

Airport Turf Building and Maintenance

No. 1 General

Airport runway turf building and maintenance becomes an increasingly important problem as civil aviation expands in these post war years. New aircraft designs, particularly those of the tricycle or nose wheel type, together with cleaner and faster civilian aircraft, require, both in the interest of safety and utility, that the runway turf on the small airport be both well built and well maintained. The federal airport act and the state airport program make possible the development and improvement of a substantial number of turf airports in the smaller communities. A well built and well maintained turf runway will repay the municipality in the form of greater utility and greater attractiveness to the transient airman, and repay the local aircraft owner and operator by eliminating costly ground accidents and reducing wear and tear on the small aircraft.

Even with state and federal aid, the average small municipality will not find the money to build hard surfaced runways nor will the volume of traffic in the next few years require or justify the installation of such runways except in rare instances. The well built and well maintained turf runway is not just a substitute on such airports but a very practical solution to the runway problem. It is, however, essential that these runways be safe, usable, and attractive. If this is to be accomplished, an understanding of the problems of design, construction, and maintenance of turf runways is imperative.

For the purpose of a better approach to the problem, it is assumed in the first seven divisions of this bulletin the municipality or airport has adequate funds to carry out a thorough program. Division No. 8 goes into the problem of communities who do not have enough money to develop the proper airport in one or two seasons and must rely on a gradual growth of traffic and the resulting funds available over a period of years.

No. 2 Seed Bed Preparation

In planning an airport, careful attention must first be paid to drainage. Proper drainage must be established before grading or filling can be started. After proper drainage has been developed, it is further wise to take samples of the soil to estimate its fertility as well as the top soil that will have to be hauled in. Soil may be analyzed for fertility to determine desired fertilizer treatment.

Grasses need plant food and more airport turf is probably in poor condition from the lack of fertilizer than from any other cause. The best time to apply fertilizer in this area is in the fall, because it insures good growth late in the season and also insures a vigorous growth in the spring. If fertilizer can not be applied in the fall, it should be used as early in the spring as possible. Fertilizer of a fairly high nitrogen content for fall application should be applied at 300 to 500 lbs per acre. Spring applications can be made at the same rate. Fertilizer should be applied from time to time once the turf has been established, in order to insure its continued good growth. In the past, seedings have been made using as high as 100 to 110 pounds of seed per acre. This amount could be reduced sharply and better results obtained by using the savings from the cost of the seed in applying fertilizer. Fortunately, in Minnesota and surrounding states, Kentucky blue grass will develop naturally in turf if it has proper care, even without the sowing of substantial amounts of seed. This is extremely important when Kentucky blue grass seed is very high priced.

As a general rule, the following steps should be carefully taken in order to establish the proper seed bed:

(a) DRAINAGE. Assuming the airport has already been graded and the drainage has been established, again check to see that the landing strips have been properly crowned and proper drainage has been established through soil tile, ditches, etc. If shallow ditches are used throughout the airport, they should be sodded immediately in order to eliminate erosion.

(b) A FIRM SEEDBED. A good seedbed is essential for obtaining good stands. Small seedings are unable to survive on dry, cloddy, loose soil. Go over the entire area with a disc or spring-tooth harrow. A disc is preferable, as it tends to pack the soil more than the spring-tooth harrow. Rework the ground until a mellow, firm seedbed is attained. When that has been done, if fertilizer is to be added, work it into the soil by further discing; and, when the fertilizer has been thoroughly worked into the soil, cross-drag it lightly in order to get a smooth, level surface. Fertilizer should be applied using a commercial spreader by an individual who has had considerable experience applying fertilizers to be sure that it is distributed evenly throughout the entire field. This is a very important procedure since, if the fertilizer is spread heavily in one area, it will burn the seedings and, if it is not heavy enough in other areas, of course, proper growth will not result.

In Western and Southern Minnesota where top soil is a heavy clay loam, the top soil shall be processed for seeding only when the moisture content is low enough so that the soil will not puddle, and can be granulated uniformly. A rotary tiller is recommended for use in preparing the seedbed. In no case shall the disc or rotary tiller disturb the subgrade during preparation of the seedbed.

