take place in what would become the club's home on Harleston Green in Charleston. The strong Scottish presence in the Carolina colony made the city an obvious location for the first occurrence of the sport in the United States. Harleston Green was the large town green on the south and west point of the Charleston Peninsula and served as the first golfing grounds in the states. The tight sandy soil and windy conditions that existed along the banks of Charleston Harbor must have been eerily reminiscent of their homeland to these Scottish immigrants. The mild winter of the south made it possible to play the game throughout the year adding further to the similarities between the game that had been transferred across an ocean. Unfortunately this little piece of Scotland would not survive, as in the War of 1812 the area that was once Harleston Green was turned into a fort and eventually evolved into the present day Coast Guard Base. The game would not reappear in the United States for nearly a century but what might have been if these roots of the game would have survived as a model for those yet to come. Is it possible that the game would have held to the principles of the courses of its homeland? Would the grass be but a mixture of various species creating a more vibrant blend of greens rather than the monochromatic nature of our modern turfgrass stands? Would the bunkers be little more than the shelters of burrowing sheep or the remnants of cannon fire from past wars? As circumstances have proven, we will never have the answer to such questions. For the past 125

years the game of golf has been adapted by the Americans who have played it, creating a style and means of playing the game not before seen in its home country of Scotland.

Throughout its history in this country the game of golf has undergone constant change. These changes have come in the way of technological breakthroughs, both in maintenance practices as well as in the equipment with which the game is played. Changes have also occurred in the social fabric of the patrons that golf serves. A game that was once almost entirely privatized in this country has grown to serve the public and become inclusive of those that were once excluded. Thirdly, the increasing environmental awareness of the public has lead to many changes in the practices of golf courses and the way they are designed. This thesis will examine those changes and the architectural reactions that followed. These changes and their resulting actions have in some cases better established the integrity of the game, and in others have diminished its character. As a life long member of the golf industry, my experience in the field has allowed me to witness diverse forms of the game created by the various trends that will be discussed. Questions will be raised as to the costs and benefits of these trends and whether they have been constructive in the flourishing of the game.

From this experience and study, inferences will be made about the direction golf course architecture in America is headed in the years to come. The future of golf course architecture is dependant upon these technological, social, and architectural trends with good design being accomplished through a complete integration of these factors to create courses that are maintainable, playable and aesthetically appealing. These points will be applied to a design that will acknowledge all of the issues that golf course architects will be faced with, presenting viable solutions for future designs.



The Elements of Good Design **Figure 1.1**

Chapter 2

Technological Trends in Maintenance Practices

April 10, 1966. This was the date that technology first had an influence on the American public's view of how a golf course should be maintained. This was the final round of The Masters Tournament at Augusta National Golf Club and for the first time the tournament was broadcast in color by the Columbia Broadcasting Station (CBS). The green grass and the vibrant colors of the dogwoods and azaleas had every golfer across the country at his golf course superintendent's doorstep demanding their course be as green and well maintained as Augusta National. While these practices had already infiltrated many of the country's more wealthy private clubs, the public was getting its first look at what a golf course could look like, given the proper resources. Just as is the case today, the Augusta National of 1966 settled for nothing less than perfection in the conditioning of their course. This chapter will discuss the maintenance practices that created these conditions including breakthroughs in turfgrass science, mowing equipment, and irrigation that would dramatically change the look of golf courses in the United States.

The First Greenskeepers in The United States

The term greenskeeper originates from the broader sense of the word green. Historically, green was meant to describe all the grassed area of the golf course or just a large open expanse of a city park. The occupation of greenskeeper for a golf course often came with the added responsibility of acting as the golf professional and club maker for the golf club. The game of golf has been contiguously played in the United States since 1888, when the St. Andrews Golf

Club of Yonkers, NY was established[1]. Over the next decade more than 1,000 courses would be created in the United States. This explosion of golf brought on a large immigration of Scottish men who had fulfilled the same role in courses in their home country, and often had worked under some of the most noteworthy greenskeepers of the day in Scotland; most famous among them was Old Tom Morris. "Old" Tom, to distinguish him from his son of the same name, is often called the father of golf due to the improvements he made to The Old Course at St. Andrews and the part he played in the standardization of the game. Old Tom Morris created the eighteen-hole layout at The Old Course from the twenty holes that had been played previously. An apprenticeship under such a legendary character boasted well with the American golf club members who were still quite new to the game and the conditions in which courses should be kept.

The occupation of greenskeeper was to mow the grass on the greens, creating the smoothest possible surface on which to putt a golf ball. In the late nineteenth century this was often done with a scythe, which demanded much skill in its use and sharpening. The time and skill constraints of such methods left only the wealthy to enjoy the luxury of a closely mown fairway. Although reel type mowers had been invented in the 1830's in England, it was not until the turn of the century that they were available in the United States. In 1900, the Pennsylvania Mower Company began to sell a 30" variety of a reel mower for one hundred dollars, which provided an excellent income for the company when it is considered there were more than 1,000 golf courses in the United States. These early mowers could achieve no lower cutting heights than one half of an inch, which is extremely high by today's standards. With such long grass, the smoothness of the greens relied heavily on the frequent practice of topdressing with sand and the

[1] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 34.

brushing of the putting greens in order to make the blades stand more vertically. These greens were mainly composed of naturally occurring grasses such as clover, bluegrass, redtop, and timothy. While other grasses probably existed in these sites, the constant mowing at close heights led to their gradual disappearance.[2] In some locations of the American South and West, there existed no type of grass suitable for putting. In these areas greens were typically oiled sand. Laborers would wait at the putting surface for groups to finish play, and then smoothed the green by dragging a damp, heavy rug across it.[3]

Much of the method described by some of our earliest greenskeepers is still the model to be followed by today's golf course superintendents in caring for turf. The practice of fertilization of the turf with well-rotted barn manure amended with leaf mold and sandy soil was often completed during the late summer and acted as a tonic for the tired turf that had been so heavily used in the prior months.[4] This practice along with the various other ways in which greenskeepers cared for their courses would soon be the subject of intense investigation.

Golf course maintenance from the 1890s through the end of the 1920s can be divided into three separate eras. According to Fred Hawkins, a greenskeeper of the time period, these eras were: the era of single horse machine or the pony mower, the triple cut mower era, and the era of the tractor.[5] As the title of each era implies, the amount of area that could be maintained at any given time was steadily increasing from the turn of the century to the late teens. Hawkins marks the beginning of the tractor era as 1918, which may have been true for some of the more formidable golf clubs in the United States, but was not true for the majority of the courses until

[2] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 40.
[3] Klein, Bradley. Discovering Donald Ross (Chelsea, M.I.: Sleeping Bear Press, 2001), 76
[4] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 36.
[5] Hawkins, Fred. The National Greenkeeper February 1927, 1.

the post World War II era. He categorizes this third time period as one where "greens have become boldly molded and heavily bunkered," implying the existence of more creation of golf holes rather than the designation of existing land as such. Hawkins goes on to add "The size of greens increases from 3,000-4,000 square feet to over 10,000 square feet. Tractors that started with three fairway gangs have increased to five and even seven. Fairway watering systems have become common on most new courses." Technology enabled greenskeepers to maintain more surface area. The added ability to irrigate the entire golf course rather than just the putting surfaces changed the natural shades of brown and green that golfers had once known to an increasing area of green, the consistency of which has become a measure of quality for the course.

To this result, greenskeeper William "Rocky" Rockefeller said, "A course with perfect turf and no bad lies is more of a park than a golf course, but nothing pleases the members more than a soft, deep, heavy turf." Pleasing the members was after all the task at hand for a greenskeeper and "Since they pay the rent, my theories must give way," Rockefeller fell in line with these new practices and advances in turf care.[6] Rocky Rockefeller (a distant cousin to John D.) found himself in the midst of such a struggle during the playing of the 1920 United States Open.

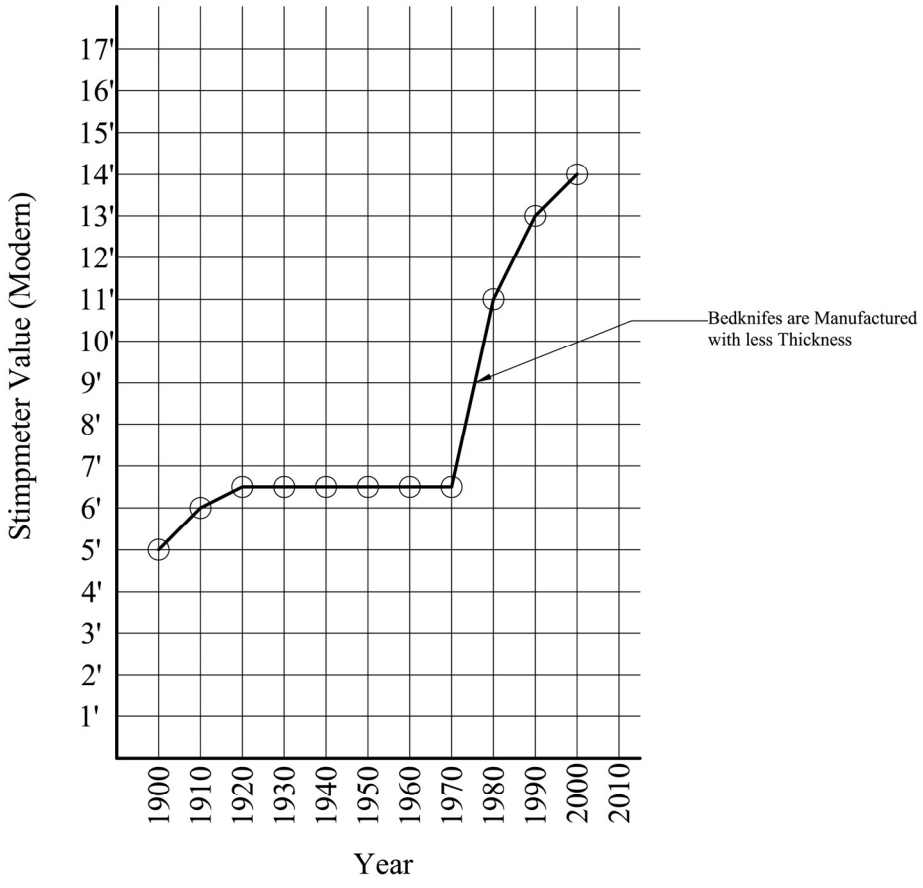
The Creation of the USGA Green Section

The National Championship was being held at Rockefeller's Inverness Golf Club in Toledo, Ohio in August of 1920. The harsh summer heat, coupled with the rigorous maintenance regime insisted upon by the membership led to the occurrence of a disease now know as dollar

[6] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 50.

A Boldly Contoured Green of the 1920s **Figure 2.1**

Green Speeds in Feet Since 1900 **Chart 2.1**



spot in the South German Bentgrass putting greens. The disease made the greens less favorable for putting and was a source of embarrassment for the club and its members.

The United States Golf Association (USGA), being the governing body of the annual national championship, took action by creating an organization known as the USGA Green Section. The Green Section consisted of "scientists and earnest amateurs" but not of the greenskeepers who had tended to the golf courses of America since their conception.[7] It would be some years before the two parties would take kindly to the sharing of information and advice from one another but nonetheless, the USGA Green Section began in 1920, ruled by the following mandate:[8]

1. To collect and distribute information for the benefit of its members.
2. To promote the proper maintenance and upkeep of courses.
3. To establish a service bureau to help individual clubs with their problems
4. To help with the training of greenskeepers.
5. To issue a bulletin filled with greenkeeping information for the benefit of Green Chairman and Greenskeepers
6. To organize an annual meeting of the Green Section at which papers were to be presented and discussions on greenkeeping take place.
7. To encourage the creation of regional green committees.

The organization brought order to a growing industry of club owners, committee members, and greenskeepers alike all of whom were in search of ways to improve upon the methods of golf course maintenance for the sake of better playing conditions.

[7] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 46.
[8] Bulletin of the United States Golf Association Green Section 1, no.1 (1921): 1-2.

At the time of the USGA Greens Section conception, the resource on the growing of turf for golf courses was a book published in 1917 by Dr. Charles Piper and Dr. Russell Oakley titled Turf for Golf Courses. The book was the result of research the two had done in collaboration with Dr. Walter Harban of Columbia Country Club in Maryland and the United States Department of Agriculture (USDA) in Washington, D.C. This group of scientists made attempts to develop scientific methods for greenkeeping and worked on various species of turf in an effort to find those best suited for the maintenance practices of golf courses. The USDA test plot was located in Arlington, Virginia at precisely the location where the Pentagon now stands and served as the first testing site of its kind. While many of Drs. Piper and Oakley's findings prescribed solutions such as plucking out crabgrass and other quite primitive means of resolution, this was an initial step towards the exploration of a science that drives the golf industry to this day.[9]

Increasing Speed in Putting Greens and its Consequences

Through the first thirty years of the twentieth century technologies in mowing equipment allowed for a decrease in the height at which putting greens were maintained. The height of ½" gave way to ¼ " by 1920 and by 1930 the standard practice was to mow the grass on the greens at $^{3}/_{16}$". The lower mowing heights led to a surface with less friction, and thus increased the distance the golf ball would travel when struck. This delighted the players of the day and was a source of boasting for members of clubs whose green speeds exceed those of other clubs. This daily mowing and maintaining of the greens at heights not before achieved spelled out added expense for American golf clubs. The need for such expense would become a necessity at the end of World War II when trying to entice new members. The great energy put into maintaining the surfaces was unheard of in the game's native country where "the rabbits are the chief, and

[9] Charles Piper, Russell Oakley. Turf for Golf Courses (New York, N.Y. MacMillan Company, 1917), 32-45.

almost the only, greenskeepers."[10] The lengths at which the wildlife maintained the grass had been sufficient for the playing of the game in Scotland, but in the United States the game was evolving and the speed of the greens would become a driving factor in this transformation.

In 1937 Eddie Stimpson developed a tool that would allow for the measurement of the speed of putting greens. His invention was named the Stimpmeter was created with careful consideration for its mobility and convenience in use. The instrument was a U-shaped piece of wood 30" in length. It had a single notch cut close to one end so that when that end was raised off the ground slowly a ball placed in it would be released at the same angle every time.[11] The measurement taken by the Stimpmeter was the distance the ball rolls across the green once released from the instrument. The process would then be done in the opposite direction (in order to negate influence of any slope) and the average distance was taken as the measurement. In an article written by Stimpson is 1937 he reports his finding from various courses around the country. The results ranged from 18 inches to 36 inches with an average distance for all the test sites of 27 inches. For the next 37 years Stimpson would continue to take measurements at various places around the United States but wide spread use by golf course superintendents did not occur. In a report Stimpson released in 1976, the average reading of the Stimpmeter was again 27 inches. The reasoning for this forty-year lull in the advances in turf science can be fully attributed to the lack of adequate mowing equipment. The element that regulates the height of cutting in a reel mower is the bedknife. This blade runs along the bottom of a reel mower and as the reels turn, the grass is forced between the reel and bedknife thus clipping the grass blades. In the 1970's bedknives began to be manufactured much thinner. Prior to this time the thickness of

[10] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 17.
[11] Thomas Nikolai, The Superintendent's guide to controlling putting green speed (Hoboken, N.J. John Wiley & Sons, Inc., 2005), 13-15.

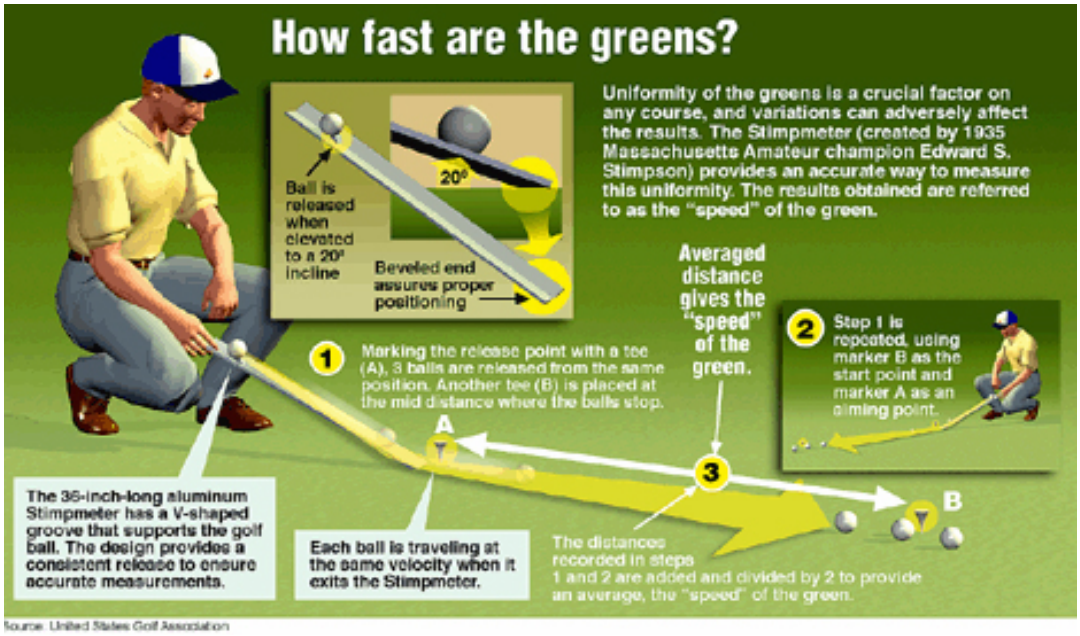
USGA Green Section Green Speed Chart **Chart 2.2**

Speeds for Regular Membership Play

8’6”	Fast
7’6”	Medium-fast
6’6”	Medium
5’6”	Medium-slow
4’6”	Slow

Speeds for Tournament Play

10’6”	Fast
9’6”	Medium-fast
8’6”	Medium
7’6”	Medium-slow
6’6”	Slow



The Modern Stimpmeter **Figure 2.2**

the bedknife was the limiting factor in mowing height, which had held at $^{3}/_{16}$" for almost half a century.[12]

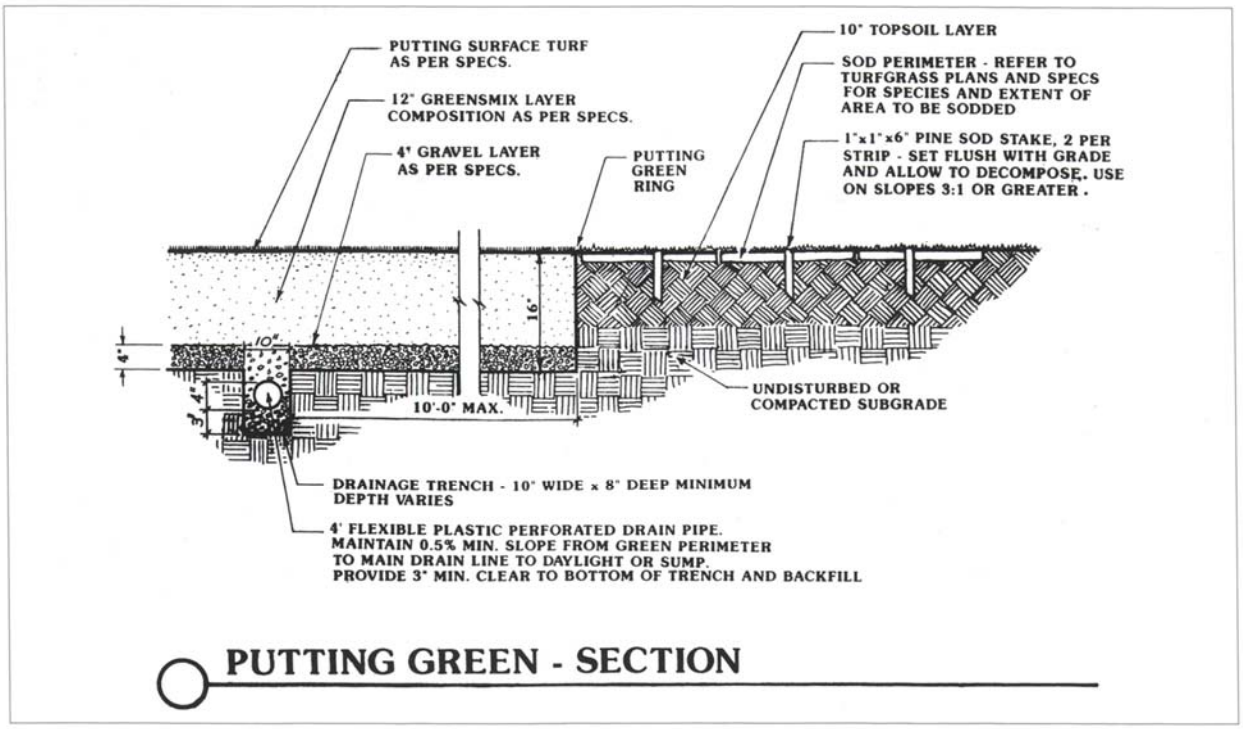
In the mid 1970s once the thickness of bedknives was reduced, the race was on to find out how low the heights could go. The USGA Green Section stepped in and redesigned the Stimpmeter and charged their technical director Frank Thomas with the task of updating the instrument. Thomas, who was to have a tremendous role in the regulation of technology in playing equipment, changed the material of the Stimpmeter from wood to aluminum for ease of mass production. He also changed the U-shape to a V-shape to reduce friction and lengthened the Stimpmeter to 36". All of these changes make the comparison of Eddie Stimpson's data and any taken since Thomas's redesign impossible. However, in terms of today's measurements, initial readings in the mid 1970s at mowing heights of $^{3}/_{16}$" were 6'6", which would be read as 6.5 on the modern scale. The conventional thought is that the added momentum of 6 inches of fall, coupled with the lessened friction on the ball upon release accounts for the difference in the data taken over 40 years by Eddie Stimpson and the first datum taking by the USGA in the Mid 1970s. The release and distribution of the new Stimpmeter was primarily so that golf course superintendents would be able to ensure that each of their eighteen greens were uniform in speed. The effect that it would have however was much different than intended. A speed chart developed by the USGA Green Section accompanied the new Stimpmeter. The chart indicated appropriate green speeds for various types of play and brought on immediate concerns from the country's superintendents. Immediately, the call from the golfing public was to have the fastest greens conceivable, regardless of what the USGA might suggest. Increasing green speed consequently meant lowering the mowing heights adding stress on the turfgrass and increased time and expense on their care.

