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Drainage

By EDWARD B. DEARIE, JR.

Read at the 5th Annual Educational Conference of the National Association of Greenkeepers of America, held at Columbus, Ohio, February 3-6.

FIFTEEN years ago the problem of drainage on any golf course was not seriously considered. Today no golf club would attempt to build a course without the services of a qualified drainage engineer to render a complete and definite set of plans of uniform drainage. Experience is the greatest teacher and nearly every club has had more or less of that.

The cost of inadequate drainage to the clubs of the country cannot be estimated due to the lack of knowledge of the fundamentals of drainage. Tile lines were inadequate and undersize with no definite outlets, usually discharged into stone wells or open ditches with no permanent outlets.

Tile drainage was mostly installed by golf course labor with no idea of drainage work, as to depth and grades of ditches, the amount of water to be taken off a given area and the trunk line sizes necessary. No general plan of drainage was adhered to usually required for a complete golf course system.

UNDERDRAINAGE REQUIRES ENGINEERING KNOWLEDGE

UNDERDRAINAGE requires not only a thorough knowledge of the principles of drainage engineering, but an extended practical experience in laying



EDWARD B. DEARIE, JR.

The author of this article is an acknowledged authority on golf course construction and maintenance. He is a greenkeeper who has branched out into wider fields and has had a wealth of practical experience.

out systems of drainage under varying conditions of different climates and soil conditions that demand a thorough knowledge of soil physics. The principles of land drainage must be clearly understood by those who are concerning themselves with the vast improvements in golf course perfection today.

The primary reason for complete and uniform drainage is the removal of storm water and excessive moisture in the ground as a result of spring thaws and rains, and, to prevent stagnation of the soil waters, which means to avoid the exhausting of O (oxygen) from the air in the soil water and in spaces not occupied by water. An abundance of free oxygen in the

soil is a fundamental necessity to turf growth. This is secured through drainage.

To germinate seeds we must have oxygen in the soil or they will rot. The roots of the plants must have it to enable them to do their work. And the vast army of soil bacteria which change the nitrogen of decaying organic matter into nitric acid which is the chief nitrogen supply for most higher plants, must have it or they cannot thrive.

Therefore the problem of acquiring and maintaining a good fairway playing surface at all times

during the season and especially the Spring, resolves itself to one thing—the removal of surface water or ground water or both.

The withdrawal of that water or part of such water that does not evaporate represents the problem of drainage. Therefore no attempt is made to enumerate the vast number of cultural principles and engineering problems involved in removing or conserving soil moisture for turf growth relative to golf courses due to varied climatic condition and the wide range of soils encountered in most drainage work through the country.

ALL LANDS REQUIRE DRAINAGE

IT MUST be kept in mind that all lands of whatever kind require drainage but it is extremely fortunate that for most lands this is done by natural methods of percolation and underflow of ground water.

The cases in which it becomes desirable to supplement the methods of natural drainage fall into four classes:

First: Those comparatively flat lands where surface waters from the surrounding higher land frequently collect.

Second: Areas bordering higher land whose structure is such as to permit the undertow of the ground water from adjacent regions to rise from beneath, thus keeping the soil too wet to play over.

Third: Lands regularly inundated by rise of tides or which would be if not shut off by dams or control means.

Fourth: Those extremely flat lands which are underlaid by considerable thickness of close, heavy clay or clay through which water does not readily percolate and which lies very close to the surface so that the clays become the sub-soil of the surface that is impossible for rain or water to penetrate.

Hence the problem of any golf course drainage is one of local conditions and the general condition existing, such as the laws governing the flow of water into the drains and ditches and how the surface of the water in the ground is related to that in the streams or lakes surrounding the property or which you continue to drain to.

An effort is made here to present in a broad, yet specific way the fundamental facts which underlie most drainage problems and the beneficial results usually obtained from proper drainage installation.

FACTS ABOUT DRAINAGE PROBLEMS

THE great demand for irrigation today is too well known. This no doubt will have a material effect on drainage. Thorough tile drainage reduces materially the amount of sprinkling water required to keep the turf in the best playing condition both as to the amount of water and frequency of application. This fact may most likely be doubted.

Drainage, by causing a physical change to occur in the natural undrained soil, actually increases the absorption and moisture holding capacity of all types of soils. Thorough tile drainage increases the content of capillary moisture in the soil to such an extent that this factor alone is of enough value to make it an asset to any club. Capillary moisture, the only form of soil moisture of value to plants, moves in all directions in soil, regardless of the force of gravity, but the rate of movement toward the surface is largely dependent upon the surface soil condition.