No. 3 Seeding

Various types of seed used in seeding down an airport vary considerably as to size; Red Top, for example, being roughly 3/16 of an inch in length, with a diameter almost too small to measure for commercial purposes. Whereas Brome is, roughly, the size of an oat kernel. For this reason Bromegrass, when used in the mixture should be seeded separately from the small-seeded grasses and the small-seeded grasses should be thoroughly mixed in the proper proportion before seeding. BROADCAST the seed, using a seeder having a good agitator to insure the seed staying mixed during the process of seeding. Be sure an experienced individual is employed in seeding the airport, since too many fields as well as airports have shown excessively heavy seeding at the beginning of the strip with little or practically no seeding at the end of the strip. Proper seeding is one of the important individual functions in developing a good airport, since any amount of money can be spent on grading, fertilizing and preparation of the seedbed; but, if the seed isn't distributed thoroughly and evenly, an uneven turf will result. Be sure to measure the length and width of each strip to be seeded so you will know the number of square feet to be covered with each strip; then the amount of seed can be determined arithmetically. Guessing or estimating is a sure way of ending up with a poor job. It may be well at this time to point out again a BROADCAST seeder is recommended. DO NOT attempt to drill the seed into the soil. It is impossible to maintain an even depth with the average commercial drill, which will result in seed being sown too deeply, with the resulting difficulties.

For the final operation use a packer to compact the soil and to imbed the seed into the soil at a depth of about one quarter inch. If a careful job is done, it will not be necessary to cross-pack, one direction being sufficient and considered generally better, since the small furrows resulting from proper packing will hold moisture. If the seedbed has been properly prepared and packed, it is conceivable a small plane could land on the runway even before the seed has begun to grow, without injury to the runway or loss of seed. Of course, it is assumed, in landing a light plane or driving across the field with

an automobile, the field is perfectly dry. Serious damage to the new seeding could result by driving over it when the soil is wet.

Final finishing of the landing strip are as shall be accomplished by the use of a multi-wheeled pneumatic tired roller or other equipment as approved by the engineer. It is very essential that the final finish of the landing strips be smooth and even so as not to affect the airplane landing or taking off and to provide positive drainage so as to prevent surface moisture from percolating down through top soil and into subgrade.

The landing strip area shall be watered after seeding if it is determined that the top soil is too dry to promote seed growth.

No. 4 Time of Seeding

Mr. L. E. Longley of the University of Minnesota Agricultural Experiment Station has conducted experiments regarding the date and rate of seeding and published the results of his findings in his Bulletin No. 355, dated June, 1941. In his experiments, Mr. Longley learned that, contrary to general opinion, late fall seeding is not desirable. Generally speaking, for the northern half of Minnesota the latest fall seeding should be around the first of September and for the Southern half of the state the deadline is September 15.

Seed can be sowed anytime from early spring, as soon as it is possible to get the ground in condition, until September, as indicated above. Seedings in June, July and August have developed very well; however, early fall seedings are preferable to summer seedings, as less moisture is needed during cool fall weather. July and August seedings will show good growth if the above instructions are followed carefully and a little water is available should the month be very dry or the soil too dry when seeding is completed. Since most airports are community projects, there should be no difficulty in obtaining the use of municipal equipment to apply a small amount of water, if necessary. Rather, the greatest problem in July and August are the sudden heavy downpours or local showers, which tend to wash the soil out before the grass is far enough along to establish a good root system. As outlined above, the possibility of erosion can be reduced to a minimum by use of a double packer and sodding shallow ditches.

No. 5 Types of Grasses

Many of the airports in Minnesota and adjoining states have shown evidences of substantial planting of legumes in the runways and taxi strips. Legumes, of course, are nice for putting nitrogen into the soil; but they are not good for turf development because of the ease in which they are damaged. Proper turf can be developed in relatively short time by using approximately thirty to forty pounds of seed per acre. The ultimate objective in seeding airports is to develop a runway with a turf of one color and the outfields a turf of another color. Experiments are being conducted along this line and another bulletin will be issued later when the results of these experiments have been determined. Red Top, Rye Grass, Meadow Fescue, Brome Grass, and Crested Wheat Grass, plus a small percentage of Kentucky blue grass, can be used to good advantage.

At the time of sowing, if the soil is light and weather dry and soil drifting is a possibility, from a half to three-quarters bushel of spring or fall grain can be used to hold the soil until the grasses have had an opportunity to take hold; however the grain should be moved off as soon as it is about twelve inches high or at the hay stage, so that it will not compete too heavily with the grasses.

KENTUCKY BLUE GRASS, the grass most common in lawns and permanent pastures in Minnesota, is very aggressive and forms a tough sod. It will stand frequent close clipping and, if given proper care, will eventually become the predominating grass in the entire airport.

RED TOP is a small-bladed grass which spreads rapidly by means of underground stems and grows to a maximum height under normal conditions of 20 to 24 inches. It too will stand frequent close clippings.