[12] Frank Thomas, "How it all Began" USGA Green Section Record 21 no. 1 (1983): 2.

The stress that was caused by the lower mowing heights became the stimulus for much research in creating cultivars of turfgrass that were more adaptable to such condition and to the environment created by putting green construction. In the 1970 the USGA Green Section introduced a treatment of the subgrade on which greens were to be built that was a highly specific, and highly expensive process. It included excavation of the site and the purchase of materials such as gravel, drainage pipes, and a 'greensmix' of sand and organic material at anywhere from an 80-20 to 90-10 mixture. The sandy mix increased the percolation rates thus taking the emphasis off of surface drainage. Costs associated with the construction of putting greens rose from $0.25 – $0.50 in the 1950s to closer to $3.00 per square foot in the early 1980s.[13] This increase in cost of construction also lead to increases in maintenance budgets of golf courses, which inevitably reflected in the cost to play the game. Courses that had been in existence since the early 1900's began to be renovated and in the name of progress pulled the grass away that had blanketed their greens since their inception. In its place, new hybrid turfgrass was laid that boasted more blades per square inch and tolerance to be cut at lower heights. These lower heights and consequentially faster green speeds made many of the dramatically contoured green complexes unplayable. The large mounds with slopes that were often in excess of five percent would not allow a ball to come to rest on the lower friction surface of the newer more tightly mowed turf. For this reason, the contours were often softened from their original design, replacing the bold and rolling topography of early twentieth century green complexes with more subdued, subtle grade changes.

Since the introduction of thinner bedknives on reel mowers, green speed has been on a constant increase, and the race to create hybrid turfgrasses able to handle the decreased mowing heights has continued. Today, modern golf greens are being maintained at only 17 % of the

[13]Tom Fazio, Cal Brown. Golf Course Designs (New York, N.Y. Harry N. Abrams, Inc., 2000), A-i.



USGA Specifications for Putting Green Construction **Figure 2.3**

Softening of Green Contours: **Figure 2.4**

Notice the crease that exists between the bunker mound and green complex. This was created by the softening of the contours within this green, in order to retrofit the surface for new turf cultivars that achieve higher green speeds.

height that greens were maintained one hundred years ago. Green speed has increased more than 100 % from the 6.5' measurements from the middle of the twentieth century to modern measurements that can be in excess of 14'. Mowing heights have decreased from ½" down to an astonishing $^{1}/_{12}$", a height that is more than 100 times lower than its natural growing height. The decline in mowing heights illustrates the amount of resources being poured into the modern golf green.[14] Resources are being poured through these greens due to the high percolation rates necessary to sustain these new hybrid turfgrasses.

Historically, Bentgrass species have been known for their fine texture and capability to withstand low mowing heights. This combination has produced the greatest green speeds among all turf types. Bentgrass is however a cool season grass and thrives in a mean temperature range of 60^{o} -75^{o} Fahrenheit. The hot and humid summer conditions of the Southeastern United States have proven to be a difficult climate in which to grow Bentgrass. However, the demand for the high green speed that Bentgrass can produce has overruled these difficulties and led to the creation of maintenance practices to try and counteract the inappropriate climate. One of the first methods used was the addition of fans around greens. The high-powered fans are used in summer months to create greater circulation, on green surfaces that are often surrounded by trees or set in bowls. The problems that are traditionally associated with the high heat and humidity are those of diseases in the turf causing diminished growth. These diseases are often caused by the presences of moisture at the surface for long periods of time, and the fans where intended to increase the evaporative rate of the greens surface.

The term "pinable area" is meant to represent that area of a putting green where a hole may be placed and provide a fair test of golf. This area is most often limited by the amount of

[14] Michael J. Hurdzan, Golf Greens: History, Design and Construction (Hoboken, N.J. John Wiley & Sons, Inc., 2004), 318-319

slope within an eight-foot radius around the desired location. Today, with increasing green speeds, the amount of slope that can be in a pinable area must be no more than 1.5 %.[15] This standard keeps the properly judge putt that just misses the target from continuing past the hole for several feet. The severity of hole locations, combined with fast green speeds can become frustrating for even players of the highest skill level, and slow the pace of play to a point of disruption for all players on the course that day. Some architects are already challenging the standard of 1.5 % slope for areas of a green appropriate for golf hole locations. These architects are prescribing a 1 % slope as a maximum for a pinable area on putting greens. The 1 % slope mandate allows for no surface drainage and relies entirely on the construction of fast draining subgrades. The speed at which water moves through this system increases the required frequency with which greens are watered. The expense of supervised frequent irrigation (often done by hand) adds to the ever-increasing maintenance budget needed to uphold the standard of modern golf courses.

Trends in maintenance practices of golf course superintendents, driven by the demands of golfers, point toward a somewhat bleak future for the game of golf. Imagine playing a golf course where bad lies are never found. The rough is maintained (albeit at a higher height) as consistently as the fairways, and bunkers often provide better lies than that found on the turf. Greens are as flat as a pool table and the only thing the player must practice is hitting putts as straight as his talents will allow him. On a golf course such as this the interest in the shots has evaporated. There is no reason to think about where to hit your next shot and reading a green will be something done once, only to judge speed, and then replicated 18 times. The mental test

[15] Michael J. Hurdzan, Golf Greens: History, Design and Construction (Hoboken, N.J. John Wiley & Sons, Inc., 2004), 112-113.

that a golf course provides is as important as the physical and in the game's evolution should be maintained with the same amount of integrity.

Reintroduction of Rough as a Hazard

As irrigation lines went from non-existent to single pipeline, and then double and triple pipelines that provide water to the entire golf hole, the consistency of rough increased. Before this innovation, courses depended upon the existing native grasses as the rough surrounding their fairways. This was the case with wiregrass of the sandhills of North Carolina which provided penalty for those golfers gone astray at Pinehurst, and the fescues of the Northeast that lay along the boundaries where piles of rock and brush discarded decades prior during construction. Such roughs provided ample penalty for the poorly struck shot but often, because of the lack of irrigation, the grasses were sparse enough that lost golf balls were not a concern. Today, in the construction of golf courses, often the entire property is reshaped by machinery, removing any of the existing vegetation, and then placing sod in its place. The result is a uniform playing surface, which can only be distinguished by the various mowing heights prescribed.

The return to such methods of penalization will protect the future of the game by providing a reduction in the need irrigation, and provide for the reemergence of rough as a hazard. The grasses designed as rough would follow the natural pattern of the seasons and the course would prove more difficult during various periods of the year when ample rainfall created greater lushness in the native grasses. While native grasses would create the greatest sense of place for courses of the various regions of country, other low maintenance grasses can serve a similar purpose. Species such as bahaigrass, most often used on the sides of highways, can produce a wonderful fine textured look while requiring minimal care. One example where this has been implemented in the design of a course is at Chechesee Creek Golf Club in Okatie,

South Carolina. Here, architect Bill Coore prescribed the use of coastal Bermudagrass in the outlying roughs of the course. Coastal Bermuda is mainly used as a hay producer on farms in the Southeastern United States. The grass requires no more irrigation than that provided by nature and creates a challenge for the golfer due to the unpredictable way the golf ball will lie in the grass.

The decision to implement these strategies in a grassing plan on a golf course would have far reaching effects on the other aspects important to the future of golf course architecture. Enriching the environment with native species and creating a variety of colors and textures on a golf hole will provide visual interest. The added degree of difficulty and uncertainty in the result of errant shots will reinstate a premium on accuracy in a game whose players are increasingly infatuated with how far they can hit the golf ball. The third effect, and perhaps the most beneficial, would be the effects of a reduced maintenance budget. The cost associated with maintaining one hundred and fifty acres of turfgrass at the modern standard drives the cost of playing the game to new heights. By decreasing the area of turf that is maintained, watered and fertilized at these levels, the game can become more affordable for the general public, providing an outlet for education, and recreation that may not otherwise be available. This is not a call for the narrowing of golf holes, but the broadening of thought of what constitutes a golf hole. There is a definite need for width in golf holes in order to provide strategy and variety in how they are to be played. A reintroduction of a less pristine framing of the golf hole should help, not hinder this fact by placing further premium on the edges of fairways, and the obvious difference in benefit of the properly placed shot that is close to the rough, but still in the good graces of the fairway.

Bunker Design and The Angle of Repose of Sand

A. W. Tillinghast was a great architect in the revered "Golden Age of Golf Course Design" in the first part of the twentieth century.[16] His courses have been cemented into golf history as some of the best in America. Tillinghast was an advocate for public golf, and one of the first golf course architects to take a conscious role in the development of municipal golf. He was the architect of the collection of courses at Bethpage State Park in Bethpage, New York. Modern architect Rees Jones has described his work at The Black Course at Bethpage as "A thesis on bunkering a golf course". When built in the 1920s the course's bunkers, situated into the up sloping faces of hillsides, were beautiful and naturalistic. Some of the hillsides however, were of excessive slope and the greenskeeper and his staff would have to work diligently to keep the sand flashed into the hillside as it often washed down the bank following rain events. The amount of energy it took to maintain these bunkers was acknowledged by Tillinghast who, during the Depression, traveled the country advising golf courses on how to save money in this time of financial strain. Often, Tillinghast's recommendations included the filling in of bunkers such as these. Today, the bunkers at Bethpage Black have been restored and the amount of energy expended on their care is still excessive.

The issue of balancing the beauty of sand bunkers and their maintainability is not only a question of artistic license but also of visibility and strategy. Another golf course architect of the golden age named Alister Mackenzie employed the use of flash sand bunkering in many of his inland courses as a tactic of visual deception.[17] In more open settings, such as seaside links, the grass-faced, flat-bottom sand bunker was preferred. Today, the bold flash sand that exists on many newer golf courses is often a source of complaint among golf course superintendents due

[16] H.N. Wethered, Tom Simpson. The Architectural Side of Golf (London, England Longmans Green, 1929), 9.
[17] Alister Mackenzie, Golf Architecture (London, England Simpkin, Marshall, Hamilton, Kent & Co. 1920) 49.

to the difficulties of maintaining them. At Royal Melbourne Golf Club in Melbourne, Australia the compaction of sand on the faces has decreased the washing out of many of their MacKenzie designed flash sand bunkers. This process is very time consuming and the cost associated with the added labor should be considered when designing bunkers for golf courses.

Machinery is a more efficient means of raking bunkers in daily maintenance regimens. If this method is to be used bunkers must be designed such that there is an entry and exit point for the maintenance vehicle. The size and slope of the bunker must also allow for the maneuvering of the equipment within the hazard.

In the case where hand raking will be used for bunker maintenance, there are several products that can be used to improve the stability of the sand faces. Products such as Bunker Aid® or SandTrapper® can reduce the amount of erosion of sand on steep banks. [18] These products are liners that lie below the sand allow for water to move through the sand into the underlying drainage system more quickly. These products are not fool proof and bunkers with steep faces are still likely to erode in heavy rain events.

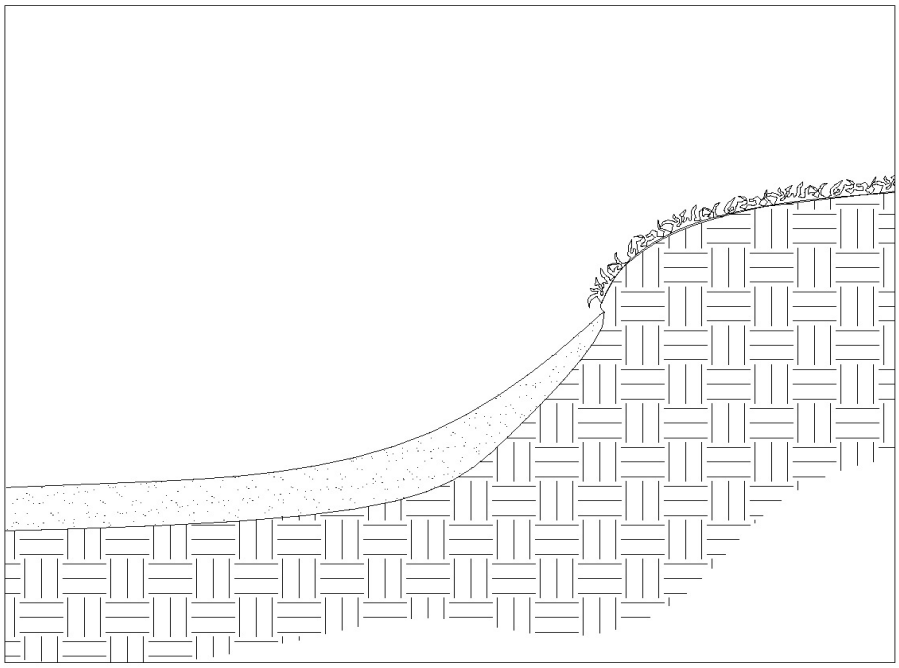
A newer technology that is being put to the test by golf course superintendents is the use of soil stabilizers and solidifiers. These products are often used for dust control on construction sites and for temporary parking lots. Their use in golf course design is also being considered for alternatives to asphalt or concrete cart paths. The use of soil stabilizing products such as Soiltac® or Klingstone® are amended into or sprayed onto the sand faces to hold the sand in the face. The application in bunkers is meant to create a more solid surface along the face of flash sand bunkers, allowing for water to roll off the face towards the bottom of the bunker where the water will infiltrate into the drainage system. These products can be useful if the proper mixture

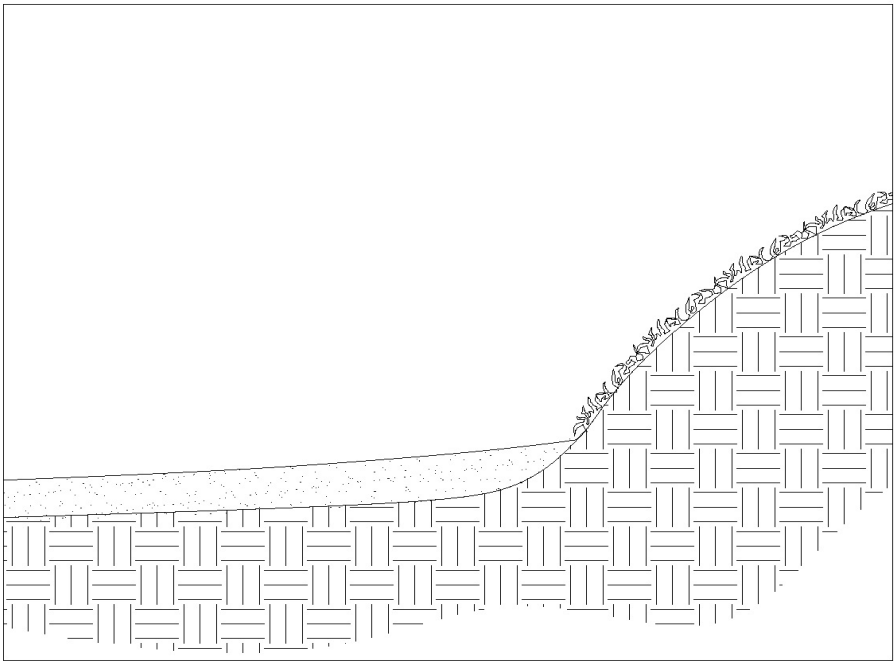
[18] Michael J. Hurdzan, Golf Greens: History, Design and Construction (Hoboken, N.J. John Wiley & Sons, Inc., 2004), 129.

is used to create a surface solid enough to reduce saturation of the sand in the bunker face, but not so tempered as to create a carom effect off the bunker's face when struck with a golf ball.

The other solution to this problem is to design bunkers in such a way that the sand will remain stable on the slopes under normal amounts of environmental stress. The angle of repose of soil in the pure sand category is approximately 33%. This level should never be breached. Flash sand can be accomplished in appropriate places without breaking these limits and causing excess maintenance. The placement of bunkers into hillsides of appropriate slope should be considered very early in the design process. When routing a course, a golf course architect should make every effort to identify these locations as they exist naturally and to utilize them accordingly. Often, bunkers with less steepness can be made more daunting and eye-catching simply by properly positioning them on an upslope along the line of play. Taking this issue into account during design and construction can have far reaching effects on the game by decreasing the cost of maintenance operations, and consequently decreasing the cost of playing.

The playability of sand bunkers has been aided by improvements in industry construction standards. Manufactured angular sand has become the USGA's recommendation for bunker construction, a major cost for ensuring that a player who hits their ball into this "hazard" will find the ball in a lie that is nearly perfect. This is the expectation of the modern American golfer and one of the bridges that technology has brought us across that would be difficult to re-cross. Instead, much of the challenge created by modern bunker designs comes in the way of their depth and positioning. Often identified as the most difficult shot in golf, the intermediate bunker shot requires players to recover from bunkers placed approximately forty-yards from the green. The placement of intermediate bunkering has recently been neglected, largely due to the aerial nature of the game of golf today. The reintroduction of bunkering will restore the challenge of





Types of Bunkering **Figure 2.5**

Flash Sand Bunkering (Top) requires the pushing of sand up a slope where as sand in the rolled grass-face bunker (Bottom) remains on more level ground.

playing from this type of hazard. Bunkers have traditionally been thought of as features that create penalties on the order of a fraction of a shot. The amount of penalty involved usually increases as proximity to the green increases. By increasing the amount of penalty associated with bunkers at all locations on a golf hole, the architect can create more concern over these hazards. This means increasing the depth of bunkers that are positioned in the fairway, in order to make a full recovery a remarkable, rather than routine shot.

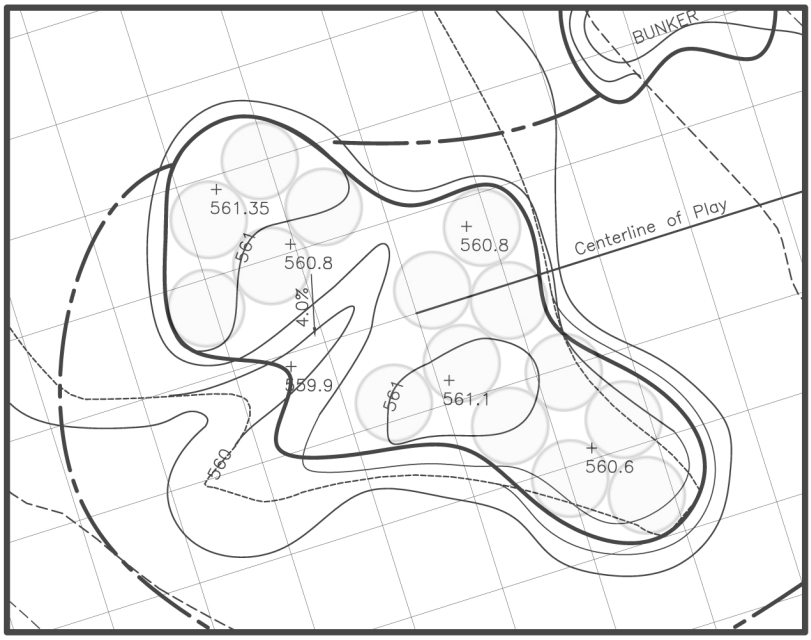
Designing Putting Greens for the Future

According to all accounts, the greatest Stimpmeter reading that can be accomplished through the limitation of friction is 18'. As golfers continue to desire greater green speeds, attention has turned to the cultivation of mosses to replace grass as the putting surface for increased speed. In 2002, construction began on the world's first fully synthetic grass golf course in Boulder, Colorado. The speeds that can be achieved through these methods leave little room for design in golf putting greens. Consider the following analogy. As you drive down a straight, flat Interstate at eighty miles per hour your level of interest, and the level of excitement is not particularly high. Now imagine yourself driving down a mountain road at forty-five miles per hour, winding through hairpin turns with steep cliffs flanking your car. Are you interested? Does your heart beat a little faster? This is the dilemma faced by golf course architects today as they design greens that must succumb to the high speeds for which the greens are going to be maintained and still provide interest. The putting green has been called the face of the portrait that is a golf hole, however what was once the source of much artistic license is become increasingly uniform. The 1 – 1.5 % maximum slope in an area appropriate to a hole location is often not distinguishable by the naked eye.

