

## Golf Course Construction

By Kenneth Welton

Golf course construction is often regarded as merely that process of taking soil from one place and piling it in another in such a manner that when it is finally smoothed out it will conform with the more or less definite plans of the course architect. Unfortunately, in many cases this is all that actually happens in construction work. Good golf course construction should be more than molding of earth into prescribed forms as specified by an architect. After the course takes form it must be covered with turf, and this turf must be maintained under the trying conditions of every-day play. In construction work every effort should therefore be made not only to provide the course with a thick covering of turf, but to make every possible provision for the welfare of that turf in the years to come.

### THE AIMS OF GOOD CONSTRUCTION

It must be remembered that the grass in turf on golf courses is often growing under extremely unnatural conditions. When any living thing is grown under unnatural conditions it is necessary to make allowances in the way of providing as nearly favorable environments as circumstances will permit, else difficulties will soon arise.

Grass, like animals, requires food, air, and water. Unlike animals, plants are unable to move about to alter their environment, and the necessities for existence must therefore be provided where plants are placed. It is not sufficient to provide only one or two of the requirements, for if one is absent all others are of no avail. One frequently finds men struggling to keep turf alive by means of heavy applications of chemicals to provide food. They soon find that such applications are useless if, due to saturation of the soil, all air is excluded from the roots.

Food and water can be applied in proper amounts any time after the turf is established. On the other hand, it is a difficult and costly undertaking to provide for the removal of excess water and the aeration of the soil any time after the course is built. Soil conditions should be made as nearly perfect as possible before any seed is planted. To accomplish this it is necessary to understand some of the fundamental principles involved in soil structure and plant growth. In this discussion we can merely mention some of these elementary principles.

Soil, for convenience, is classified according to the fineness of its particles, ranging from the fine particles of clay to the coarse particles of sand or gravel. Also, soil contains decaying vegetable or animal material, which is commonly referred to as humus. There are also present in varying amounts a great variety of chemicals in the form of salts, alkalies, and acids. These chemicals furnish food for the plants. Soil also contains countless numbers of bacteria and other microscopic animal as well as plant life. These organisms as a rule are beneficial in breaking down dead organic material and in making plant foods available. Thus some of the organisms found in manure help to decompose it and improve the soil wherever it is applied. Other microscopic organisms may be harmful and cause

injuries to plant life. The ideal soil for plant growth is one containing the proper balance of all of the above ingredients, giving it a crumbly structure with plenty of air spaces between the particles of soil. There must also be the right amount of water present in the soil to make this ideal soil effective in turf production.

A well-drained soil will warm up more quickly in the spring and hence induce earlier germination of seed or growth of grass than a poorly drained soil, and the growth will continue later in the fall. Roughly speaking, it takes five times as much heat to raise a volume of water one degree than an equal amount of air-dry soil.

Soil water is of three kinds,—gravitational, capillary, and hygroscopic. When heavy rain or excessive irrigation soaks the soil the spaces between the particles of soil are filled with water and the air is driven from the soil. If there is adequate provision for drainage this extra water runs out of the soil due to the pull of gravity and is referred to as gravitational water. After the excess water has drained away, there still remains a film of water surrounding each particle of soil. This is known as capillary water, and it is this water from which plants draw their supply under favorable conditions. When soil is dried in the air it still retains a certain amount of moisture, which is known as hygroscopic water. This latter is not available for use of plants and is therefore not to be considered here. Peat, for instance, may have a high percentage of hygroscopic water which, although not available to the plants, is often referred to in a misleading way in recommendation of peat, based on its so-called high water-holding capacity.

The main source from which plants and soil organisms derive their supply of moisture is capillary water. It is in the capillary water that most of the plant foods derived from the soil are held in solution. It is the presence of capillary water which provides also for the circulation of air in the soil, the water simply surrounding the soil particles as a thin sheet, continuous when the particles are close together, but allowing for air spaces when the soil is more open. Oxygen in the soil is necessary for the roots, since there is an exchange of gases in plants similar in some respect to breathing in animals. Air also aids the beneficial organisms in their normal development in the soil. When the pore space in loam or clay soils is filled with water, as it is when gravitational or surface water is present, the capillary water which held the soil in crumbs is dispelled, with the result that the soil particles fall apart. No matter how mellow the soil may be, the soil particles or crumbs at once begin to puddle or pack. The longer the saturated condition exists, the more compact the soil becomes.

Gravitational water seeps down around the soil particles in an open soil, carrying away with it injurious salts as well as toxic materials developed from root decay or the decay of other organic matter. It also fills up the pore spaces in the soil and thus displaces the air; but as nature abhors a vacuum, fresh air naturally enters the soil again as the free water descends. The gravitational water replenishes the capillary water around each soil particle, and the fresh oxygen supply assists in making fresh plant food available.

It would naturally be inferred that water which will carry away harmful salts will also carry away soluble salts which are of value.

Doubtless much of the readily soluble fertilizing material used today is lost in this manner if applied in excessive amounts, or if the soil is too open in texture, such as very sandy soil. If, however, the soil structure is right, the plant roots quickly absorb much of these soluble fertilizing elements, and a great deal of the soluble plant food remains also in the capillary water. The general tendency of capillarity is to bring water to the surface from varying depths, the flow being always from soil where the water films are relatively thick towards soil in which the films are thinner. This action is comparable to that when a piece of blotting paper is dipped in ink. Hence as the top soil becomes dry, the soluble salts are brought into contact with the plant roots by being drawn to the surface in the capillary water. In this way the plant roots are able to select such soluble materials as they require as long as the materials are present; but the roots may reject to a certain extent injurious salts. In well-drained soils both injurious and needful salts are finally washed or drained away beyond the power of the capillary attraction to bring them to the roots. Everything considered, soils should therefore not be allowed to remain saturated with water too long, and if the soil can not get rid of surplus water by natural drainage, ditches or lines of tile should be provided to carry it off.

#### EQUIPMENT

Often in golf course construction it is not realized until too late how much more economical it would be to purchase or hire adequate equipment for the work. As an example, it may not be realized until the job is half over that a team and wagon might have been bought



Snatch team loading a wheel scraper.

and paid for had they, rather than a wheelbarrow, been used from the start. In other cases it would be far greater economy to employ tractors than horses, and in still other cases the greatest economy would be in the use of still heavier machinery, such as steam shovels.

It is important to decide at the outset just what machinery can be used to advantage. Man power, horse power, or machine power are all used more or less on golf course work. Man power on golf work is the most expensive, even as it is in most construction, farming, or manufacturing operations. A good many details of golf course