RYE GRASS establishes quick growth but lacks winter hardiness. Its only useful purpose, therefore, is to hold the soil while the slower growing grasses are becoming established; consequently, there is no point in using it in spring-seeded mixtures where a small grain is included to hold the soil or in fall-seeded mixtures.

BROME GRASS is a long-lived, sod-forming perennial. It thrives under a wide range of conditions and is fairly drought resistant. The Canadian grown seed of brome grass is satisfactory for Minnesota.

MEADOW FESCUE is a perennial sod-forming grass, but which is not entirely winter hardy in all parts of Minnesota. It has been found to be well adapted in northwestern Minnesota. It has good seedling vigor and is easy to establish.

CHEWINGS FESCUE is a winter hardy perennial grass frequently used on lawns in shady places. It is dark green in color, low growing and produces a bunch type growth.

CRESTED WHEAT GRASS is a long lived, drought resistant perennial best adapted for the western part of Minnesota. The leaf blades are narrow and blue-green in color. The Fairway strain has been found to be most desirable for Minnesota.

TIMOTHY is generally considered a relatively short lived perennial when compared to such grasses as Kentucky blue grass and brome grass. Under humid conditions, such as exist in eastern Minnesota, it produces a good sod. Seed of timothy is usually pure and cheap.

No. 6 Mixtures

The type of mixtures used will vary in different parts of the State due to climate, soil and rainfall, so any mixtures suggested below are for general guidance only. It is essential that only adapted grasses be used in the mixtures. Seed is expensive and, if the proper mixture isn't used, it will result in the loss of approximately \$15.00 to \$16.00 per acre in the cost of seed, plus labor in preparing the seed bed and cost of fertilizer. However, suggested mixtures and pounds per acre apply in the various areas are generally as follows:

Northwestern, West Central and South Western Minnesota:

- 6# Kentucky bluegrass
- 6# Red Top
- 10# Brome grass
- 6# Meadow Fescue
- 6# Crested Wheat Grass

All of Eastern and Central Minnesota:

6# Kentucky bluegrass

6# Red Top

10# Brome Grass

6# Timothy

IN ADDITION TO ABOVE MIXTURES, USE 10 LBS. OF RYE GRASS OR $\frac{3}{4}$ TO 1 BUSHEL OF SMALL GRAIN AS A COMPANION CROP DEPENDING ON THE DATE OF SEEDING WHETHER FALL OR SPRING.

NOTE 1. Where close, frequent clipping is to be practiced, the rates for Kentucky bluegrass and Red Top may be increased and some Chewings Fescue added and the other grasses decreased. Where no close, frequent clipping is to be practiced, the rates of Kentucky bluegrass and Red Top may be decreased.

NOTE 2. On sandy land, the brome grass should be increased and the other constituents decreased.

The above mixtures are figured on a per acre basis and should cost not more than \$15.00 to \$16.00 per acre, maximum, depending upon the type of mixture. Generally speaking, cost per acre, which covers the seed, commercial fertilizer, preparation of seedbed and seeding operation, should not cost over \$40.00 to \$45.00 per acre.

No. 7 Maintenance

There is considerable difference of opinion regarding the number of times an airport should be mowed. Too many airports visited during the spring, summer and fall have shown no evidence whatsoever of mowing or, if mowed, of mowing after it was too late. Quite often a deal has been made with a farmer to mow the field without cost for the hay he is able to take from the field. This is good for the farmer; but frequently costly to the airport owner. Mowing should be often enough to maintain a turf at from three to five inches in height, which of course, may vary somewhat, depending upon climates. In warm, humid areas turf can be clipped closer; and in dry, arid regions, a higher cut is more desirable. Runways should be mowed frequently and, since most communities have golf courses, it should be no great problem to use their power mower in maintaining a closely cut turf. Then, in extended periods of drought, water the runways is very desirable. In any case, it must be realized that both traffic and non-traffic areas must be kept cut at regular intervals in order to maintain a proper turf. Everyone has noticed beautiful pastures driving through the country during the summer months which cattle or sheep have been grazing very closely. The turf is generally practically all Bluegrass and of smooth, even texture. This is because it is kept so closely cropped that the weeds and other coarse grasses do not have a chance to develop.

In our opinion, too much emphasis has been made in the past to heavy original seedings and not enough attention paid to proper fertilization and maintenance once the turf has been started. During the War, the Army was able to produce a usable turf on its runways in sixty days by combining all factors of heavy seeding, proper fertilization and maintenance. However, time is no longer as important a factor and substantial amounts of money can be saved by reducing the amount of seed sown, using only adapted grasses and analyzing the soil for proper fertilizer application before the seed is planted.