The goal in future green design must focus on the blending of pinable areas with a reemergence of bold swales and rises in the putting green surfaces. This movement will require the concentration of slope in what can be considered transition areas between hole locations. Slopes of 4 –7 % can be used to provide interest in putts traveling through the transition areas and bring back the conscious thought required to read the direction in which a putt will roll. Such features in greens allow superintendents to increase green mowing height while maintaining the perception of high green speeds.

In terms of maintainability, development of regionally appropriate turfgrasses that achieve green speeds comparable to the fastest rolling turf is becoming increasingly successful. Hybridization of warm-season turf grasses has led to the creation of species that can be mowed at closer heights than ever before. Bermudagrass, a naturally coarse-textured grass, has been altered over the past fifty years to create more fine-textured cultivars that produce greater green speed. One of the first was Tifdwarf Bermuda, a strain of Bermudagrass that has been used on putting greens in the Southern United States for over a quarter of a century. In recent years, the "ultra dwarf" cultivars of Bermudagrass have become the standard in warm season putting green surfaces and have produced green speeds more comparable to that of Bentgrass. Until this stereotype of Bentgrass being superior to that of Bermuda is dispersed the presence of the fine textured Bentgrass putting green drives the market.

The desire for green speed by golfers has led to the creation of new cultivars of Bentgrass, meant to deal with the heat of the Southern summer. Along with the creation of new strains of turfgrass, new technologies are continuing to emerge in efforts to keep Bentgrass greens healthy in the sweltering summer heat. The first of these to be used on a wide basis is Subair©. The ability to control the amount of moisture that exists in a system allows for a

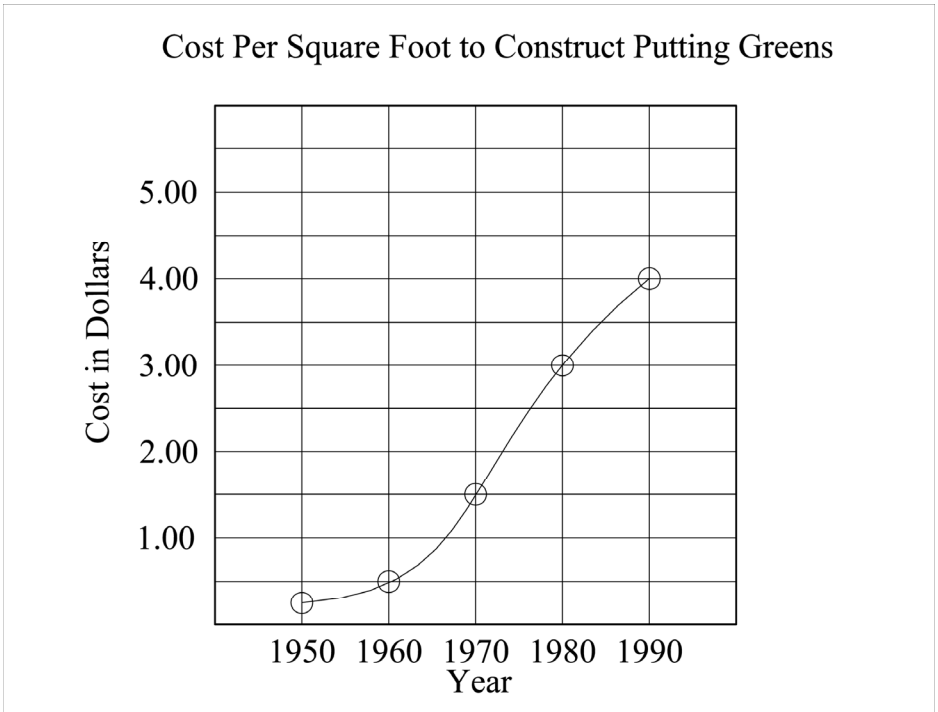


No. 11
Par 4 5325 Ft.²

Typical Green Design **Figure 2.6**

The circles on this green have a radius of eight feet and show what would be the pinable area on this green. The transitions, areas of greater than 2 % slope, are not suitable for hole locations.

Cost of Green Construction Since 1950 **Chart 2.3**



superintendent to create optimum growing conditions, and playing conditions on putting greens. The Subair© system provides this ability by placing a system of pipes beneath a green's surface to either force air out toward the surface or to force air in drawing water through the subgrade more quickly. This technology will allow for the moisture on the green surface to be monitored and controlled more closely, decreasing the likelihood of emergence of disease in the turf.

Another technology that is being used to increase the health of putting green turf is the use of heating and cooling systems in the subgrade. This system often referred to as cryogenics, requires the installation of tubing in a radiator-like pattern below the surface of the green allows for water from the irrigation system to be circulated through the green. Before circulating through the subsurface of the green, the water is heated or cooled to a desired temperature by an air conditioning unit then circulated in an effort to cool or warm the surface of the green. The water then returns to the air conditioning unit to be adjusted in temperature and the process is repeated.

Technologies such as these are impressive in terms of their ability to control the environment of a putting green and improve the quality of turf. The costs that are associated with such technologies however make them unrealistic for a majority of golf courses in the United States. Designs in the future can limit the need for such innovations by relying more heavily upon tactics that reduce the need for specialized systems. Most simply employed is the maximizing of morning sunlight on putting greens. Merely by placing greens in areas where there is little shade created from the east, allows for greater rates of evaporation to take place in morning hours, thus reducing the period in which moisture is on the turfgrass surface. Another way to create greater evaporation is by increasing circulation around greens. This can be done by paying close attention to the prevailing winds of a site and creating corridors that allow for

that wind to move through the golf hole more frequently. This tactic can also improve the interest in playing a course, since the wind is more likely to be a factor on any given day.

The other rather obvious tactic in creating more maintainable golf courses is the use of more regionally suitable turfgrasses. The progress made in the hybridization of Bermudagrass shows that in the future green speed will be indistinguishable from Bermuda to Bentgrass. In the mean time, any difference in speed can be quickly resolved simply by adding severity to greens and holding to a more liberal 1.5 % to 2 % slope in pinable areas. Green speed is more often an issue of perception than actual measurement and the creation of more undulating green complexes will leave players with the perceptions that the greens were faster than they might actually be.

Function was followed by form in many early putting greens. These greens were built on native soil and designed with surface drainage in mind, and the interest of meandering putts was the byproduct of the flow of water. Today, the stringent guidelines for creating a green drive the cost of construction upwards and leave little room for exploration in design. By reestablishing the importance of surface drainage in design of golf greens, the emphasis on an expensive multi-layered subgrade can be lessened and greens can be more affordably constructed. To reiterate, the need for green speed has led to new cultivars that require more specific growing conditions. These conditions include the need for greater drainage. However, the increased green speeds make it difficult to balance the slopes needed for surface drainage and the slopes appropriate for playing golf. This paradox leaves a decision to be made by the golf course architect and the golf course developer as to which direction their course should move. The ability to provide high green speeds will require the careful construction of greens to provide an adequate environment for the new hybrid turfgrasses. A less rigorous construction method would leave the designer

with the need to insure surface drainage and would require the specifying of a less fragile turfgrass cultivar. In this case, green speeds will be lessened in terms of the measurements taken by a Stimpmeter, but *perceived green speed* will show little difference. The label of Bentgrass greens and the history of its superiority make it a strong marketing tool for golf courses hoping to attract new members or daily fee players. Overcoming this common belief is essential to decreasing the costs associated with golf course construction, thus making the game more available to all those who have interest in playing.

Chapter 3

Technological Trends in Playing Equipment

Today's sports culture is one of power, where home runs and slam-dunks are the reasons why Americans love to watch and play sports. The game of golf is certainly not immune to this effect. The game once played with handcrafted persimmon wood club heads on hickory shafts, golf has progressed to one highly dependent on latest breakthroughs in metal alloy development. This dependency has led to the creation of a field of research that has unfurled into many others fields providing valuable information about physics and aerodynamics. The impacts of technology in golf equipment have changed the game in more substantial ways than they have in any other sport in the world. In this way the game of golf has evolved, rather than standing idle as a backdrop for the world to play out before. Instead, golf has been a view into the American way of life at various time periods. Nowhere is this truer than in the examination of the equipment with which the game is played.

The Evolution of the Golf Ball

The history of the ball with which the game of golf is played has been the topic of numerous books and has caused much controversy among players and designers alike. Each time the golf ball is altered it has created the greatest change in the way golf is played. Much of this change took place during golf's infancy in the British Isles; the best-documented instance of this was the shift from the Feathery to the Gutta Percha golf ball. In 1848, famed golf course greenskeeper "Old" Tom Morris was not yet old and was working for his predecessor Allan Robertson. As was the case at this period, Robertson was a clubmaker, as well as greenskeeper

and provided the players of St. Andrews Golf Links with golf balls. The ball of the time was the Feathery, a leather pouch jammed full of wet feathers that would expand and harden within the leather cover creating a suitable ball to play. The ball would travel at best 140 yards and was expensive to manufacture due to its handcrafted nature. A competitor began to arise in the Gutta Percha golf ball, which was easier to manufacture, was more durable for play, and had the added bonus of traveling some fifty yards further. The ball was made of the wood from an Indian tree with rubbery characteristics. Robertson made every effort to stomp out this competition and was adamantly against the increased distance that was provided by the Gutta Percha ball. When Robertson discovered his understudy playing the new Gutta Percha golf ball Morris was instantly transformed into a nomadic greenskeeper for the next twenty years, laying out many of Scotland's most notable courses and working at Prestwick Golf Links before returning to St. Andrews as its head greenskeeper in 1865.

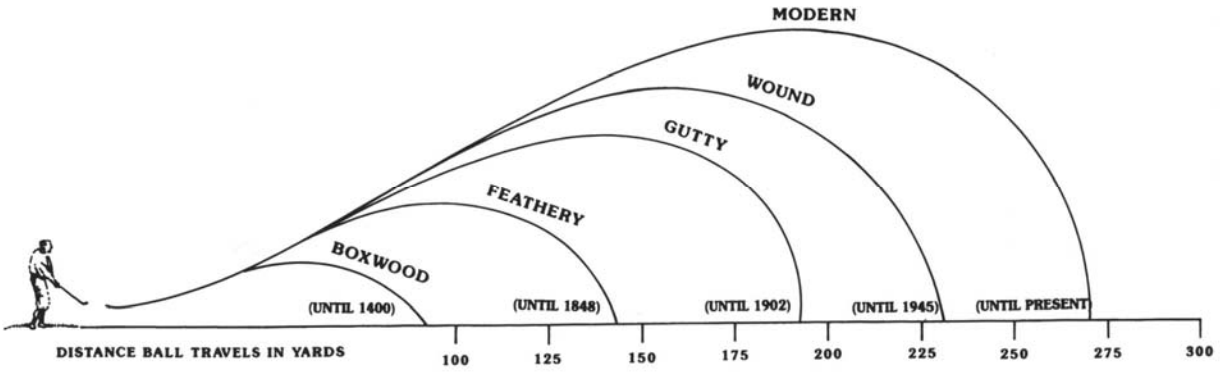
The Gutta Percha golf ball would reign as the standard in golf for nearly fifty years and was the ball that many of America's early courses were played with. However, in the early 1900s, the golf ball was again revamped and again its new merits were not only in its durability but its distance as well.[1] The new Haskell golf ball consisted of a plastic cover and wound rubber bands that made up the core. The wound golf ball was also the first occurrence of the concave dimples that are now a recognizable feature of the golf ball. This design was a refinement of scuffing the surface of the Gutta Percha ball, which created a similar, albeit a less significant, effect of lessening wind resistance.

The wound rubber ball would travel what was then an amazing 230 yards, nearly 100 yards greater than the standard fifty years earlier. This 230-yard distance became the basis of design for many of America's most cherished golf courses. The strategy in designing golf holes

[1] Michael Hurdzan, Golf Course Architecture (Chelsea, M.I. Sleeping Bear Press 1996) 13.

The History of the Golf Ball **Figure 3.1**

Distance Gained in Golf Ball Technology **Chart 3.1**



Circa	Material	Distance Driven
(Until 1400)	Boxwood	90 Yards
(Until 1848)	Feathery	140 Yards
(Until 1902)	Gutty	190 Yards
(Until 1945)	Wound	230 Yards
(Until Present)	Modern	270+ Yards

Source: *Golf Course Architecture, By Dr. M. Hurdzan*

during this period was largely based upon the distance a well-struck shot would travel in the air. That distance was somewhat less than provided by modern golf equipment and therefore the distance required to create challenging one, two and three shot holes was less than that of today.

Along with the added distance that the rubber-core ball brought to the game, its adoption as the standard ball brought forth greater spin rates. The spin rate of a golf ball has a great amount of influence on how far the ball will carry in the air. The lifting effect created by backspin increased the trajectory in which players are able to hit golf shots. This increased elevation in which the game is now played is a fundamental difference between the game of golf in this country and the game in Scotland. The game of golf has largely been played on the ground for the majority of its existence. The reasoning for this can be linked to a few principle motives. First, the game was conceived on the links land of Scotland where wind was, and continues to be, a constant deciding factor in how shots were to be played. Second, the equipment that existed during the early period of golf's history was not capable of producing shots that traveled long distances in the air. Also, the American golfer's desire to play green golf courses lead to frequent irrigation of fairways thus making the ground much softer making it less likely that the ball will roll after landing. The creation of the rubber core golf ball made hitting shots that carry long distances in the air commonplace among great and mediocre players alike.

Today, the modern golf ball is under constant renovation and golf equipment companies spend millions of dollars a year in research on how they might improve their golf ball. The balance of softness and distance is the topic of most of this research, as scientists look for the right mixture of materials to provide the player with control of the golf ball and the ability to hit it further than ever before. In the past thirty years, scientists have been able to provide more distance than afforded by the Haskell wound ball, but in an incrementally smaller dose than that

of the two previous innovations in golf ball technology. The law of diminishing returns shows that in terms of the golf ball, technology is nearing its beneficial limit in terms of notable distance gains from golf ball technology.[2]

Golf Club Shaft Improvements

During the late 1920's, the business of clubmaking would also be the subject of dramatic change. Up to this point, golf clubs had consisted of metal heads ground down by hand and attached to a hickory wood shaft. As steel became more readily available, wooden club shafts were replaced with steel shafts, lessening the torque on the club head at impact. This created a greater squareness of strike from that of the hickory stick shafts, generating further distance for golfers. Steel shafts were also much easier to make consistent among all of the clubs in a set. The USGA legalized the use of steel shafts in 1927, and by the 1930s they were in widespread use among American golfers, including golf course architect Donald J. Ross.[3] Similar to that of mowing equipment, the technology involved with golf club shafts changed little in the middle portion of the twentieth century. Then, in the 1970's the Shakespeare Sporting Goods Company began to experiment with alternatives to steel shafts. Union Carbide was providing graphite fibers for use by NASA, in pressure vessels and structural sections of its aircraft. This material piqued the interest of then Chief Design Engineer for Shakespeare, Frank Thomas. Shakespeare, better known for its fishing rods and reels, produced the world's first graphite shaft. The material was 14 times stronger than steel of the same weight creating a lightweight shaft that is possible to swing with greater speed while expending the same amount of energy[4]. This combination creates an addition of on average five yards of distance compared to that of steel shafts.

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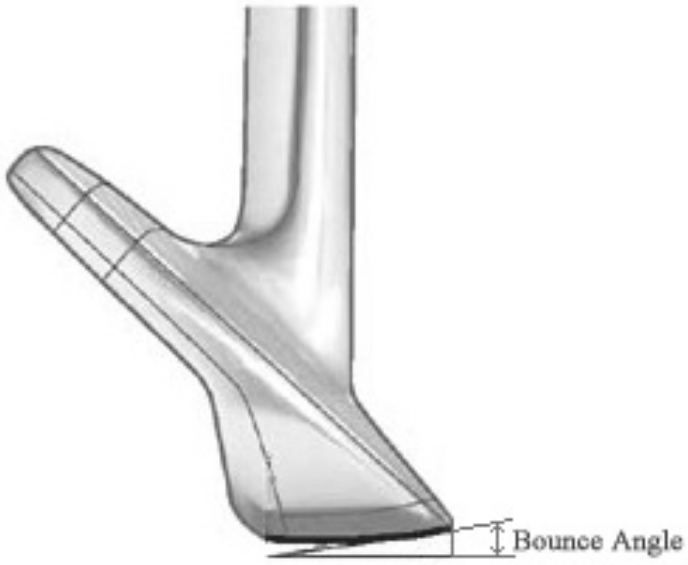
[2] Frank Thomas. "The Aerodynamics of Golf" June 2003 <http://franklygolf.com>.
[3] Bradley Klein, Discovering Donald Ross (Chelsea, M.I.: Sleeping Bear Press, 2001), 223.
[4] Frank Thomas. "Shafts: The engine of the golf club" 16 April 2001 <http://franklygolf.com>.

Today, graphite shafts are widely used, especially in drivers, where distance is often the most important element. Here again, evidence of decreasing benefits in each step of the progression of technology in shafts leads one to believe there is little distance left to be gained through this equipment.

The Rise of the Sand Wedge and the fall of The Bunker

In 1926, the first patent was issued for a "sand iron" to a gentleman named Edwin MacClain from Houston, Texas. Many tournament players, including Bobby Jones, used the club but due to its concave design, the club was deemed illegal in 1931 and banned from play by the USGA. The spoon-like clubface made contact with the ball twice upon impact projecting it first upward, then forward onto the adjacent putting green.[5] A second attempt at increasing the ease with which a golfer can free the ball from a sand bunker was made in 1933 by Gene Sarazen. His design was produced under the Wilson Sporting Goods label "R-90" and proved to be a valid one in which one basic change was made to conventional golf clubs. To promote the lifting of a ball out of loose sand or thick rough, additional material was added to the bottom of the club to create an angle between the ground plane and the bottom of the club. This angle is known as "bounce". The bounce of a club, ranging from six to twelve degrees, allows it to slide underneath the ball at rest in sand without digging excessively deep into the sand. The ball is then lifted out of the hazard along with a thin layer of the sand that lay below it. Prior to this invention, the difficulty of bunkers made them a hazard whose avoidance was imperative. However, since the 1930's, the sand bunker has become an increasingly tame beast for the golfer to slay. The continued refinement of the sand wedge, coupled with the increased playability of bunkers provided by maintenance practices, has made this part of the game a lesser challenge for the golfer.

[5] John M. Ross, ed., Encyclopedia of Golf (New York, N.Y.: Harper & Row, Publishers, 1979), 215.



The Anatomy of the Sand Wedge **Figure 3.2**

Unlike a conventional iron, the sand wedge's bounce angle keeps the club for continuing downward into the sand.

Square Grooves and the Arrival of Target Golf

Prior to the early 1900s, the faces of golf clubs were basically smooth, and had no patterned indentions. At this point grooves began to be ground into the face of the club, to increase friction allowing the ball to roll, rather than slide, up the clubface slightly at impact to produce greater spin rates. This spin aided in the flight of the ball, as well as the rate at which the ball could be stopped once it descended onto the ground. As golf clubs have begun to be mass-produced these grooves have played a large role in manufacturers' attempts to create better equipment. From the early days of grooves, they have evolved into highly refined specifications of design. Their shape has ranged from U-shaped to V-Shaped and finally to square, producing what is thought to be the greatest result in terms of controlling a ball through spin. Square grooves were first produced by Karsten Solheim, the founder of PING golf equipment manufacturer in 1985 and became the source of controversy in the late 1980s. In 1989 the PGA Tour and the USGA made attempts to have clubs with square grooves deemed illegal. Through a three-year legal battle, square grooves were deemed to be legal in golf and the result has been further movement of the game to an aerial attack. This new technology allows the player to hit the ball the full distance desired in the air and stop the ball more quickly upon contact with the green's surface.

This takes much of the guesswork out of playing a golf shot, and puts little emphasis on the study of the subtle bumps and swales of the ground. For this reason, little attention has been paid to such details in the design and construction of golf courses in the past half century and greens have become further entrenched with bunkering and other types of hazard to promote only an aerial attack to achieve a desired target. Such fortified green complexes provide little difficulty for the more talented golfer, but leave little interest for the beginning golfer who has

little chance of hitting their shot in this manner. In recent years, this issue has begun to be addressed by some golf course architects by leaving a rather self-explanatory gap between bunkers in the front of the green as if it was the proverbial clown's mouth. While this provides a friendlier ground based route for the beginning golfer and does not decrease the difficulty facing the good golfer it leaves little room for interpretation. The mass grading by heavy equipment makes the ground absent of subtleties that can create beneficial bounces to the prudent player.

The over-watering of golf courses makes the low, running style of play relatively rare, and makes players focus entirely on the aerial attack that has become the defining characteristic of American golf. By reintroducing these elements of interest into the ground around putting green complexes, while engaging in more sustainable maintenance practices, golf courses can be designed to welcome players of all skill level. The ability to hit a golf ball a desired distance, within a matter of feet, is a great achievement, but a skill that is realized by less than 1% of all the golfers in the world. Building courses in a manner that challenges the best players takes little creativity and can be done quite objectively. According to golf course architect Donald Ross, "The ideal course is one that presents a test of golf for the everyday golfer and the first-class player."[6] This has been the hope of many and the proclamation of all golf course architects in America over the past century. However, as technology has moved forward, golf courses have only further separated "the men from the boys", so to speak, in efforts to confront the abilities of a few, while inconveniencing the majority. Exacting shots that require the player to play the game through the air are not inherently evil, and can be used in moderation to provide a proper level of challenge for the player. This usually means controlling the point at which a player will attempt such a shot. This characteristic points towards the use of a Par 3 hole as an outlet for

[6] Donald J. Ross, Golf Has Never Failed Me (Sleeping Bear Press Chelsea M.I., 1996) 38.

such shots. The distance from the tee provides the appropriate challenge and the implementation of multiple tees allows for the enjoyment of players of all skill levels.