Drainage keeps the soil mellow and open: In puddled soils, that is, soils that have been compacted by heavy rolling when full of free soil water, the capillary moisture supply and replacement is reduced to a minimum, hence more watering or rain is required. Free soil water or gravitational water is absolutely detrimental and if saturation is maintained for more than a few days air starvation will result in killing the turf. Properly installed drainage produces and maintains the proper aeration of the soil.

Soil aeration is the benefit resulting from increased soil aeration which makes profitable tile drainage. Air and water cannot occupy the same space at the same time, hence when the soil is full of free water, air is entirely excluded. When the free soil water is removed by run-off through the drains fresh air is pulled into the pores of the soil. The rapidity and frequency of this ventilation of the soil is the most important factor in growing good turf.

There is a universal law in organic life, be it plant or animal life, that if it be maintained it must have the right kind and amount of food, air, moisture and warmth. If any of these are taken away there is lack of growth. Soil air, the element generally lacking in the combination that constitutes the

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vital forces in plant life, can be permanently and cheaply supplied by tile drainage.

Nitrogen and oxygen, so essential to soil fertility and plant life are the two principal constituents of air, totaling nearly 98% of the entire volume. Grass plants must get their oxygen through their roots as well as through their leaves. Grasses have no air circulatory system with which to pass air from the leaves down to the roots hence it follows that if the roots cannot get air from the soil they cannot get it at all. Heavy rolled, packed and puddled soils and soils saturated with free water can supply little or no air to the roots.

DRAINAGE SAVES MONEY ON FERTILIZING

FERTILIZING of all fairway areas that are uniformly drained shows about ninety-five per cent efficiency as against about sixty-five per cent on undrained fairways. This holds equally true with new seeding or reseeding of fairways due to improved soil temperature.

Drainage reduces the cost of putting the course in condition in the spring by preventing heaving of the fairway surfaces which results in winter kill and root destruction of the grasses, making constant reseeding necessary.

Drainage permits the use of all course equipment much earlier without damage to the turf. Drainage reduces erosion and washouts of trap bunkers and embankments. Properly installed drainage in traps and pits is of vital importance. Tons of sand are wasted yearly on poorly installed drain lines in traps and pits.

To install uniform drainage throughout from tee to green requires the services of a qualified drainage engineer to prepare plans covering the entire course area with a supplementary radius survey indicating or locating a definite and permanent outlet. The survey is usually taken in two hundred foot squares, co-ordinated alphabetically, the contour lines to be shown in two or five-foot intervals.

A topography map is indispensable in laying out a complete drainage system, and no club should attempt the planning of a system otherwise. Equally important is it necessary to have a soil plat showing the general geological formations to determine the sizes, depth, and spacings of the tile lines. This in-

formation is the basis of arriving at the cost of a complete drainage installation.

Uniform drainage will lengthen the playing season of any golf course on an average of 35-50 days in a year, permitting play shortly after a heavy rainfall, whereas, undrained courses present a picture of lakes and pools all over the landscape and create an irritated membership who leave the course in disgust. Therefore drainage is the foundation of any course and the course without properly installed tile drainage can never be conditioned for championship play except at a great cost of upkeep and expense.

In conclusion of this article permit me to say that the purpose of drainage relative to golf courses is more than the mere idea of running a line of tile from one sand trap to the other or from one low spot to the other without any definite plan of outlet or understanding of functional principals of drainage. One must have an understanding of the various ramifications, and problems encountered by the elements of nature and man's attempt to control them.



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GREENKEEPING— TODAY *and* TOMORROW

By PROFESSOR LAWRENCE S. DICKINSON

Assistant Professor of Horticulture, Massachusetts State College;
Professor in charge of Greenkeepers' School, Massachusetts State
College; Honorary Member of the National Association of Greenkeepers
of America.

CHAPTER V—THE INFLUENCE OF LABOR-SAVING MACHINERY ON GOLF COURSE MAINTENANCE

GOLF clubs throughout the United States are reducing, or have already reduced, the course maintenance budget. Some reductions have been made because of real necessity, some because of believed necessity, many because other clubs have done so, and some because of the belief that better management will be the result.

Whatever the cause is, the fact remains that the budgets have been reduced and the Green chairmen and greenkeepers are faced with the problem of redistribution of the budget.

Undoubtedly the quickest and surest way to meet the reduced budget is to employ fewer laborers, and use labor-saving machinery, for labor is usually thought to make up a large proportion of the golf course maintenance budget.

A consideration of what labor-saving machinery has done for golf maintenance in the past is extremely important at this cost-cutting period of golf course maintenance. Without doubt the greatest labor-saving machinery has been mowing equipment, and its influence on golf course maintenance has been very marked, and I believe in many cases misunderstood.