Generally, fertilization, mowing and watering will comprise about 90% of the maintenance cost of the airport.

(a) FERTILIZING. It is not enough to fertilize the field only when the seedbed is prepared. Fertilization must be continued from time to time as required, the amounts applied being dependant upon the fertility of the soil and the standards under which the airport is maintained. Most of the experimental work done with lawn or turf fertilizer at the Minnesota Experiment Station does not indicate the need of much phosphate or potash. For this reason the fertilizer used should be high in nitrogen content. A good fertilizer is one having a formula of approximately 10-8-6; that is, 10% nitrogen, 8% phosphoric acid and 6% potash. Other formulas, such as 8-8-6 and 5-10-5 are also good. Of course, the lower the nitrogen percentage the more fertilizer that must be used. When using any kind of commercial fertilizer it is always desirable to apply just before rain is expected or during rainy weather, to prevent burning.

(b) CLIPPING. Keep runways clipped to about 2 ½ inches; the outfields to 4 inches. Cut as necessary, leaving the outfields longer for protection, to discourage landing elsewhere than the runways. For communities having a golf course or extensive park systems the municipal gang lawn mowers may be used. For the outfields, a good farm type mower is very satisfactory. At this point it would be well to note that keeping the outfield and runways properly clipped is of prime importance, since too great growth is injurious to the turf and tends to shade or crowd the smaller grasses.

(c) WATERING. Watering is very important during prolonged dry periods and should be applied generously, particularly on the runways. It is amazing how far a nice, green, healthy runway can be spotted from the air and how attractive it can be to visiting pilots.

No. 8 Developing Small Airports

This section is devoted to the discussion of problems of the smaller communities who find it necessary to develop their airports over a period of years. Many of the smaller communities want and need airports but, obviously, lack the funds to develop the entire tract available and must necessarily develop it gradually over a period of years. On this basis is one or perhaps two runways should be developed, as outlined above, the balance of the tract can be put into meadow crops or grain. Certain areas of the State, particularly the northern half, are extremely suitable for growing Legumes for seed. There is always a ready market for this type of seed and it is possible for the airport to get enough revenue from its outfield to pay the entire cost of running the airport year after year. The airfield at Thief River Falls, Minnesota, comprises a tract of approximately 375 acres (1/2 section). A year ago this municipality produced enough grain at this airport to pay for the cost of administration, salaries, etc., with enough left over to erect a small hangar and enough improvements to permit licensing by the State. Revenue from the crops amounted to roughly \$5,000.00. For further information regarding this write E.J. Barzen at Thief River Falls. During times such as these, when the price of flax, for example, is very high, the outfields can be seeded into flax with the usual good results. Red Clover, Alfalfa, Alsike and White Dutch Clover are other seeds that can be produced to advantage in certain areas of the State. Lower growing types of grains such as Flax, Oats and Barely are desirable. In addition to providing a source of revenue, this helps prepare the ground for the eventful turf that is necessary. Airports tin the northern half of Minnesota, for example, can be put into flax for one or two years, depending upon market prices, and eventually sown down to Red Clover or Alfalfa alone or in a mixture with some Brome grass. The first two or three years Red Clover or Alfalfa will be the predominant crop, after which brome will begin to crowd out the legumes and, once brome has become established, it will gradually give way to bluegrass. It is a cheap and very desirable way of getting a good turf at very little or no cost over a period of years. Further, it reduces the cost of adding fertilizer, since legumes put nitrogen into the soil. This is extremely important generally, because so often the tracts available for

airports have usually been chosen from the poor or marginal lands near the community and they need considerable building up before they develop fertility enough to maintain good turf.

The southern half of Minnesota is not as conducive to developing Red Clover, Alfalfa or other legumes for seed; but they do produce good growth and one or two cuttings of hay can be taken off during the course of the year, although this is not particularly desirable. It would be better, depending upon markets and areas, to sow flax, oats or barley for a year or two, then seeding the outfield down to a mixture of a brome and alfalfa as outlined above.

No. 9 Summary

There is no reason why any community, regardless of size, can not develop an attractive airport over a period of years. The smaller the community, the longer time it will take to develop an attractive field; but, if proper methods and a definite plan is followed, this can be done to very good advantage. It must be pointed out, however, thoughtful and progressive plans should be made to cover periods of not less than five years and these plans carried out to an exacting degree.