The Titanium Era and the Great Driving Debate

In the mid-1980s a contradiction began**.** This contradiction was that the clubs that have long been known as woods began to be made of metal. Manufacturers first introduced steel club heads to replace those made of persimmon. In the early 1990s club heads were increased in size to enlarge the area of truest strike, or the "sweet spot". This change proved troublesome for the production of steel club heads due to steel's limitations in thickness. When the club head was enlarged, the steel walls of the club head were made thinner to keep overall weight down. When tested, these clubfaces began to collapse at impact. For this reason, club heads could not be made any larger out of steel and be durable enough for play. So began the use of titanium in the production of golf club heads.[7] The titanium head could withstand thinner walls without collapsing but an interesting effect did result, higher initial ball speed. What had been created was a spring-like effect that can best be described by Newton's second law.

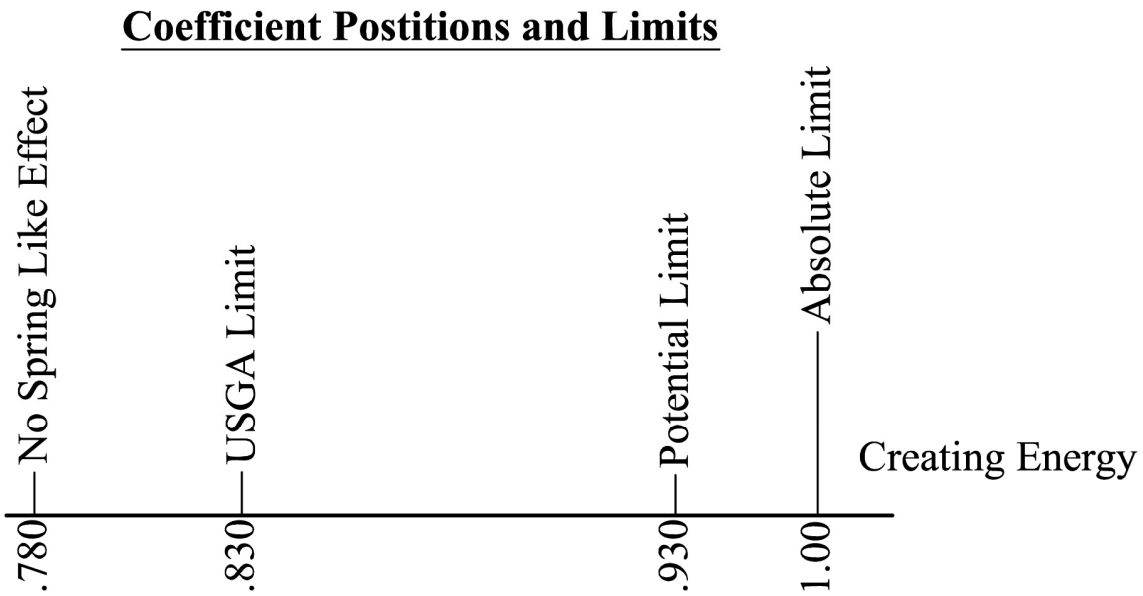
The coefficient of restitution (COR) measures the efficiency in a collision between two bodies. For instance, when a ball is dropped from a tenth floor window it will bounce back some fraction of the total distance that it was dropped. If it were to bounce back as high as the seventh floor, the COR of the ball and the ground would be .70. Intuition reminds us that this ball will never bounce all the way back to the tenth floor window from which it was dropped, and physics tells us that the practical limit in which it might rebound is just past the ninth floor, or .93 in terms of COR. If anyone were ever able to create a collision between two objects that exceeded 1.0, they would be creating energy and, consequently very rich.

[7] Frank Thomas. "Shafts: The engine of the golf club" 16 April 2001 <http://franklygolf.com>.

The titanium-faced golf club deforms and recovers at impact, taking some of the deformation and energy that would otherwise be taken up by the golf ball. This lessening of the compression of the golf ball increases the COR thus creating a spring-like effect. A look at the history of the rules of golf will show us that this should in fact be an illegal property of a club head. In 1909 rules on the subject first were introduced to read, "club should not contain any contrivances such as springs."[8] In the mid 1950s the rule was revised to cover the use of any finish that might be applied to the club head "unduly influencing the movement of the ball."[9] Then, in 1984 Appendix II was amended to read "The clubface should not be designed and manufactured to have the effect at impact of a spring which would unduly influence the movement of the ball."[10] This rule has remained unchanged since then, but recent additions have created some divergence in the rules of conformity. The USGA directly addressed the COR issue in 1998 by setting a limit for woods made of metal at .822 with a test tolerance of .008, bringing the limit to .830.[11] This is approximately .05 above that of creating a spring-like effect and has brought an increase of nearly fifteen yards in distance since the late 1980s.

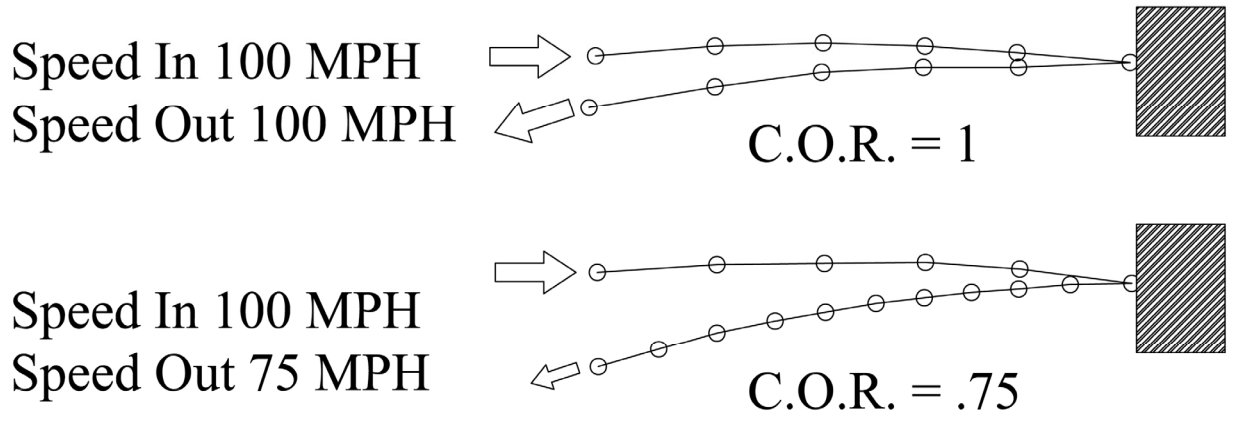
Technology in terms of the golf clubs is nearing an end of additional distance it can provide. Even if the USGA were to allow for greater COR value in clubs, that value could only equate into a distance gain less significant than the fifteen yards produced in the last fifteen years.[12] This again points towards the laws of diminishing returns and gives some hope for a more concrete and lasting standard in length of the course.

[8] USGA Rules of Golf (Far Hills, N.J.: The Association, 1908) 21.
[9] USGA Rules of Golf (Far Hills, N.J.: The Association, 1954) 37.
[10] USGA Rules of Golf (Far Hills, N.J: The Association, 1983) 32.
[11] USGA Rules of Golf (Far Hills, N.J: The Association, 1998) 87.
[12] Frank Thomas. "To Spring or Not to Spring." 9 February 2001. <http://franklygolf.com>



The Coefficient of Restitution **Chart 3.2**

Limits of C.O.R. **Figure 3.3**



The Lengthening of the Course

Many golf course architects of the early twentieth century were conscious of the effects that technology would have on their courses in the future. In his book, Golf Architecture, Alister Mackenzie lists his 13 principles in designing a golf course. One of these principles is "there is a slight walk forwards from the green to the next tee; then the holes are sufficiently elastic to be lengthened in the future if necessary."[13] The lengthening of golf courses as a means to counteract the effect of technology has become commonplace among golf course architects in recent years, continually renovating many older courses. These courses, most of which were built around the 1920s have been stripped of much of their strategic character due to the new distance standards in golf equipment. The Haskell golf ball made it possible for players to hit their drives about 60% of the distance they are able today. For this reason, golf courses have taken action by adding length to the holes. This practice is likely to continue into the future for those courses that have yet to be updated, and for those who feel it necessary to make further renovations due to any added distance the future may provide. However, this does not mean that each hole should be lengthened to the point that a driver is the obvious choice of club on the tee of every par four and five. Much to the contrary, golf courses should provide some rhythm, presenting the golfer with variety among the first shots on various holes. This was the original intent of many of the courses that are now being "restored" in the name of technology and this point is often overlooked. While some golf holes that measure a mere 365 yards maybe defenseless against today's 300-yard drives, some were simply meant to provide the player with a decision to be made off the tee. Looking deeper at such a hole might show that the astute approach to the hole is one of restraint, where the player who hits an iron off the tee is provided a better angle of attack or view of the hole. Due to the recent increase in distance, the positioning of the elements

[13] Alister Mackenzie, Golf Architecture (London, England Simpkin, Marshall, Hamilton, Kent & Co. 1920) 23.

of the golf hole that provide such strategy may be out of place by five, ten, or even twenty yards. However, the need to add fifty or more yards to such a hole would be as if you were playing the wrong note entirely in an otherwise well-composed symphony. Not only does the addition of excessive length confuse the flow of the course, it can also lessen the defense of the hole by being too clear in its intentions.

One course that has been clearly documented in its continual battle with increasing driving distance is Augusta National Golf Club. Over the past five years, Augusta National Golf Club has gone from being 6,985 yards to the nearly 7,400 yards it will play for the 2006 Masters Tournament. A 415-yard increase over just five years shows the impact that technology has had on the game just since the release of the first metal headed "wood" club in the early 1990s. The stated mission of Augusta National Golf Club is the restoration of the shot values that existed on the course prior to the driving distance explosion of the last two decades.[14] Through a combination of steps, decisions are made by the club to add length to holes and make changes in order to make the course play more like it did upon its conception in the 1930s. This requires that the well-struck tee shot end up in the originally designed landing area. By doing this, the course will reclaim much of the original rhythm designed by Alister Mackenzie by requiring a variety of shots by the player.

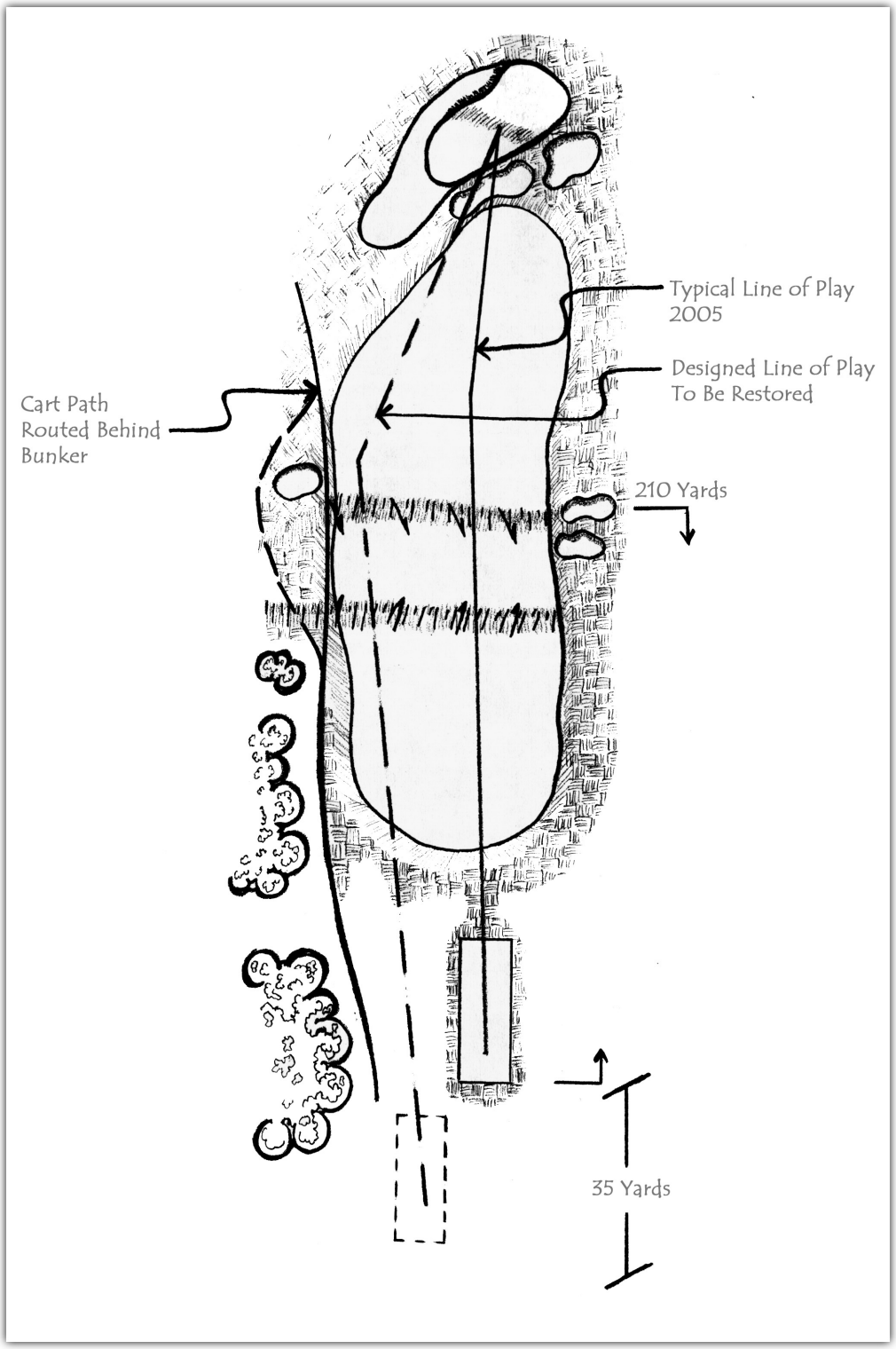
A good candidate for restoration similar to that of the charge of Augusta National is the fifth hole on the South Course at Athens Country Club in Athens, Georgia. This par four was designed by the golf course architect Donald Ross in 1927 and has lost much of its character due to technology. The 340-yard hole is straightaway, and has bunkers on either side of the fairway at approximately 240 yards from the tee. There is also a deep swale running through the fairway that must be carried in order to have a clear view of the putting green. This swale undoubtedly

[14] Marsh Benson, interview by author, October 10, 2005.

was a major concern for the player in the middle of the twentieth century, but hardly comes into view of the modern golfer. This is partially due to its subtlety as a hazard, something not often recognized by the modern golfer more apt to aiming at the center and firing away. It is neglected also due to its distance from the tee, a mere 190-yard carry from the furthest teeing ground. Another element that has disrupted the rhythm of this hole is the retrofitting of the cart path down the left side of the hole. The path was brought inside of the fairway bunker, making the bunker seemingly unimportant and not a part of the hole's design. However, due to the orientation of the green, angled away from the player from left to right, I would argue that this bunker played a major role in the strategy of the hole upon its conception.

One element of design Ross was famous for was his ability to alternate the type of shot that was best suited for play from left-to-right, or right-to-left. Here, it can be suggested that the best-suited shot off the tee was a right-to-left shot, placing the ball close to the fairway bunker, just beyond the deep swale. From here, the left-to-right shot would allow the player the best angle into the putting green. The addition of some length, on the order of twenty to thirty yards, would allow for the deep swale to better infiltrate the player's vision from the tee. Also, by removing the cart path and shifting the tee to the left, the hole would better indicate the right-to-left line of the tee. These changes would return the player to the originally designated landing area, bringing back the alternating effect originally designed by Ross.

This practice of adding length must also be done with careful consideration of the economic impact of additional land purchases. The growth of American cities often caused many golf courses that were once a full day's trip from the city to be landlocked on all sides by urban development. This poses a major problem for these clubs when faced with changing standards in the length of a golf course. Courses that have long been considered the best in the



Athens Country Club, South Course Hole Number 6 **Figure 3.4**

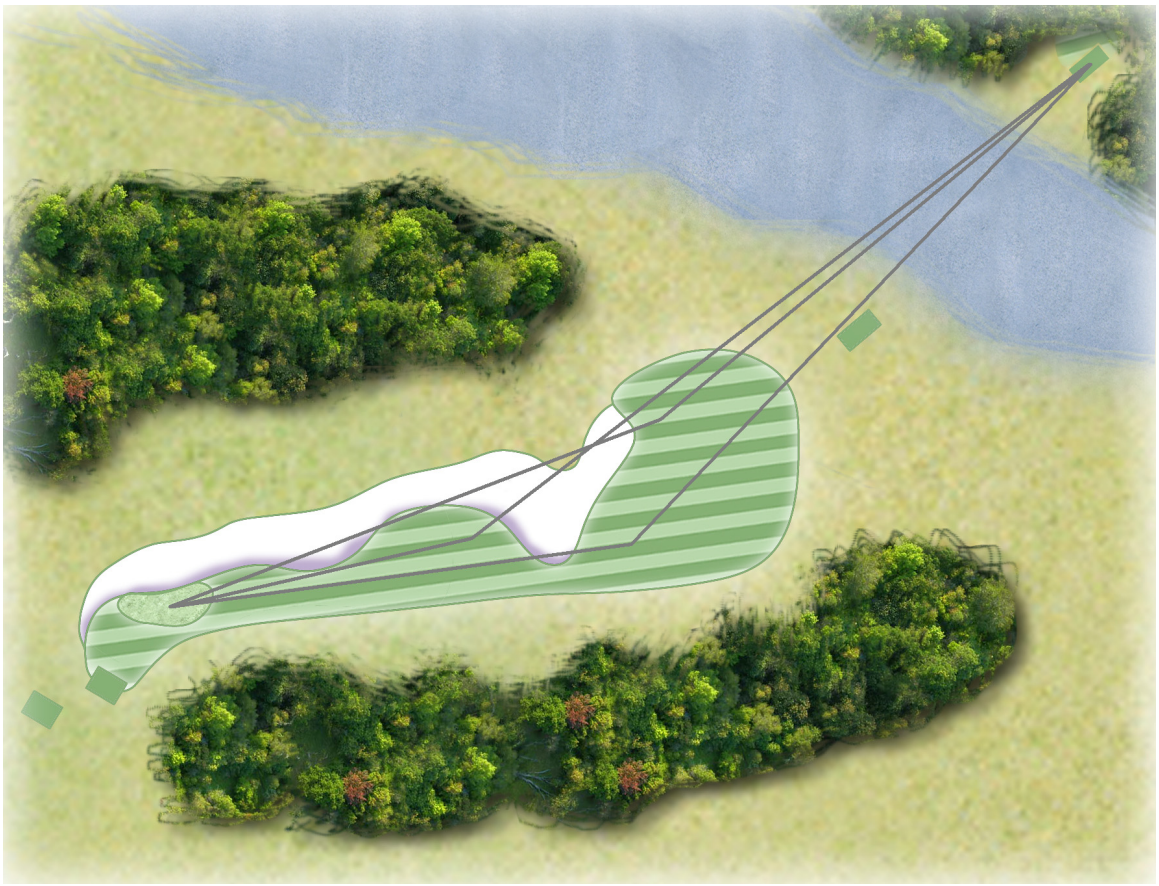
country, such as Merion Country Club in Philadelphia, PA, are now considered obsolete due to their length. Merion Country Club measures 6,412 yards from the back tees.[15] This is a far cry from the 7,000-yard mandate that many golf course architects feel is necessary to provide a true test and maintain a par for the course of 70 or better. Merion Country Club has nowhere to grow in its immediate surroundings, making it impossible to expand its present yardage. Other courses that do have the ability are purchasing adjacent properties in order to update their course. While those that are already established have little choice but to make some well-reasoned changes, the charge of golf course architects in the future should be to find ways to create playing length without expanding the physical yardage needed to create interesting and challenging courses.

Creating an Experience through Perceived Distance

It is believed that, being governed by the laws of physics, the golf ball can only travel between 10 and 15 yards further than it does presently. This increase takes into account the physical limitations of the coefficient of restitution in club heads, as well as other technologies in the equipment earlier discussed. Today, the best golfers in the world are averaging slightly greater than 300 yards with their drives according to PGA Tour statistics. In 1968 that number was closer to 275 yards. With all data pointing towards an end in the benefits of technology in playing equipment, it is sensible for golf course architects to design their golf courses with some amount of elasticity, such that distances can be adjusted to accommodate for this possible ten to fifteen yard increase.

However, the wild card in this equation is that of the human being. The increasing consciousness of health and fitness has made us stronger and bigger than ever before. Technology has played a role in this, providing opportunity to analyze the golf swing, identifying

[15] Tom Doak, The Anatomy of a Golf Course (Short Hills: Buford Books, 1992) 10.