GOLFERS DEMAND BETTER PLAYING CONDITIONS

THE modern mowing equipment has made possible the playing quality of the tees, fairways, rough, and greens. Such playing conditions are so good, and expected, that none will tolerate a reversion to the old greens and fairways. The "labor-saving" machinery has influenced the golfers'

demand for better playing conditions by making such conditions possible. Has golf course labor really been reduced by the use of such equipment?

Twenty years ago, one shepherd tending his flock of sheep, or in some instances the sheep alone, mowed the fairways at a very low cost, or no cost at all to the golf club. Today one mechanic (?) tending a tractor which hauls three, five or seven cutting units, mows the fairways. During the growing season; when the fairway watering system is liberally throwing water, and the fertilizer spreaders are distributing their stimulants (in some cases "hooch" to the grass) these modern fairway mowers work continuously throughout the week. Are labor requirements reduced by their use? No!

Thirty years ago putting greens were mowed by hand-pushed machines cutting approximately the same width of swath as the modern machine. Those machines were operated by men who walked just as fast (probably faster) than the modern greensman. Has "labor-saving" machinery really reduced the labor payroll? No! The influence has been to increase the labor payroll to maintain the playing conditions made possible by the use of modern machinery, and more labor hours are required.

This fact applies to all golf course machinery. Believe it or not, but be sure to answer this question. How many golf courses are being maintained today with fewer laborers than they had in 1911?

The greatest influencing factor in the increased labor payroll is "labor-saving" machinery.

Today, executive committees and Green committee chairmen are listening with an attentive ear, and in a receptive frame of mind to any salesman having a labor-saving device to sell, and the magic phrase—"this piece of equipment represents a saving of so many hours of labor"—leaves nothing but the signature on the dotted line to close the sale. Green chairmen, before signing the order, think what experience has taught, and carefully weigh and evaluate all other factors involved. Labor-saving machinery is valuable to golf course maintenance if properly used and managed, but it can be the direct influence that will cause great expense if its influence is not fully understood.

LABOR-SAVING MACHINERY MUST PRODUCE RESULTS

LABOR-SAVING machinery must produce results equally as good or of better quality, at a lower labor-hour cost and a lower total cost of any unit, to be worthy of consideration. On golf courses, as any place where plant life is a factor the results must also guarantee no ill effect upon the turf that will be cumulative.

Labor-saving machinery and devices have been made for routine work only. This is quite natural and right, because an obvious and definite saving of labor can be made in this type of work. However!—the devices have caused routine work to become still more routine or mechanical.

Golf course maintenance can be divided into routine work, new construction, alterations, and turf nursing or puttering. Other divisions can be made to suit the individual club, but whatever they are, routine work and puttering or nursing are the two most important operations.

Routine operations on most golf courses represent the bare necessities of golf course maintenance. Whether the management is good or bad, they consume an almost uniform number of labor hours each week or day. Routine work seldom considers its influence on the turf next week, next month, or next year. Today is all important.

The present *very dangerous* influence that labor-saving machinery has on golf course maintenance is not due to the machinery itself, but to shortsighted management. This dangerous influence

is the cutting of labor hours to carry on routine work only. "If we can reduce labor-hour requirement on this or that job", says the manager, "we can save money."

If the influence of the labor-saving machinery is not great enough to cause a reduction of labor to a routine minimum it is influencing a reduction to such a low point that turf nursing is absolutely out of the question, and new construction and alterations reduced to far below the longed-for changes. Note, I said reduced for the new construction and alterations. No matter how small the budget is, a Green chairman would not consider his job properly done if some changes were not made.

BEWARE OF TOO MUCH LABOR SAVING

THE influence of labor-saving machinery will mean one of two results. Golf course labor will be reduced to such a point that all labor will be operating labor-saving machinery doing routine jobs! No labor will be available to nurse the sick green, to do the many individually small jobs that make the golf course enjoyable. An emergency will be a calamity and small repair jobs become rebuilding operations.

Such an influence of labor-saving machinery is being fostered on many golf courses this year. The result will be very costly in money, prestige, members and turf. Such an influence is not intended by the manufacturers of labor-saving machinery, and the better type of salesmen warn against such an influence.

On the other hand, labor-saving machinery can influence a course to better conditions at lower labor-hours cost. If a portion only of the labor hours saved by any device is stricken from the payroll, and the remaining hours released, are applied, first to turf nursing and puttering, and then to alterations and construction, then real benefit can be derived from the use of labor-saving machinery. The hours released are turned into a profit, and under such management the influence is for the good.

Labor-saving machinery divides the greenkeepers' force into two groups. One, mechanics, so-called or actual, and two "lowly laborers." This is a very great influence that the greenkeeper must correct. The "mechanics" look down on the