Design Hierarchy **Figure 3.5**

The Various lines of play on this hole show how each player will have the chance to decide their level of risk in the tee shot. Notice how the shots that leave the player the shortest approach shot are also the smallest targets.

the muscles used, and isolating them for specialized training. So while physics may limit us within what is thought to be human abilities, those abilities may also progress just as golf equipment has done over the last two centuries. For this reason, designing golf courses based on length as a major defense is likely to be unsuccessful both strategically and financially. Instead of catering to the hunger of golfers to swing seemingly aimlessly into broad open expanses, creating a great rhythm of shot sequences and a hierarchy of risk and reward for the straight as well as long hitter, can provide an opportunity to hit the all important driver on any given hole, but the choice to do so should not be without consequence.

The first step towards controlling the increase in distance is to think three dimensionally when creating the initial routing for a golf course. Topography has always played a pivotal role in this process, but now more than ever, the use of slight inclines to control the distance a ball might carom forward can act as a distance control mechanism and place golfers more in line with the landing areas that are being designed. While no golfer would want to play a golf course in which he is constantly faced with severely uphill shots, a more subtle tilt can provide a well-presented target without being daunting in their climb. This can often be achieved by playing along a ridge or hill in a parallel fashion, rather than into the path of greatest resistance. On occasion, one might hear a golfer proclaim that a course he has played is "the longest 6,500 yards I have ever seen." This is typically due to an extraordinary thriftiness on the part on the designer in his use of the land provided.

Par for a course being 72 has become a requisite among golfers, architects, and developers alike. One way of dealing with this is to create courses that achieve a par of 72 in combinations other than that of the traditional four par three, four par five, and ten par four holes. Instead, by creating equal numbers of each, many pieces of property that would otherwise not be

suitable for eighteen holes can be managed. This is made possible by the added par three and par five holes that more greatly lend themselves to be broken up across terrain otherwise unsuitable to golf. Here, the total yardage for the course would be equal to that of a traditional par 72 course, but the amount of property required to construct it would in some instances be much less.

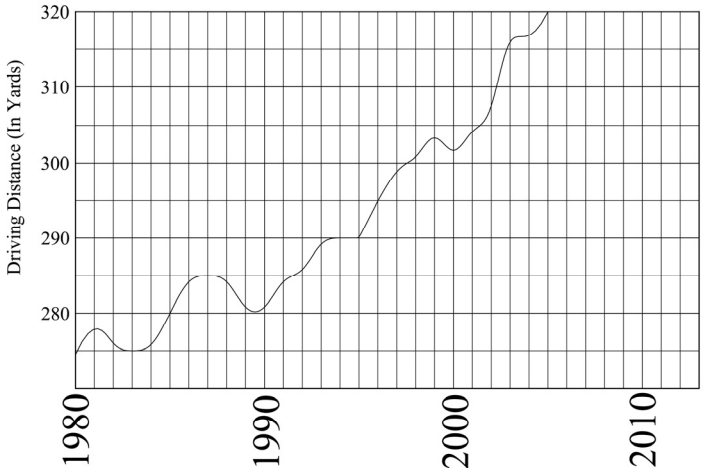
Distance in Relation to Scoring

While architects and the golfing public continue to raise red flags about the distance that today's player is able to hit a golf ball it is important to note that the increase in distance has had little effect on scoring. Since 1995, scoring average on the Professional Golfers Association Tour (PGA Tour) has actually increased by more than one-quarter stroke.[16] The same can be said for that of the average golfer in the United States whose scoring average has remained around 100, prior to and since the introduction of technologies such as square grooves, titanium metal woods and the modern golf ball. Consider this relationship between driving distance and scoring average. Today, the best players in the world are hitting the golf ball nearly twenty-five yards longer than they did in 1968 but are actually scoring worse. Since, as the old golf saying goes, "its not how you drive, but how you arrive", it is my opinion that less emphasis can be placed on increasing the length of the course beyond 7,800 yards as some recently designed courses have done and instead focus on returning rhythm and variety to golf courses. More emphasis should be placed on challenging the golfer's restraint in shot selection off of the tee. Golf course architects should take comfort in the fact that there will always be the player who looks to overpower such rhythms, for that is where subtle defenses can be created to challenge distance domination. By balancing the number of holes that play right to left and left to right, each individual will be challenged and rewarded in accord with their strengths and weaknesses.

[16] Bill Pennington, "High Tech in Golf Hasn't Lowered Average Scores" New York Times. 24 May 2005, sec. D.

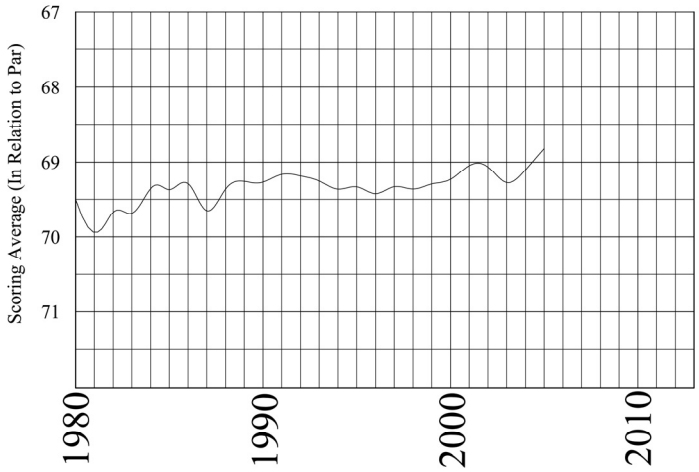
PGA Tour Driving Distance **Chart 3.3**

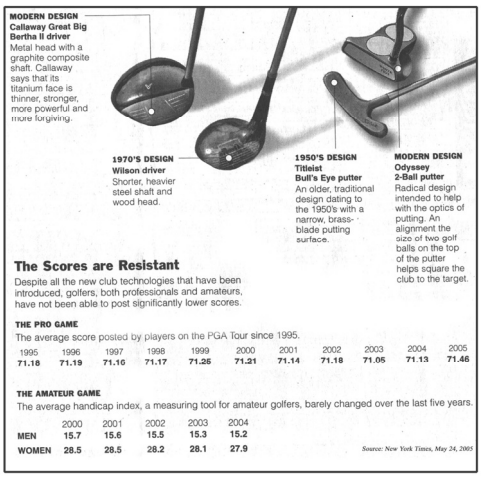
This chart is reflective of the PGA Tour's leader in driving distance since 1980.



PGA Tour Scoring Average **Chart 3.4**

This chart is reflective of the PGA Tour's leader in scoring average since 1980.





Resistance of Scoring Average **Figure 3.4**

Those who show constraint and understanding of their own abilities deserve to be rewarded with a good score, while those who do not will suffer the loss of any strokes they may have gained playing holes better suited to their abilities.

Defending Par at the Green

The final and most effective way to defend the golf course from the effects of technology is testing the player on and around the green. This fact can be witnessed in the longevity of the work of golf course architect Donald Ross. It is often said of Ross that he defended par at the green. The green is the place where more than fifty percent of the strokes taken by a golfer in a round occur, and where technology has had the least impact in the way of playing equipment. Although, due to the physical athletic ability required, there are few people in the world who can hit the ball 300-yards of the tee, the ability to become a good putter or to hit good short shots exists in the majority of American golfers. On the green golfers find themselves most often perplexed, and golf course architects can have the most impact on the challenge a*nd* enjoyment found in playing their courses. It begins two or more shots prior, on the tee, where a player is required to wade through numerous options based upon where a hole may be located on that particular day, and deciding upon an angle of attack. It further develops around the green by providing players with subtle hints of the various paths of play. This allows for each player to solve the puzzle in his own way. These options are best presented in the absence of rough directly surrounding the green. In a tightly mown area, the technology of the sand wedge's bounce angle works against the player and forces the player to think about other way he might be able to play the shot.

Importance of Details

Designing courses that provide adequate challenge to players equipped with modern technologies requires careful attention to detail, in design and in construction. Today's golf course architects are too often fixtures in an office, churning out designs that show little of the detail to such subtleties needed to create interest. While there are some who have taken an initiative to limit their work regionally, or take no more than one project at a time, the majority still rely heavily on the ability of general contractors to interpret their design effectively. Eventually, each golf course architect should make a decision about his involvement during construction. If the commitment to being on site at any given project is low, the architect should take extra care in developing plans that are articulate, and easily interpreted by a contractor. This will ensure that the work bearing the architect's name will reflect their philosophy satisfactorily. While a golf course may cover a vast amount of acreage and be reflective of hundreds of thousands of cubic yards of earth moving, it is often a few shovels of dirt that make the most profound impact on how a course will play.

Chapter 4

The Effect of Social Changes on Golf

In the history of the United States, sport has often acted as a vessel for social reform. When Jackie Robinson broke the color barrier in baseball, it was a gentle reminder to all who witnessed it of the injustice that had been played out over the country's history. When Jesse Owens ran victorious in the Berlin Olympics under the watchful eye of a Nazi regime the world took note of erroneousness of the times. The history of golf in the United States includes similar events, some in reaction to racism, and others to social standing. Each has played a part in the growth and evolution of the game of golf that, despite its early shortcomings, has grown to be a game of inclusiveness rather than exclusiveness.

In the 1920s, golf course architect Perry Maxwell said "We have learned nothing from Scotland and England where the Ancient and honorable game can be enjoyed on marvelous links at one tenth the admission fees, dues, and greens fees that prevail in the land of the free." It is arguable that future golf course architects should reverse the inadequate levels of democracy that existed in the game's early days in America by continuing the trends that have led us to the greater inclusiveness that exists today.

The Events that Changed the Game

While golf experienced rapid growth through the 1890s in the United States that growth was almost entirely limited to the upper-most social classes in the country. Some larger cities made efforts to rectify the situation such as New York City, which opened the country's first municipal golf course, Van Courtland Park in the Bronx in 1896. Boston and Philadelphia

would follow suit over the next two years opening Beacon Park and Cobb Park respectively.[1] This trend however was merely a drop in the bucket when compared with the quickly rising development of private golf courses in the United States. Then, in 1919 an event took place that would change the face of the game forever.

Francis Ouimet was the son of a French immigrant father and Irish mother. The family lived along the perimeter of The Country Club in Brookline, Massachusetts, and young Francis took employment with the club as a caddy. The game of golf piqued his interest and Ouimet began to play in whatever open field he could find at an early age. In 1919, when Ouimet was nineteen years of age, The United States Open Championship was to be held at The Country Club at Brookline and the club's professional, along with one of its members saw to it that Ouimet would be admitted to the field as an amateur golfer. Amateurs had always been allowed to play in the USGA's championships, however it was required that a golf club would sign off on the player as competent for such a level of competition. This meant that all the amateurs contending for these championships were of the upper class, able to afford the luxuries that come with being the member of a private club. The rest of the amateurs competing, all members of a higher social class, cast out Ouimet thinking it inappropriate that a man of such low social class should not have the right to play in the tournament. When Ouimet tied with Scotland's Harry Vardon and Ted Ray after the final round, Ouimet became the crowd favorite in the playoff and was treated as a hero when victorious over the Scotsmen. His victory gave hope to others in the working class of America that they could also be successful in what had previously been a game only for the elite of America. More cities, both large and small began to create municipal golf

[1] [1] Bob Labbance, Gordon Wittenveen. Keeper of the Greens: A History of Golf Course Management (Chelsea, M.I.: Ann Arbor Press, 2002), 60.

courses both of the nine and eighteen hole varieties and by the middle of the 1920's many cities had multiple facilities, such as Toledo, Ohio, which boasted three municipal courses in 1926.

In 1922, the United States Open Championship was held at Skokie Country Club outside of Chicago, Illinois. The buzz of hosting a national championship did wonders for boosting interest in golf and Chicago's two municipal courses recorded 250,000 rounds of golf played in a single year. This number represents nearly half of the number of golfers that existed in America at that time, proving the demand for such public facilities existed, and the creation of more opportunity for people to play would be welcomed.

Further public interest was created in 1930 when Bobby Jones, another American amateur golfer, completed the greatest year of golf in its history. The Grand Slam of golf, as it was coined in 1930, was the act of winning all four major championships of golf: The United States Open and Amateur Championships, and The British Open and Amateur Championships. Jones' completion of the Grand Slam engaged the American public and made front-page news throughout the country, bringing joy to an otherwise bleak time in many American lives due to the stock market crash of 1929.

Other events have occurred through the twentieth century that have led to further American interest in golf, each providing another niche for golf courses, and would-be golfers to fill in American society. These events, and the people associated with them, have become benchmarks for the history of golf in America. They have provided catalysts for its evolution and produced certain social perceptions that continue to change with each passing day.

Validating Golf Course Architecture

The events that surrounded Ouimet and Jones, coupled with the booming economy of the 1920s, were the main reasons for the growth of the game in the United States. The increase in interest

led to the creation of many of the United States' most cherished clubs, making the 1920s the era in golf course architecture known as "the golden age". This was the period when golf course architects first gained notoriety both in the United States and abroad and many architects began to write books on their design philosophy and general thoughts on golf course architecture. Golf course architect A.W. Tillinghast believed that the "The next ten years probably will find training schools for golf architects, constructors, and greenskeepers."[2] In some ways, this prophecy has come to light in that each of the above has grown into various fields of study throughout American universities. However, the specific quest for knowledge on golf course architecture remains tucked away amidst various titles in academia that require some persistence in the discovery of answers. For this reason, golf course design continues to be a somewhat misunderstood field, even under the umbrella of the disciplines in which it is studied.

In recent years, the rise in celebrity of golf professionals has lead to the "player/designer" tag as a stereotype of golf course architects. Often this requires very little input from what is thought to be the architect and has become a tremendous marketing tool to sell lots in golf course community developments. A look back in history shows us that a similar phenomenon took place in the early 1900s among golf professionals of the era. The saying "eighteen stakes in a Sunday" refers to the act of a notable golf professional visiting a town with intentions of taking a commission for designing a golf course and simply walking a site, placing stakes in the ground along the way to mark desired tee and green locations. While this process is much further refined by today's professional player/designer, the result tends not to identify with the environment in which it is built. It is interesting to note that nearly all of the courses that have survived as America's finest were those designed by architects less celebrated in their own era that lived lives of relative obscurity in comparison to the touring professional. The future will

[2] A.W. Tillinghast, Reminiscent of the Links (Rockville: TreeWolf Productions, 1998), 159.

provide a similar result in which examples of our modern architecture will survive. A few more generations of professional golf course architects, whose playing ability will be unimportant, will lead to greater appreciation for the field and provide a platform for it to stand alone as a discipline of study.

From Private to Public Golf

The game received a further advancement in the 1960s when television brought the game to life and exposed the American public to characters like Arnold Palmer whose playing ability and charisma shone through on the course. This blue-collared character from a steel mill town of Pennsylvania was an instant hit with the American working class of the 1960s and led to the explosion of another type of course. The municipal courses of the United States had been very successful throughout their existence but have lacked adequate supply of golfing opportunity for the rising number of golfers in the United States. For this reason "pay as you play" or what is now known as daily fee golf courses began to be built at a record pace in the late 1970s and early 1980s.

Daily fee courses are often associated with real estate developments and are privately owned courses open to the public. Golfers would pay greens fees for a single round at a time; this provided flexibility for those who could not afford the full costs associated with joining a private club and gave golfers the opportunity to play a variety of courses, rather than being a member of just one. Donald Ross, prior to his death in 1948, foresaw this stating, "I also see a brilliant future for the pay-as-you-enter golf courses of America," calling it a "tremendously big new industry."[3] The desire for variety in the courses that American golfers were playing led to the boom in golf course construction during the 1980s and 1990s. The daily fee course brought an increase in the golfing population due to the lessening of the economic commitment necessary

[3] Donald J. Ross, Golf Has Never Failed Me (Sleeping Bear Press Chelsea M.I., 1996) 194-195.

to play golf. Today, the casual golfer has more opportunity to play just one round a month or even less, without having to pay membership fees. The increased amount of golf facilities in the country put less decreased the distance in which all Americans live from a golf course. The importance of such proximity to Americans has been reflected in the rise in popularity of the golf course community.

Living on a golf course has become a symbol of status in the American suburbs and a chance for developers to entice would-be residents to new neighborhoods. The attachment of a famous name to a golf course has further added to the desirability to live in such communities and therefore drives the decision as to who the architect of these developments may be. Often these golf courses have proven to provide more of a backdrop for these communities than an integral part of the residents' daily lives. The attitude of most golf course managers, golfers, and residents of golf course communities is that the golf course is off limits unless you are playing a round of golf. This is meant to include not just the fairways, tees, and grounds where the game is played, but also the outer most perimeters of the holes. Often the reasoning for this reaction is primarily based upon the safety of individuals who are not playing golf. Signage is almost always found at the intersection of roads and cart paths that explain the risk involved and request that pedestrians walking their dog or riding their bike stay off the paths associated with the course. A question of why is often posed in reaction to this request. The answer can be found by tracing back to the roots of the game in this country. The privatization of the game is widely an American accent on a tradition that had been more a part of daily life for all people in the British Isles. To this day, the Old Course of St. Andrews, Scotland welcomes members of the community to come and walk the course as a social activity. Crowds often gather at the eighteenth hole, where the town meets the course to watch players finish their round amidst the

buildings of the historic town. How is it possible that non-golfers and golfers alike can exist in the same environment without incident? Having an understanding for the game of golf is a common trait that almost all Scots have and is essential to making this relationship possible. With the growing number of golfers in the United States it can be expected that Americans, especially those who see merit in living in golf course communities, will develop and similar understanding of how a course can appropriately be used for both passive recreation and golf. With this understanding will come further use of the golf course, and with use will come greater appreciation of the environment it creates.

The Rise of Minorities in Golf

In 1996, Tiger Woods made the decision to become a professional golfer, leaving Stanford University to pursue a career on the PGA Tour. Woods, the son of a Thai woman and African-American man immediately drew international attention for his talent, but also because of this race. Golf has long been seen as a predominantly Anglo-Saxon game in which very few African-American players had ever played at the professional level. Tiger Woods became an instant role model for millions of minorities around the country, providing an example of possibility for achievement most had never thought possible. Within two years of Woods' first win at The Masters Tournament, the number of minority golfers rose over 100 % from what it had been in 1990.[4] The growth in the game led to creation of many initiatives to provide opportunity for people to play golf that otherwise would not have had the chance. One of these initiatives was The First Tee organization.

The First Tee has a mission "To impact the lives of young people by providing learning facilities and educational programs that promote character development and life-enhancing

[4] National Golf Foundation Factbook (Jupiter, 1999), 35.

values through the game of golf."[5] In this case, the game of golf is being used as a vessel in which a much greater message is being carried. Through the program's nine core values (See Appendix I) The First Tee teaches kids life lessons that hope to build future generations who are strong in character and leadership abilities.[6] The program is also providing a service to the golf industry by expanding its client base to people that may otherwise never be exposed to golf.

The facilities that are being created around The United States, Australia, and Canada are not full-scale golf course developments. Instead, the facilities are usually created on tracts of land, often funded by municipalities, of approximately forty acres. This acreage provides room for a practice facility as well as anywhere from three to nine golf holes. While this program targets children of ages five to seventeen, the facilities open their doors to all golfers, young and old and are often located in urban areas making them more accessible than full scale courses, which require three times the land. These facilities can often be created as brown-field developments: a piece of land that a manufacturing plant may have once called home, but now sits idle in an otherwise bustling city. The reclaiming of lost green space provides a reprieve for the heat island effect that influences most cities as well as providing a service to the community.

When listing the most famous golf holes in the country, rarely if ever does a hole from a nine-hole executive course enter one's thoughts. However, there is no valid reason why holes at such facilities cannot provide as much enjoyment as those associated with America's most cherished clubs. As an architect, one might see opportunity within a small piece of property to create a unique and interesting golf hole. The fact that there might only be room for eight more holes to complement such a notable example of architecture should not lessen the merit of what

[5] "The History and Background of The First Tee," October 2005. <http://www.thefirsttee.org>.
[6] James Petrick, Peter Witt. "Evaluation of the Greater Austin First Tee Youth Golf Life Skills Program." (Texas A&M University: January 2004) 7-8.

Hypothetical First Tee Facility **Figure 4.1**

Nine holes and a driving range have been fit to this forty-acre site by enlisting the use of double greens. The short walk from greens to tees and the scale of the golf holes provides a comfort size for the courses target audience.

has been created. If good golf holes are created in facilities such as these, they can produce just as much attention as full-scale golf courses.

Golf's Time Dilemma

The PGA of America says that the amount of time that it takes to play golf is the number one reason why more people do not play, and that people who do play, do so less often than they would otherwise. There exists no better way to lessen the time commitment than by providing ample opportunity to play courses that take less time to get to, and less time to play. In a study performed in preparation for the GOLF 20/20 conference in 2002, 62 % of golfers who quit playing the game of golf listed the reason for doing so as "don't have time to play."[7] When it is considered that the average round of golf takes approximately four hours to complete, this response comes as little surprise. For this reason, The PGA of America has made it the goal of its golf club professionals to lower the time commitment and raise the value of the golf experience. One way the PGA is attempting to put such an initiative in place is with a list of best management practices that are made available to its professionals. One of these practices is to "Aggressively market the idea of playing nine-hole rounds and establish a special price. If your golf course allows, look at a three- or four-hole loop that you can sell to those looking for an hour of golf in the early mornings or late evenings (often on the back nine before morning front nine players make the turn). Actively promote the idea of playing more golf often for less money, in two hours or less."[8] The ideas laid out in this practice should immediately strike golf course architects as something in which they can have an active role. By creating smaller loops of holes that return to a central point, the opportunity to play four- to six-hole rounds would be easily accomplished.

[7] Roger Graves. "Golf-Time Dilemma." PGA Magazine 86 no. 3 (2005): 26.
[8] Roger Graves. "Golf-Time Dilemma." PGA Magazine 86 no. 3 (2005): 30.

This possibility would be of interest to those 62% of golfers who claim to have too little time to play golf. These golfers could now play an hour in the morning before work or in the evening after work without being faced with becoming caught in the dark long distances from where they started playing. Management plans for organizing play on such layouts might allow for play on the final holes for the first two to three hours of regular tee times with out disrupting the flow of golfers starting on the first tee. Again in the afternoon, this practice may be done on the first holes where play intended for eighteen holes might refrain from teeing off within four hours of sunset; players could fill these tee times with intentions of playing only the first few golf holes and still be returned to the clubhouse area.

The second most frequent response to why golfers do not play more and why non-golfers do not play golf is listed as family obligations. This poll, taken in the fall of 2002, showed a major increase in this response, from previous polls. This is thought to be due in part to the importance in family reestablished in the American people after the events of September 11, 2001. The PGA of America's President, Roger Warren, has addressed the issue of family by creating a Family Tee Program at the facility where he acts as General Manager, Kiawah Island Resort. The program sets aside open tee times in the evenings at fifteen-minute intervals (as opposed to the normal 8-10 minute interval) in which children play free when accompanied by a paying parent. The tee locations are moved substantially closer to the greens, providing families the opportunity to play golf together in an environment suitable for enjoyment of all levels of player. "Programs such as Family Tee are identifying golf as a family activity again," according to Warren, who created the President's Council on Growing the Game in January of 2005.[9] The council's mission is to provide ideas in which to create more involvement out of key

[9] Roger Graves. "Golf-Time Dilemma." PGA Magazine 86 no. 3 (2005): 38-40.

Hypothetical Tee Time Plan — Chart 4.1

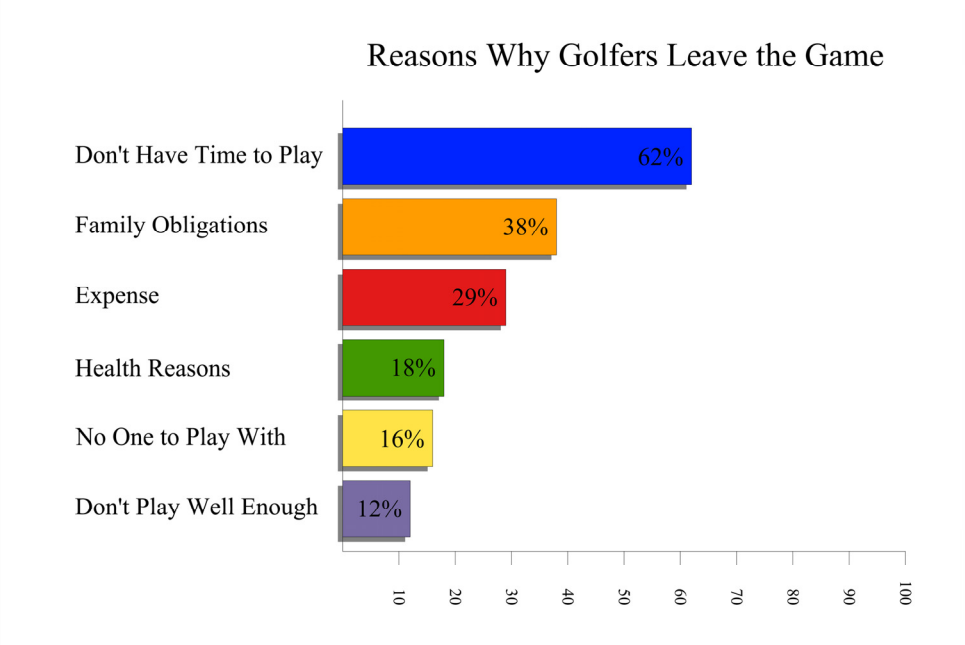
Morning Schedule of Tee Times, May 1 – September 30

Holes 1-5	Holes 6-9	Holes 10-12	Holes 13-18
8:00	8:00	8:00	8:00
8:10	8:10	8:10	8:10
8:20	8:20	8:20	8:20
8:30	8:30	8:30	8:30
8:40	8:40	8:40	8:40
8:50	8:50	8:50	8:50
9:00	9:00	9:00	9:00
	9:10	9:10	9:10
		9:20	9:20
		9:30	9:30
		9:40	9:40
		9:50	9:50
			10:00
			10:10
			10:20
			10:30
			10:40

Afternoon Schedule of Tee Times, May 1 – September 30

Holes 1-5	Holes 6-9	Holes 10-12	Holes 13-18
5:00	5:40	6:40	N/A- Full Round
5:10	5:50	6:50	Groups Tee Times
5:20	6:00	7:00	Until 4:30
5:30	6:10	7:10	
5:40	6:20	7:20	
5:50	6:30	7:30	
6:00	6:40	7:40	
6:10	6:50	7:50	
6:20	7:00		
6:30	7:10		
6:40	7:20		
6:50	7:30		
7:00			

Reasons Why Golfers Leave the Game — Chart 4.2



demographics identified in a 2003 study performed by DYG Incorporated, a time-management firm.

Growing the Game of Golf in Key Demographics

The most significant of the demographic groups identified by DYG was that of the women. The study showed that while only 19% of women play golf, 68% would like to play, or to play more golf. The two issues of time commitment and family obligations are highly important in thinking about America's working women, who do 25 hours per week of household duties in addition to their jobs, compared to 13 hours per week performed by men. An increase of 63% in women's income over the past twenty years, compared to 0.6% in men's, further explains why women are an important demographic to be considered in the golf industry.

One of the first architects to recognize the important role that women golfers play in the design of golf holes was Alice Dye. Alice and husband Pete Dye have been recognized as the most influential golf architects of the last fifty years, training over a dozen of today's top architects. Alice is often known as the voice of reason in Pete's ear when designing golf courses. Dye's designs are often characterized as daunting and tremendously intimidating for golfers of all skill levels. Alice Dye began the movement to call the shortest set of tees the forward tees, rather than what had become known as the ladies tees over the past seventy-five years in the United States. The Dye's efforts in this attempt were meant to encourage golfers to look at their ability level to choose the appropriate set of tees to play, rather than the label of men's, seniors', or ladies' tees. The wide variety of playing ability that is found in American golfers today makes tee placement especially important in creating golf holes. One of the most remarkable things about golf is the ability for golfers of all skill levels to compete with one another, through the USGA handicapping system and a variety of teeing grounds on every golf hole.

The effort of golf course architects must be to create various teeing locations that provide an appropriate amount of challenge for every player. The same strategies of the hole should be built into each set of tees, so that each golfer is playing the same type of shot, and a suitable amount of risk and reward exists from each tee. Designing holes in this way will allow for golfers to fairly compete with one another, testing each player in a similar fashion, in the same holes. This can mean a difference in distance of a hole, or the distance required to reach a fairway. It can also be accomplished simply by changing the angle in which a golf hole is approached. It is possible to test all players equally from the same distance, if the direction from which the hole is played is varied.

Golf continues to serve as a frequent place of business for many business people in America. The increase in women in the American business world further explains the high numbers of women that have shown interest in playing golf. Women now hold the majority of advanced degrees in the United States and bring in an equal or greater amount of income in 55% of the homes in the country.[10] Their purchasing power is evident in every facet of the American way of life, especially in where they and their families live, a decision that is reportedly 92% driven by women.

Throughout the history of golf in America, there have been people who have acted as role models and sources of inspiration for various groups of would be golfers. Today, a rising young star named Michelle Wie may provide this inspiration for young women throughout the United States. Wie's popularity will undoubtedly be boosted by the commercial factors of being backed by some of today's widely recognizable symbols such as Nike and Sony. Her youth, talent, and multicultural roots draw immediate comparisons to Tiger Woods, whose impacts continue to be seen in today's society. Wie may provide a similar boost for women golfers to that of Woods'

[10] Barletta, Martha. Marketing to Women (USA: Dearborn Trade Publishing, 2003), 57.

A Radial Golf Hole **Figure 4.3**

Here is an example of how the angle of a hole can be an effective tool for providing difficulty for various levels of golfers. This par three is the same distance from every tee. The orientation of the green, as well as the differing elevations of the tees provides a more difficult test for the strong player, while being playable for the weaker player.

impact on minority golfers. The increase in women golfers, as well as other groups of new golfers, brings equal importance on building golf holes for the forward and middle tee boxes, as is given to the championship tee boxes. The attention to such details will further enhance the experience for the beginning golfer, often found in these key demographics.

The Loss of Community in the United States

In today's America, citizens are often so reliant on individual transportation that they have little time to interact with what would be the members of their community. The one place where community can still be witnessed and some commonality among people of all races and social classes come together is in the arena of sport. When faced with the awkward silence of being surrounded by strangers for prolonged periods, often the lone icebreaker is the recognition of the logo of one's favorite team being worn by another. Instantly, a sense of community is established. This can be seen in the participation of viewing sporting events as well. Where you might be celebrating a victory with a stranger within the friendly confines of the stadium, once again each individual is off to races once outside, retreating to the privacy of his home where he no longer acknowledges such comradeship, even if it existed next door. These are the problems associated with the sprawling American suburbs. These issues have become the topic of much debate in recent years. Our city centers have begun to erode as businesses, and people have moved further from their centers creating rings of growth, each further away than the last. Americans' reliance on the automobile has evolved from one of pleasure to one of dread, as millions of people sit in gridlock on our roads each day trying to get to and from work. In 1993, the first Congress for the New Urbanism (CNU) met in an effort to solve the problem that was continually growing around American cities. The CNU drew a charter, in which its mission is explained as:

> "The Congress for the New Urbanism advocates the restructuring of public policy and development practices to support the restoration of existing urban centers and towns within coherent metropolitan regions. We stand for the reconfiguration of sprawling suburbs into communities of real neighborhoods and diverse districts, the conservation of natural environments, and the preservation of our built legacy. Rebuilding neighborhoods, cities, and regions is profoundly interdisciplinary. We believe that community, economics, environment, and design need to be addressed simultaneously through urban design and planning."

Its now 2,300 members have carried out this mission internationally, attempting to produce designs that meet the community, economics, and environmental needs of each project. Much of these projects have come in the way of green field development, creating new suburban growth that incorporates all aspects of life into its design. Instead of having just single family homes these communities use new zoning standards to integrate commercial with residential, in a walkable environment. The walkability of a place takes people out of their automobiles, increasing the chance of interaction with one's neighbors, creating a sense of community that has long been lost in the American suburbs. While in the case of green field developments where community members may still drive back and forth to work, the reliance on the automobile is still lessened by some 35%. By providing communities with services such as grocery stores, restaurants, and other daily needs that would otherwise require a trip to their nearest strip mall, people are more often out of their cars, walking through these neighborhoods, creating possibility for more human interaction will occur. This human interaction is further stimulated by ways in which these communities are constructed.

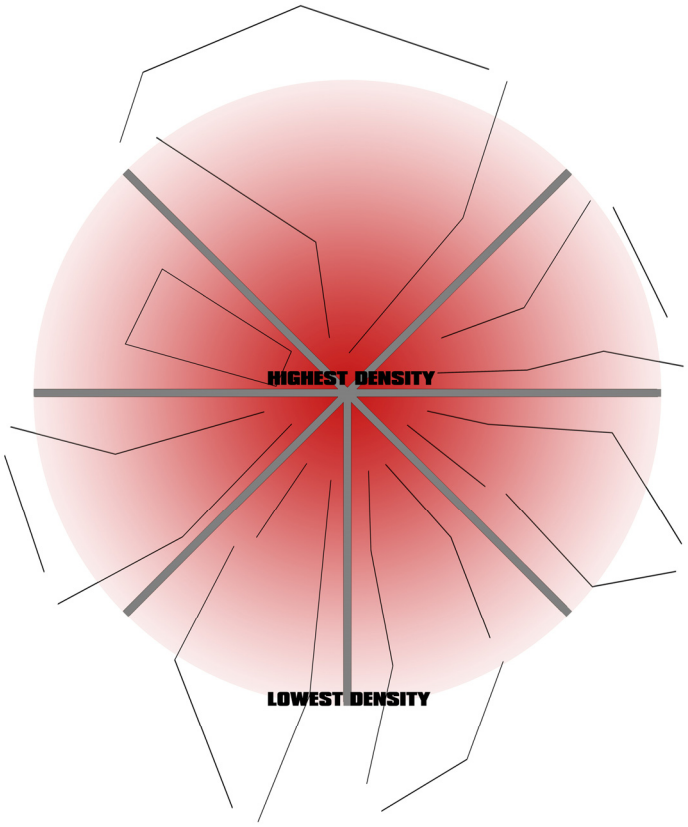
In Suburban Nation the authors provide a checklist for the development of a traditional neighborhood. In this checklist, careful attention is paid to the hierarchy of street widths, in order to control the speed of cars, and also the order of density in which a community is developed. The suggestions involved with the density of a development suggest that it should increase from the edge to the center. The edge of a development however should be "roughly a five-minute walk-a quarter mile-from edge to center" thus creating the same types of environment that exist in an entire American city, on a much smaller, more human scale.[11] The more intimate situation of homes along the street edges also adds to this sense of community more than that of the suburban half-acre lot with homes set well back on the property.

A similar set of guidelines is being produces by LEED for the construction of "Compact, Complete, and Connected Neighborhoods" and provides similar suggestions in terms of building size and density and street width hierarchy. Mixed-use developments such as this can provide people with greater chances to interact with one another as well as addressing the issue of time management and consequently the desire to meet family obligations.

The Radial Golf Course

By bringing people more closely together in their daily lives and providing for greater chance of interaction the ingredients of community still lack some common thread. Golf can provide this commonality for a community, just as it has for centuries in the British Isles. Imagine a neighborhood that, instead of simply being adjacent to, is integrated with a golf course. The corridors of such a course could have a great deal of impact on the community by providing pathways to and from the center of a community. Prospect-Refuge theory suggests that humans are instinctively edge animals. By providing edges that lead from the outer limits of a community inward from all directions to the center of circulation, a golf course can provide

[11] Andres Duany. Suburban Nation (New York : North Point Press, 2000.) 247.



Radial Golf Course Community Concept **Figure 4.4**

The multiple loops of holes make short rounds possible, as well as creating a routing that features holes arranged in a wide variety of directions. The golf hole corridors can also provide an enjoyable, natural path from the community's center to its edge.

St. Andrews Golf Links and Town **Figures 4.5 and 4.6**

The relationship between the town of St. Andrews and its golf courses is shown above looking down the first and eighteenth holes at The Old Course.

scenic pathways to and from daily activities, uninterrupted by automobile traffic. Such a design not only serves the community well, but also is a good model for the routing of a golf course, where several loops of three to five holes can be made to return to the town's center, and rarely would any two holes play in the same direction consecutively.

The relationship of St. Andrews, Scotland and its golf courses is as special as any region and people have around the globe. The game is built into this community's daily lives and nowhere is there a greater social gathering than that of the edges of the Old Course. The relationship of a golf course and its community stretches beyond that of just playing and watching, but also by creating jobs that can be filled by those in the community. What if there existed ample opportunity for the youth of a community to work right out of their own front doors? Perhaps a child's first job might be to mow fairways or rake bunkers before going to school. The establishment of a caddy program could allow children to work on weekend mornings, and expose them to a game that has proven to be therapeutic for the mind and constructive for the character of America's youth. Such programs that would promote walking by golfers would also enhance the playing experience, allowing players to feel apart of the environment in which the course is situated rather than merely race through it in a golf cart.

The use of workforce housing within these communities can also provide affordable housing for service people in the community, such as schoolteachers, firemen, shop owners, and, in the case of golf courses, superintendents and golf professionals. These homes might be indistinguishable from all others in the development, but are sold to these workers at below market value under certain stipulations. By providing this service, building a diverse, intimate community is possible and serves purposes such as those outlined in the CNU charter.

Finding a common thread to connect people is crucial in the rebuilding of America's sense of community lost as development has sprawled out across the landscape of the United States. Producing an environment where people can commune under the umbrella of a common interest will breed an intangible element of design that can only be measured by the quality of life of the people who live, play, and work within these types of developments.

Chapter 5

Architectural Trends Driven by Environmental Concerns

The general belief that golf courses are fundamentally bad for the environment is an opinion that is largely based on emotion and intuition rather than on fact and logic. Throughout the history of golf in America, golf courses have been built in environmentally sensitive areas and have followed similar trends in maintenance to that of parks, residences, and other areas that are largely turf. In recent years, golf courses have fallen under continued scrutiny as destructive elements of the environment, and claims have even been made that golf courses use 4 to 7 times more pesticides than American farms. Claims such as this one, made in a New York State Attorney General's report are sorely misrepresentative of golf courses and the impacts they have on the environment.[1] Just as the country's agricultural practices, recreational facility management, and others have evolved in the way turf is maintained, so have golf courses. In this chapter, we will discuss the changing way that golf courses have been designed, constructed, and maintained in the United States. The form of golf courses can be easily linked to the functionality provided by the trends of the time of its conception.

The Golden Age of Golf Design

These trends in the American way of life have come to define the style of architects of the various periods of history of golf course architecture. The first of these is that of "The Golden Age of Golf Design" that is deemed to have existed from the early 1900s up to World War II. This era in golf design brought forth the artistry often associated with one's ability to seamlessly blend the built environment into what existed. This was a period in American history

[1] Michael Hurdzan, Golf Course Architecture (Chelsea, M.I. Sleeping Bear Press 1996) 371.

that was absent of heavy earth moving equipment such as bulldozers, backhoes, and other mass grading tools. Instead architects such as Donald Ross, Alister Mackenzie, and A.W. Tillinghast relied on the mule-driven plow and great amounts of manual labor to move the earth required to design green and tee complexes. For this reason, the routing of a golf course was of the utmost importance, in order to "take advantage of every existing feature that can be seen." The words of Donald Ross ring true to his style of his courses that were built from 1898 through 1945 in North America.[2] Making sure to use all the naturally occurring features of a property allowed the architects of this era to design their courses within what was there, rather than constructing a vision that may have only existed within their own minds. This was a time when the study of the world's most famous golf holes was a necessity for would-be architects to gather the understanding of strategy and beauty that good golf holes possess.

This time period was the origin of many of America's most cherished courses, many of which were built in some of America's most treasured and fragile environments. On the Monterey Peninsula in Northern California, Cypress Point Golf Club was more discovered than it was constructed, along the rocky cliffs of the Pacific Ocean and winding inland through vast dunes. The golf course is an integral part of the environment in which it exists. These are green spaces, woodlands, and dunes that will never be lost to the construction of condominiums, ocean front resorts or commercial development. The management of a golf course in such an environment requires careful planning and implementation on the part of the golf course superintendent so that he and the course act as good stewards of the environment and its inhabitants. This can be accomplished by adhering to the "Best Management Practices" set out by the Golf Course Superintendents Association of America (GCSAA).[3] This might include

[2] Donald J. Ross, Golf Has Never Failed Me (Sleeping Bear Press Chelsea M.I., 1996) 12.
[3] "Best Management Practices," USGA Green Section Record, 34 no.1 (1995) 1-8.

Cypress Point Golf Club **Figure 5.1**

Constructed in the 1920s, Cypress Point Golf Club was weaved into the existing dunes of the site.

Early Construction at Pinehurst, North Carolina **Figure 5.2**

In the foreground, laborers use horse drawn plows to shape a bunker near a green site at one of Pinehurst's early golf courses.

leaving dead trees or brush to provide habitat for birds and ground dwelling animals. It must also include the planting and use of native plants, that are "of the place" providing a good experience for all species that use it, including humans, who should also have the chance to experience and learn from such unique and important environments.

The word that best describes the Golden Age of Golf Design is "minimalist" since golf course architects moved only enough earth to create greens, tees, and bunkers where they saw fit. This meant that much of the naturally occurring vegetation, landforms, and ecosystems were left intact, and what is thought of as the golf course proper bled into a native environment with little clue as to where one began and the other ended. The minimal amount of earth being moved meant that soil structure and drainage patterns were very rarely disturbed. This meant that storm water concentrations were not significantly increased, and topsoil remained in place, as to not diminish any of the percolation benefits associated with the soil structure. Green complexes were often created from native soil and bear the name "push-up greens", descriptive of the manner in which they were constructed. These greens often were grassed with whatever type of grass was most suitable to the region in which they occurred. This meant that maintenance practices also were minimalist in nature since the need for stringent fertilizer and pesticide applications was not necessary. This may well have continued throughout the twentieth century if not for the creation of large earth moving equipment, for which the next era can be named.

The Bulldozer Era of Design

After World War II, the rise of heavy earth moving equipment provided golf course architects a tool that architects of the past undoubtedly would envy. This was the ability to move large amounts of earth and correct a hole that could not be fit on the property that had been provided. Now architects such as Robert Trent Jones, Sr., George Cobb, and others would be

able to create golf courses on otherwise mundane featureless property and provide room for improvement of what would otherwise be weak holes on a golf course. Jones boasted the ability to create 18 "signature holes" on a course, each one being worthy of gracing the cover of a magazine or a postcard.[4] Now, golf courses that might otherwise sit on flat pieces of property could be built into rolling landscapes, reminiscent of the links land of Scotland. Bold features could be easily created without the daunting cost associated with blasting or large amounts of labor. This era coincides with the rise of "Augusta National Syndrome" in the United States, when golfers demanded greener golf courses to match that which was being shown on television and in glossy magazine pictures. This was also a period in history when pesticide and fertilizer use was at an all time high throughout the United States and little understanding existed as to the effects being felt in the environment.

This type of design catered to the growing American culture of sensory overload where "a thrill a minute" was the only way to entertain and keep the attention of the American golfer. No longer did the "breather hole" exist on the modern golf course. On these courses each hole often provides a greater challenge than the last. The movement of large amounts of dirt often led to problems that had never before existed on golf courses in the way of drainage. By creating mounds throughout the course, pockets of land would collect water. This coupled with a disrupted soil structure caused American courses to have poor drainage. This created a need for more elaborate drainage systems than what had previously been installed on courses of the golden age of golf design. The use of man made features such as mounds on golf course first occurred primarily in the areas most frequented by play: the landing areas and the green complexes. This left most of the property more or less flat, making for a very fragmented appearance in the landscape.

[4] Geoffrey Cornish, Ronald Whitten, The Architects of Golf (New York, N.Y.: HarperCollins, 1993), 57.

The bulldozer era has led to the creation of what is known as the "Framing School of Design" in which each golf hole, and even each golf shot provides its own scene, encapsulated into a view that lends itself to being photographed.[5] The framing of each scene usually comes in the way of mounds built on either side of the golf hole sometimes referred to as "containment mounds." These mounds serve a dual purpose in containment of both golf balls, and the golfer's field of vision.

This type of design has received some criticism due to the recurrence of similar views throughout the various environments in which golf courses are built. By framing each hole with mounding, courses are severed from the naturally occurring environment that existed before the creation of the course. This means that you can often play golf courses in two vastly different regions of the country and feel as if there is little to distinguish one from the other. While this can be a critique for some, others may find comfort in familiarity of two designs when faced with being long distances from their homes. For the majority of golfers however, the excitement of experiencing the environment in which they are visiting will outweigh the desire for comfort. When visiting a tropical island dotted with palm trees and vast stretches of white sand beaches, few people would see the merit in blocking the views of these features in order to create continuity between the course they are playing, and one in the American Midwest. Each landscape of America should be celebrated and indicated by establishing a sense of place in the design of a golf course.

Enhancing the Environment through Golf Courses

Another product of the bulldozer era is architect Pete Dye. Rather than creating mounds strictly around green complexes, Dye incorporated mounding throughout entire properties, blending golf holes into these features creating a more legible contiguous environment. The

[5] Geoff Shackelford, Grounds for Golf (New York: T. Dunne Books, 2003), 32.

movement of such large amounts of earth again required more elaborate subsurface drainage systems but the existence of such systems provided the catalyst for creation of systems to lessen environmental impacts of a golf course. During the construction of Old Marsh Golf Club in Palm Beach, Florida, Dye faced stringent environmental restrictions due to the proximity of construction to the marshland that surrounded the property. In an effort to reclaim all the irrigation water used on the course, Dye designed all of the golf course with some slope inward towards voluminous water catchments that directed the water back to self contained ponds on site. This produced a "bathtub effect" according to Dye ensuring that any chemicals applied to the golf course as well as any other agents associated with runoff would be contained within this drainage system, allowing the soil structure of the course to act as a filter for the water as it was directed toward the drainage system. Old Marsh is a prime example of the environmental awareness that was building in the United States during the last twenty-five years of the twentieth century. Here, Dye created nearly thirty acres of new wetlands, paying careful attention to contour these areas in terms of depth so that the same species of wildlife that inhabited the old would inhabit the new. In talking about the design of Old Marsh Dye had this to say:

> "The main objective should be to improve the aesthetics of the course by establishing, vibrant, attractive marshes that enhance the beauty of the land. With a little care, the architect can not only produce clean, clear marshes, but actually attract new species of wildlife that never existed in the area before."[6]

This should be the effort of every golf course architect in future golf course designs, taking the extra steps associated with the careful construction and management of environments like

[6] Pete Dye, Bury Me in a Pot Bunker (Chicago: Contemporary Books, 1999) 184-185.

Water Reclamation System **Figure 5.3**

Golf Course Architect, Pete Dye, stands on one of the water catchments first used at Old Marsh Golf Club in Palm Beach, Florida.

marshes, prairies, and other ecosystems that may exist along the perimeter and within the golf course.

The ability to create an environment where the existing conditions lacked certain character is the source of a new type of golf course development. Brownfield golf courses have become the newest hot commodity in golf course development in the past decade. The number of golf courses built in landfills or areas deemed as brown fields, where development once existed and has since been abandoned has increased substantially from essentially none of this type existing in the later 1980s to 70 facilities at the end of 2002.[7] That number is expected to grow to more than one hundred once projects currently under construction are opened. One group of courses in this category is planned for The Meadowlands in Northern New Jersey. The courses provide opportunity for golfers very close to major populations and reclaim green space that had been lost to industry or waste. The land, that would otherwise be too expensive due to its proximity to urban centers, is often very inexpensive or even free since it is unsuitable for residential or commercial development. The downfall of such sites is the time-consuming, often expensive measures that must be taken to prevent the escape of methane and remove other contaminating materials from the site. However, there are often state or federal agencies able to provide financial help in completing this process. In some cases, the methane gas produced by decomposing contents of a landfill can act as a further source of income by capturing the gas from the site for sale to local energy companies.

Even without these sources of revenue, the golf course itself will be an economic source rather than a sink of resources while reducing environmental decay. Courses like these are providing people of nearby urban areas a more accessible source of outdoor recreation and adding to the green space of America's cities.

[7] Jim Dunlap. "Brownfields go green," Golf Inc. 14, no. 10 (2005): 30.

Environmental Demonstration

In Scituate, Massachusetts an abandoned sand and rock quarry sat idle between the New England village and the Cape Cod Bay. This site had become an eyesore for the town, collecting trash of illegal dumping and providing little wildlife habitat. In 1993 an initiative by *Golf Digest* magazine, the National Wildlife Federation, and the Center for Resource Management was started to create a demonstrative golf course that would act as a source of education to study the effects of the course on the environment.[8] In 1998 Widow's Walk Golf Club opened to rave reviews, both architecturally and environmentally. The course continues to implement the best management practices outlined by the GCSAA and conducts studies on water quality, wildlife habitat, and other environmental factors. Just as the early courses of America used turf species that naturally occurred in the region, Widow's Walk was planted with fine fescue grass. The particular fine fescue that was used in 1900 was sparse in density but new cultivars of fine fescue provide greater leaf density while still possessing the positive characteristics suitable to withstand the climate of the United States Northeast. The turf at Widows Walk is allowed to turn various shades of brown and green during the hot, dry spells of the summer providing a visual flow from the course, to the natural environment and giving a strong sense of season and of place.

Today, golfers and non-golfers alike should take comfort in knowing that the use of pesticides and fertilizers is of a corrective nature, rather than of a typical maintenance practice. In order to secure the permitting necessary to build golf courses in the late 1980s and early 1990s many golf courses were required to conduct environmental monitoring of their golf facilities and surrounding environments. These courses have produced results time after time that show no negative effects on the environment. It is interesting to note that of the area of the United States

[8] Michael Hurdzan, Golf Course Architecture (Chelsea, M.I. Sleeping Bear Press 1996) 387.

that is covered by turf, only 1-2% is attributed to golf courses.[9] This 1-2% of land is managed by educated, state-certified pesticide applicators with a great understanding of the effect of misuse of such chemicals. The other 98-99% can be attributed to all of those working feverishly towards that community association yard of the month award. Still golf courses will continue to receive criticisms from the 5-10% of the population that believes they are the source of pollution for the environment.[10] The only way to reverse this guilty verdict is to prove golf's innocence, and also to work towards improving the quality of the environment in which golf courses are constructed.

There have been some efforts in recent years to build what have been coined "organic golf courses" where no synthetic fertilizers or pesticides are used. While these experiments have produced mixed results, a combination of these practices, and the use of the most suitable turf have produced good results. While performing few maintenance operations and providing turf with no outside sources of nutrition is not possible throughout a course, it can be done on the majority of the turf that makes up a golf course.[11] If the right species of turf grasses are chosen for a given region, a surface suitable to golf can exist on the tees and in the fairways. The exception to this is on the putting green complexes, where the excessively close mowing practices require a more stringent maintenance plan. This is the situation that has surfaced on Long Island, New York at Sebonic Golf Club. The joint design effort of golf course architects Tom Doak and Jack Nicklaus has faced strict environmental guidelines in its construction and maintenance. The course will not use any fertilizers or pesticides on the fairways, tees, or other portions of the course commonly referred to as the area "through the green" in the rules of golf.

[9] Michael Hurdzan, Golf Course Architecture (Chelsea, M.I. Sleeping Bear Press 1996) 377.
[10] Americans' Attitudes on Golf (Jupiter, 1992), 16.
[11] Matt Nelson, "Is Inorganic of Organic In?," USGA Green Section Record, 43 no. 1 (2005) 1-13.

The green complexes themselves will recapture 100% of the irrigation water used on them by creating liners under and around each green's surface.

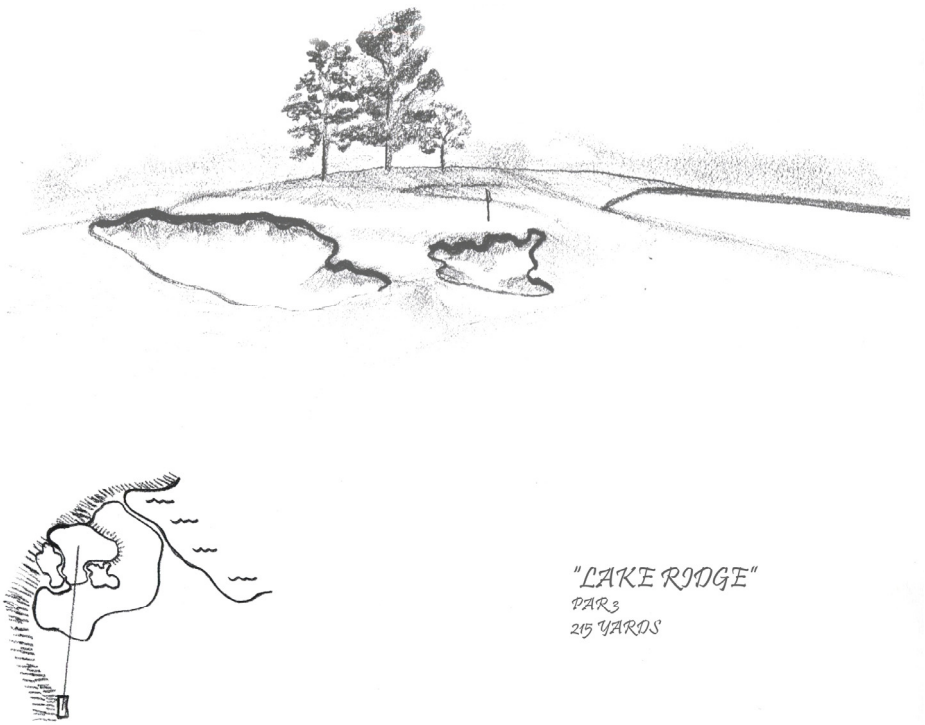
A New Era in Golf Course Architecture

While architect Tom Doak classifies the Golden Age and The Bulldozer era into the Classical and Modern eras respectively, the point can be made that a new era has begun just as we have started into a new century. This era plays to the emotions of Americans who long for the good old days. This era is a consequence of the increasing environmental awareness of modern America. At its most simplistic level, this era is one of renaissance. Golf course architects such as Tom Doak, Bill Coore, and others are cut from the same cloth of that of the architects of the golden age of golf design, where minimalist designs provide maximum reflection of the existing surroundings in the golf course. These architects have been praised for their work on some of America's most beautiful and golf suitable landscapes such as Long Island, New York and the sand hills of western Nebraska. Here, there is no substitute for a superior routing of a golf course. The recognition of places most suited to tee, green, and fairway locations makes the design of the course a practice in discovery and requires the ability to distinguish notable landforms that lend themselves to good strategic golf holes.

There also exist those who are embracing the abilities we have acquired in the past sixty years by creating beautiful courses on otherwise bleak landscapes void of life. The wonderful example of the marriage of all of the ideals brought forth in the history of golf course architecture in America is that of Bulls Bay Golf Club in Awendaw, South Carolina. Here, architect Mike Stranz was provided with a property that included approximately a half-mile stretch along Bulls Bay with the majority of the land situated inland, consisting of old tomato fields. The land had no notable water features, and very little change in elevation. Bulls Bay

Golf Club is now the site of the highest elevation in Charleston County as Stranz's design called for the creation of several ponds on the sight to provide the volume of earth needed to build the hill on which the golf course is centered. Along the marshes of Bulls Bay, very little earth was moved, to be sure and reflect the natural environment that exists there and celebrate the vast stretches of marsh grass that reaches outward to open water. The massive hill on which the clubhouse is perched provides a location for three green sites, and three tee sites, all of which provide dramatic views of the rest of the course that reverberates outward gently softening in their slopes as they spread. A genuine appreciation and understanding of the architecture of golf's golden age is evident in the strategy that Stranz designed into each hole at Bulls Bay. Stranz claims the influence of the writing of Alister Mackenzie in his design at Bulls Bay where multiple lines of play exist on most holes and the built golf holes fade seamlessly into their natural surroundings.

Golf holes of today's era are being built in such a way to reflect both the natural environment in which they are built, as well as the historic landscape in which they are a part. Terraced agricultural fields might be incorporated in the design of a golf hole today, rather than being plowed under and reshaped. Other features like dikes that may have been built to protect a coastal community against high tides or were a part of a rice plantation can also be incorporated into golf holes. This has been practiced for hundreds of years in the British Isles, where courses like Royal Lytham and St. Annes Golf Club incorporated the craters made by the bombs of World War II into bunkers on the course. Stone walls that once separated family farms are often incorporated into golf holes, providing a hazard that Americans might find somewhat unconventional.



Historical Reflection in Golf Holes **Figure 5.4**

Using an existing dike along the edge of a lake can give an added element of history of the site. Here, the landform implies a left-to-right shot, and the hole is designed as such.

Bulls Bay Golf Club **Figures 5.5 and 5.6**

Architect Mike Stranz created an interesting environment on an otherwise flat, uninteresting field (Left), while retaining the unique and beautiful qualities of the lowcountry's salt marshes.

Late in his life, when reflecting on his design of Seminole Golf Club in North Palm Beach, Florida, Donald Ross said "In these days of steam shovels and modern improvements, it is possible to do wonderful things on flat, level country."[12] In reaction to some critique of his style of moving large quantities of earth, Tom Fazio said, "We've gained the experience and confidence to know that, even without good land, we can do what it takes to meet that goal. Would Donald Ross or Alister Mackenzie be turning in their graves to hear this? No, I don't think so, because they'd be doing the same thing."[13]

This new era should be thought of as one of progressive reflection and architects should provide opportunity for golfers to play the game in such a manner. People should have the opportunity to take advantage of the advancements technology has provided while still testing the golfer mentally. By surveying the nuances of each hole and searching for the various ways to play a golf hole, golfers will be sure to appreciate the strategy designed in a course. By reconnecting golf holes to create a more legible contiguous environment, whether created or adapted, architects have the opportunity to enhance the experience of golfers that grace their courses. The culmination of these elements is sure to bring to life the best features of both of the previous eras in golf course architecture in America and produce golf courses that will serve as good tests of golf, as well as aesthetically pleasing environments.

[12] Donald J. Ross, Golf Has Never Failed Me (Sleeping Bear Press Chelsea M.I., 1996) 172.
[13] Tom Fazio, Cal Brown. Golf Course Designs (New York, N.Y. Harry N. Abrams, Inc., 2000), 33.

Chapter 6

Conclusions

As a means of example, the design of an eighteen-hole golf course and surrounding community has been completed on a site known as the Kiawah River Plantation on Johns Island, South Carolina. The 1,400-acre site was once a rice plantation and includes nearly 400 acres of both salt water and fresh water wetlands. A series of dikes connect much of the property. The highland of the property is a mix of open farmland and lowcountry forest including many large Live Oak trees.

The community design is reflective of the historic city of Charleston, South Carolina, which lies 12 miles to the northeast. The high-density area of the village will include residential units above commercial, as well as the traditional Charleston Row house that is such a large part of the historic city. On the waterfront, a park and walkway atop a seawall will be created, patterned after Charleston's Battery Park. The railing along the top of the sea wall will extent inland along the edge of the golf course's eighteenth fairway, reminiscent of a similar feature found along the edge of the first and eighteenth holes at The Old Course in St. Andrews, Scotland.

As the course spreads outward from the town's center, the density of development paralleling the course will decrease, providing room for larger single family homes, to be built in a rural lowcountry style, often found in the area. The golf course's edges will provide corridors of travel from these homes to the town center. A path in the wooded edge of the golf hole creates a comfortable natural environment for people to travel from one point to another. By

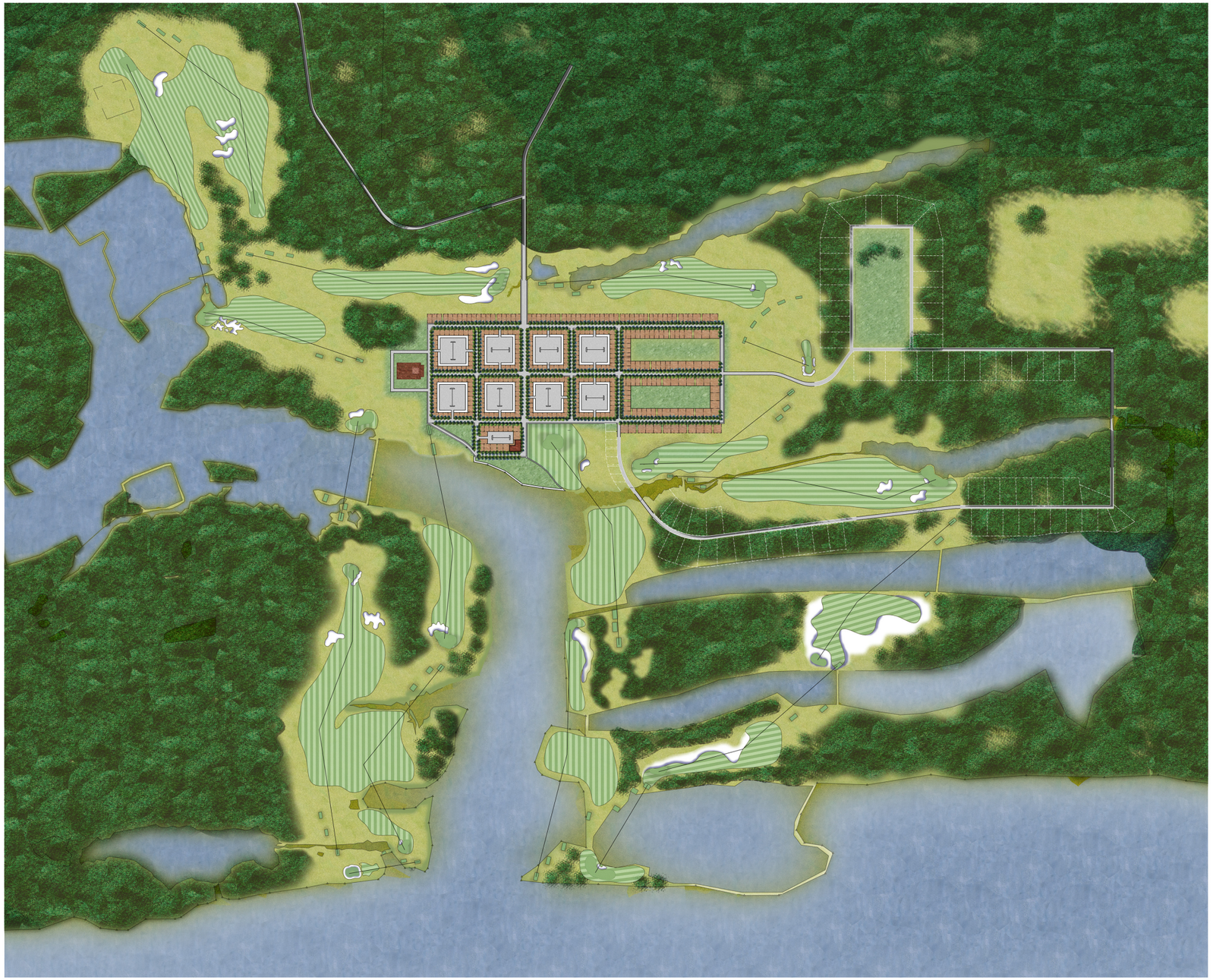
more closely linking the golf course to the community, the members of the community will gain a greater understanding of the game of golf and how they can safely interact with the golfers on the course.

The course itself will return to the town's center four times to create smaller loops of holes to provide opportunity for shorter rounds of golf to be played, late in the evening or early in the morning, for those with who often struggle to find the time to play golf. The short walks from green to tee and flat nature of the site make the course easy to walk.

The golf course is a study in sustainability, using the most suitable turfgrasses to the area, and maintaining low requirements for water use. Along the course's edges the use of coastal Bermuda grass, Bahaia grass, and other low maintenance grasses that may be native to the area there will eliminate the need to irrigate the roughs of the golf course. By grading the fairways such that the edges of the irrigated area all pitch inward, all irrigation water (not lost to evaporation) can be reclaimed in water catchments. The water can then be monitored for nutrient and chemical levels, and then reused on the course. The green complexes will be composed of native soil, a composition that has boasted well for Champion Bermudagrass. For this reason Champion Bermudagrass is the turf that will be used on the greens. In order to create a healthy stand of this turfgrass without the excessive use of fertilizers, watering, or other expense, the grass will be maintained at a mowing height of $^{3}/_{16}$", a height that should provide green speeds of approximately 10'. For this reason the greens will be built with pinable areas of 2.5% slope and transition areas as high as 7%. These slopes will create a greater perceived green speed than the 10' measurement and relieve the stress on the turfgrass, allowing it to grow longer, healthier roots.

The course will measure just over 7,000 yards from the back tee and have a par of 72. The decisions that are required for the tee shots provide opportunity for players to hit their drivers, but require somewhat greater accuracy for that choice to be beneficial. The landing areas are positioned in such a manner as to provide various lengths and shapes of shots into successive holes. The areas around the green complexes are to be maintained at mowing height similar to that of the fairway, providing players with many different options for playing a shot onto the green. The use of native soil to build the green complexes will maintain a level of consistency in the green surfaces and the adjacent areas so that the firmness of the approaches match that of the green, and a ball that hits in the approach will react similarly to that which hits on the green. The bunkers are designed to fit in with the hierarchy of risk and reward that is associated with each shot. The golfer who pursues the more rewarding line of play will be penalized at a level higher than those who chose a safer line of play and fail to reach the fairway. The dikes that are remnants of the rice plantation that once thrived on the property will be incorporated into the design of the golf holes, using them as connections, as well as topographic features to provide difficulty and interest in the course.

Overall, the Kiawah River Plantation should provide a fair test of golf for all levels of player, and create a greater level of interest each time the course is played. The integration with the village will make the course an element of the community that will bring a sense of pride and ownership similar to that of the town of St. Andrews. The similarities of the Kiawah River Plantation and the city of Charleston might also be reminiscent of the roots of golf in America, and the golf course that once existed at Harleston Green. The natural appearance of the Kiawah River Plantation, laid out within the framework of a village might act as a reminder of what might have been, and what is still possible to achieve in golf course architecture.

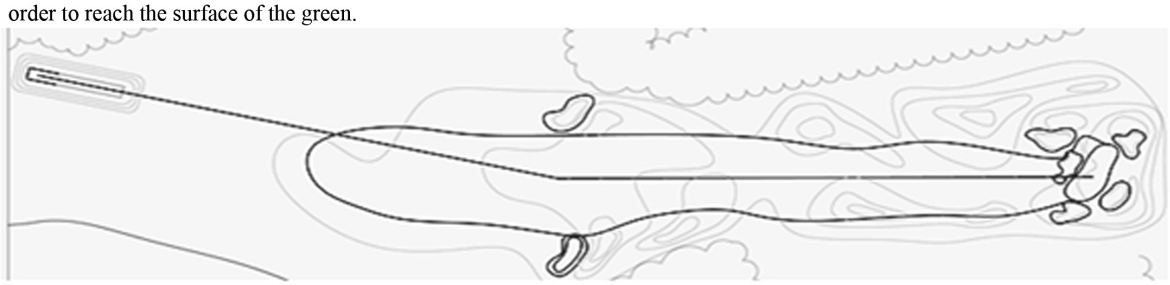


The Kiawah River Plantation Golf Course and Community **Figure 6.1**

1920 Design: Respecting the Treelines, very small amounts of earth are moved around the tee and green only. The cross bunker is pulled some thirty yards of the front of the green to allow players an opportunity to bounce the ball onto the green's surface.

1950 Design: Runway tees are introduced and grading around landing areas, tees and greens increases. The 404-yard hole is now 439 yards long and the bunkers are more closely placed to the green. The use of the treeline as a strategic element of the tee-shot is replaced with "aiming bunkers" to guide the player into the fairway.

1980 Design: The 439-yard hole is now 480 yards long. The entire golf hole is graded and mounds have been added to contain the golf hole, both visually and physically. The green is heavily bunkered on all sides, requiring an aerial attack in order to reach the surface of the green.



Today's Design: The hole remains 480 yards long and retains the existing treelines as a strategic element of the hole. The cross bunker is moved closer to the green due to the higher trajectory of shot that can be expected due to technology of today. Grading is limited to the green and tee complexes.

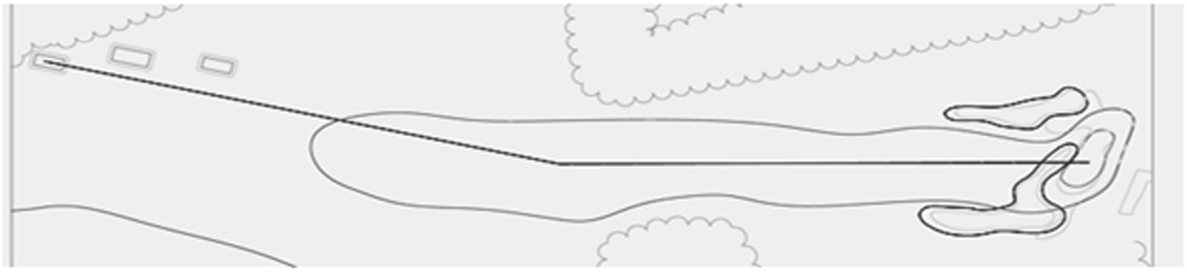
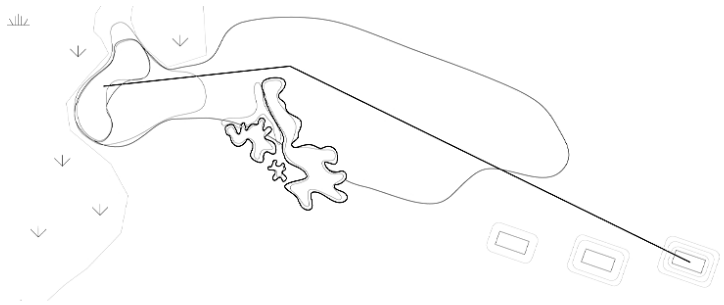
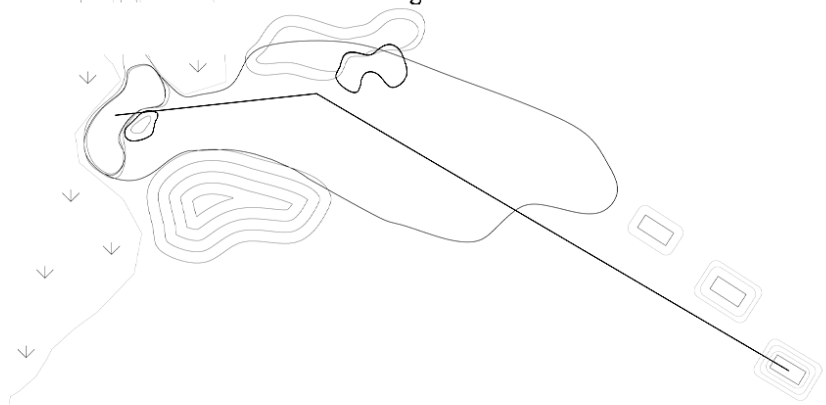


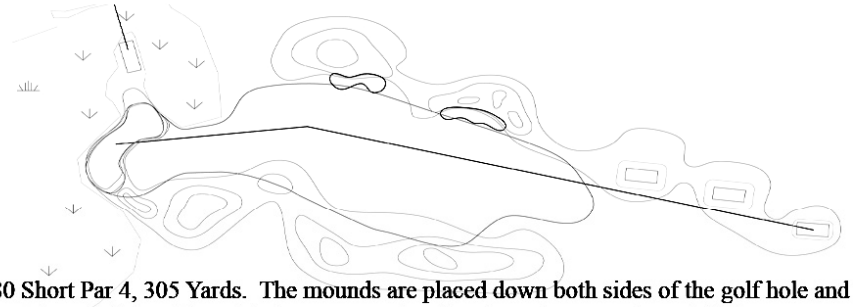
Figure 6.2 Long Par Four Design Through the Years



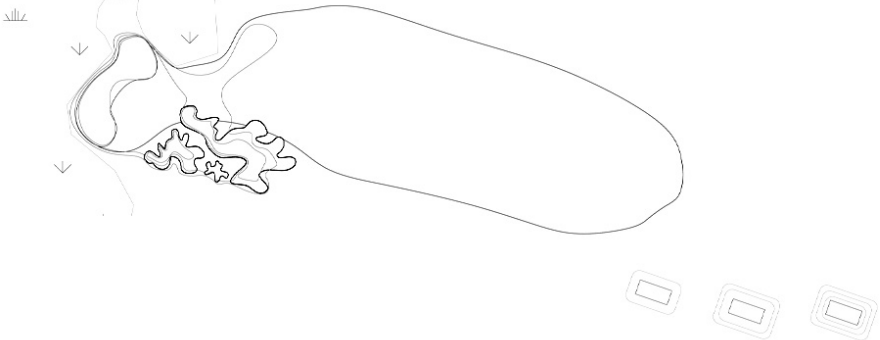
1920 Short Par 4, 285 Yards. The bunkers are pulled back and the back slope allows for the player who clears the bunker to roll the ball onto the green.



1950 Short Par 4, 305 Yards. The large mound on the left makes it difficult to see the green from the tee making it a more intimidating for the player who tries to reach the green in one. Also the central bunker at the green makes it difficult to play a running shot.

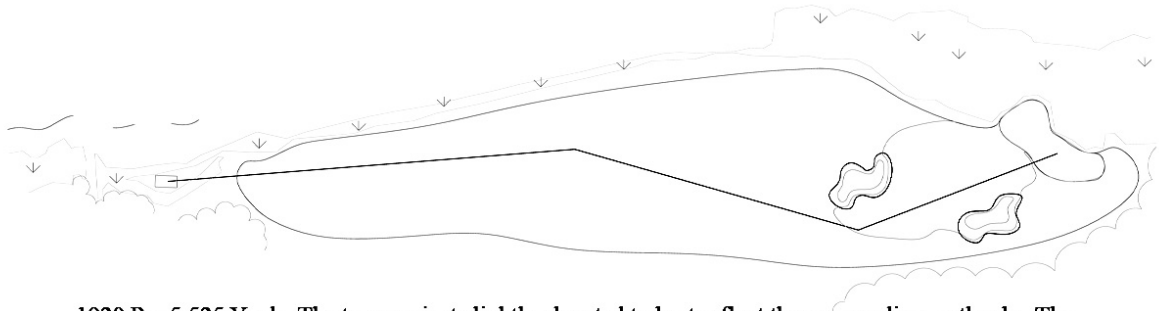


1980 Short Par 4, 305 Yards. The mounds are placed down both sides of the golf hole and the tees are placed in a straighter line with the green so that the player has complete visibility..

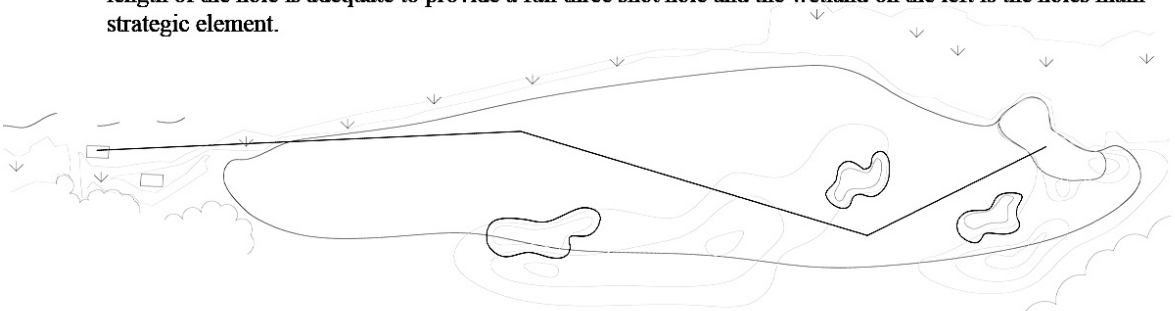


2005 Short Par 4, 335 Yards. The bunkers are moved closer to the green to provide an appropriate challenge for today's technology and grading is kept to a minimum.

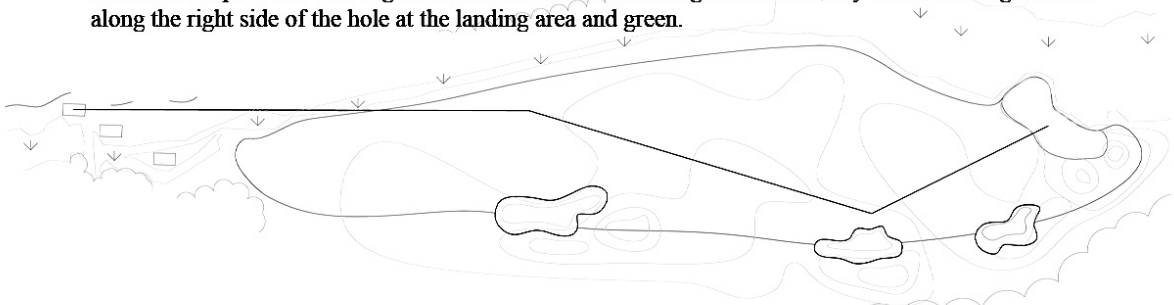
Figure 6.3 Short Par Four Design Through the Years



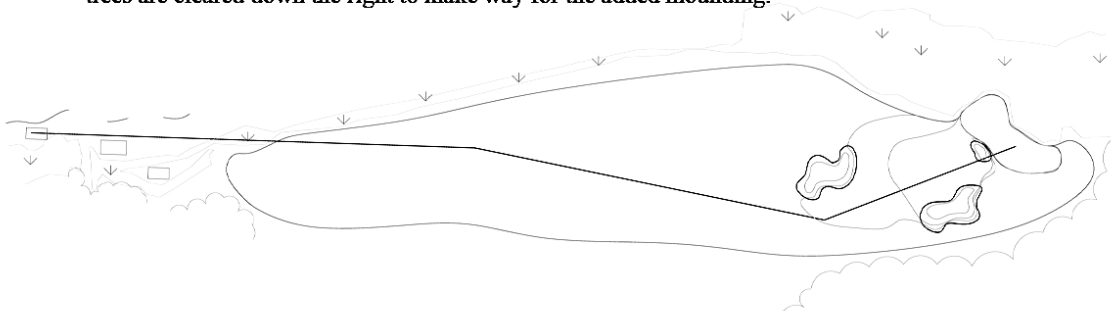
1920 Par 5 525 Yards. The tees are just slightly elevated to best reflect the surrounding wetlands. The length of the hole is adequate to provide a full three shot hole and the wetland on the left is the holes main strategic element.



1950 Par 5 545 Yards. The green is further elevated above the wetlands and bulkheaded along the left and back portions. An target bunker is added down the right of the fairway and mounding is added along the right side of the hole at the landing area and green.

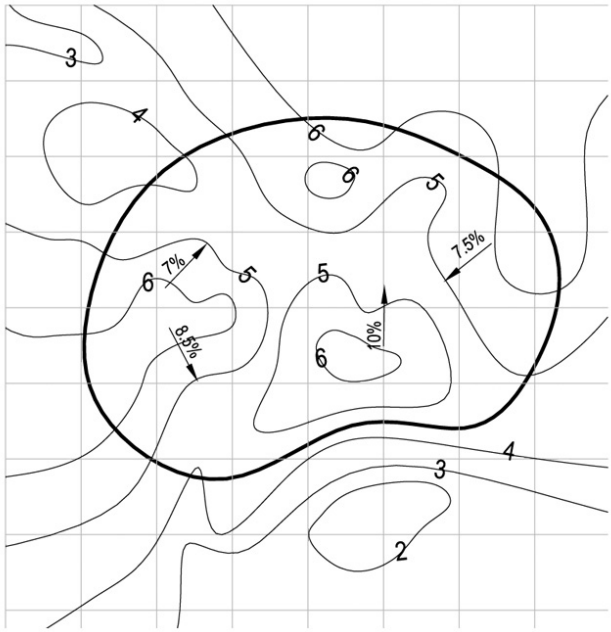


1980 Par 5 575 Yards. The central bunker is removed from the hole and mounding is added down the entire right side to frame the golf hole. The level of the fairway is raised further above the wetland and more trees are cleared down the right to make way for the added mounding.

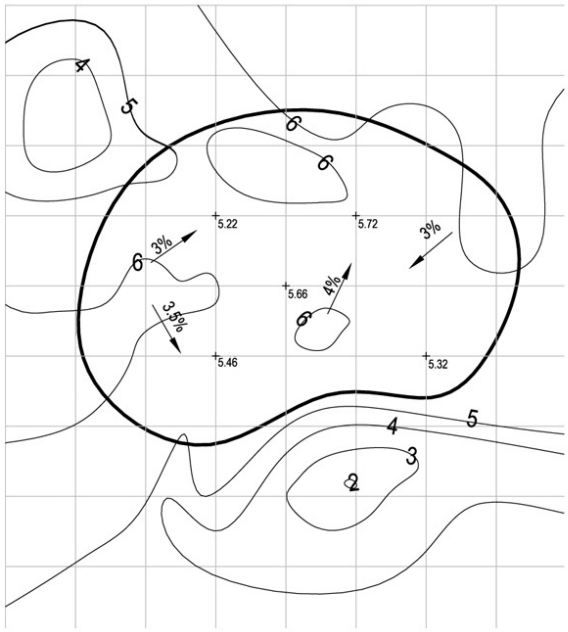


2005 Par 5 585 Yards. The tees are just slightly elevated to best reflect the surrounding wetlands. Grading is limited to the area of bunkers and the green. The strategic value of the wetland is seen on both the drive and the second shot as the central greenside bunker makes the player decide on a position left or right of the central fairway bunker.

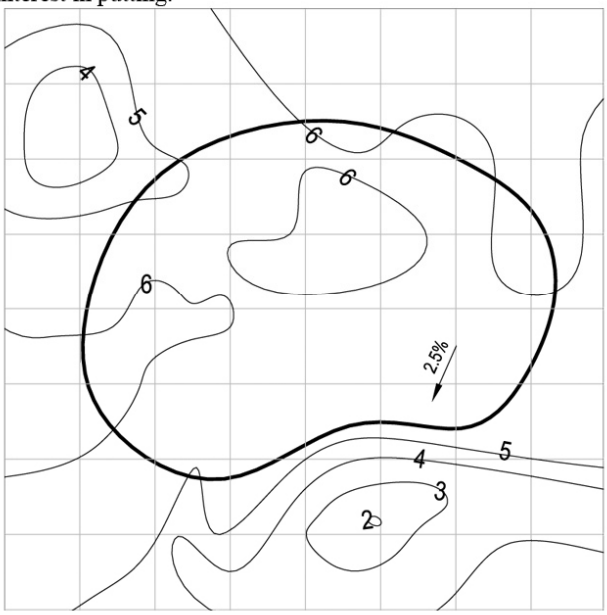
Figure 6.4 Par 5 Design Through the Years



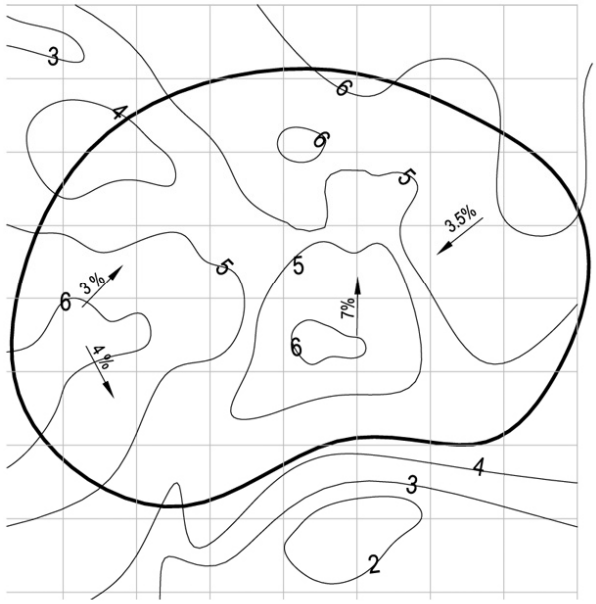
Typical Green Design 1920. Speed = 5.5'. The bold contours of this green provide a greater perceived green speed and add interest in putting.



Typical Green Design 1980. Speed = 10.5'. The pinable area is now limited to slopes less than 3 % and the greens are typically void of slopes greater than 7 %



Typical Green Design 2000. Speed = 14'. Contours are now typically less than 5 % due to the possibility of scalping at close mowing heights. Pinable area is restricted to areas of less than 2 % slope.



Typical Green Design 2005. Speed = 11'. Bold contouring is returned to the greens and the size of the green is increased to provide room for more severe transition areas between pinable areas. The more severe slopes create a greater perceived green speed thus relinquishing the need for mowing heights lower than one-eighth inch.

Figure 6.4 **Green Design Through the Years**

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