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Plans and Procedure for the Construction of a Baseball Field

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PLANS AND PROCEDURE FOR THE CONSTRUCTION OF A BASEBALL FIELD

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CHAPTER I

INTRODUCTION

It is the purpose of this paper to review information and material of other writers concerning plans and construction of a baseball field, then to evaluate and integrate the information and material and to form a more substantial program for the planning and the construction of a baseball field.

Baseball diamonds have progressed a long way from the pasture and sandlot to the excellent playing areas found in the professional ball parks. High schools, colleges, and park departments cannot afford to provide all these features. However, the teams that will be playing should not be hampered by fields that are just a notch above the pasture and sandlot variety.

A properly constructed baseball field is a very durable facility and provides a practice and competitive field for the physical education classes, the school baseball team, boy's summer leagues, the summer recreation programs and the town or local amateur teams from April to September.[1] No other field is used as often or for as long a period during the year as the baseball field. However, some fields are so poorly constructed that a heavy rain may prevent their use

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[1]Clark V. Whited, "Constructing the Baseball Diamond", Athletic Journal, XL (December 1959), p. 12.

for a considerable period of time. This is a serious handicap to the players, coaches, and spectators which more foresight in planning and a little more expense in construction will correct.

Every job has a starting point and once the area needed for the baseball field has been established, the initial point in setting out a baseball diamond is the location of home plate. The section of the country makes a difference as to where home plate will be placed because of the rays of the sun. When this decision has been made, the diamond should be laid out in detail.

A properly graded and drained field is a great asset, especially in the part of the country where there is known to be excess amounts of moisture. When grass will not ful-fill ample drainage and drying qualifications, sub-surface drainage would be recommended. In sub-surface drainage, the first step is to locate an outlet of sufficient depth to properly drain the property. It is important to carry away the excess moisture as quickly as possible following a heavy rain. The location of the drainage tile will depend on the slope of the field, location of main outlet, and the type of drainage plan that will best suit the needs of the field that is being constructed.

After the grading and drainage have been completed, then the finishing grading and seeding is done. The important aspect in the grading prodecure is to have the entire diamond slope away from the pitcher's mound.[2] This will include the foul areas but will exclude the dirt areas of the infield, baselines and home plate area. Before the area can be seeded the following questions should be answered. Is it advisable to plow over old seed and re-seed? Is it possible to put a new turf on an old field without putting the field out of play for a season or more? What is the ideal time span for building a new field? Is top soil needed, and how much? What are the best grasses for your local conditions? What care is needed after seeding? Is a grass infield better than a dirt infield?

A good backstop will pay for itself in a ten year period in the number of balls that are saved. The backstop and wings, which are approximately 10 to 12 feet high and run parallel to the baselines, are most commonly constructed of woven wire or cyclone type fence. Steel posts securely anchored in concrete in the ground will constitute the frame work for the backstop.

When the field has been properly constructed, a plan for the maintenance of the diamond should be drawn up. Proper main-

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[2]Lee M. Carey, "Maintaining the Baseball Diamond", Athletic Journal, XL (January 1960), p. 16.

CHAPTER II

PLANNING

Of all the factors involved in the design and construction of indoor and outdoor educational facilities, perhaps the most important single item is that of intelligent, unhurried and careful planning.[3] Just as athletic teams practice many hours in an attempt to achieve approximately one hour of flawless performance, so do planners work endless hours to develop perfect facilities. According to Clarence L. Barnhart, "To plan is to think out beforehand how something is to be made or done; design, scheme or devise."[4]

Engelhardt and Leggett[5] agree that any new physical education facility about to be constructed should be the result of a unified, long-range planning program directed by the central office of the school system. In most school districts the superintendent of schools is the chief executive of the board of education. In small communities he may be given another title, such as supervising principal, or

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[3]Harry A. Scott, From Program to Facilities in Physical Education (New York: Harper & Brothers, 1958), p. 1,2.

[4]Clarence L. Barnhart, Comprehensive Desk Dictionary (New York: Doubleday & Company, Inc., 1958), pp. 595-596.

[5]N.L. Engelhardt, N.L. Engelhardt Jr., and Stanton Leggett, School Planning and Building Handbook (New York: F.W. Dodge Corporation, 1956), p. 7.

principal, but no matter what title he is given he serves as the chief executive. He may delegate others to help him with the details, but he can never delegate his responsibility.

Many times there are people living in the community who possess special talents and abilities that make them valuable to the planning team. These people should be given the opportunity to express their thoughts and ideas and be made a member of the planning team. Good planning involves all persons who will eventually use the facility and according to Gabrielson and Miles[6] this includes the coaches, teachers, recreation department personnel, local baseball managers, and other lay persons.

Procedures used in the development of a facility will vary according to the type and philosophy of the agency for which the facility is being constructed. Gabrielson and Miles in their book, Sports and Recreation Facilities: For School and Community, give a general outline of procedures involved through which slight deviations can be applied to most school situations.

1. The idea of a new facility is born within an individual, or as the result of group discussion.
2. The actual need for the facility is determined.

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[6]M. Alexander Gabrielson and Caswell M. Miles, Sports and Recreation Facilities: For School and Community (New Jersey: Prentice-Hall, Inc., 1958), p. 37.

The question of "Why do we need this facility?" must be answered.

3. Visits to similar facilities in the community or adjacent communities are made by the individual or groups with the idea of becoming familiar with similar types of facilities.
4. Data on cost of construction and operation of such a facility are obtained.
5. The idea originator or group now submits the idea to the appropriate administrator. This is usually the person's immediate superior (supervisor, principal, director, etc.).
6. The supervisor, etc., then determines whether further preliminary study is desirable and usually involves other members of the staff in the discussion.
7. The idea, accompanied by collected data, is presented to the board, commission, or any other form of managing authority for its consideration.
8. The managing authority (board, commission, committee, etc.) may establish a planning group involving professional and lay people to study further the need for the proposed facility.
9. After the necessary study is made of the educational or recreational needs, the planning group makes specific recommendations back to the managing authority on such matters as: (1) desirability of project, (2) need for special consultants or services, (3) general scope of the project, (4) suitable site or sites for the facility.
10. The managing authority interviews several architects, and on the basis of criteria established by them selects the architect for the project.
11. The selected architect receives statement of educational or recreational needs and specifications and draws up preliminary plans and cost estimates.
12. Preliminary plans and cost estimates approved by the managing authority.
13. Discussion of the plan for financing and the possible selection of bond attorneys, if necessary, by the managing authority.
14. Managing authority begins to promote idea with public through the newspapers, radio, television, public meetings, discussion groups, special brochures and special displays of proposed plans in prominent places.
15. Submit issue to the voters for approval if necessary. (In some instances public hearings must be conducted before a referendum is held.)

16. If a plan is approved by voters, draw up educational or recreational specifications for the facility for the architect.
17. Contract with the architectural firm for the preparation of final drawings and specifications. (It usually is the same firm that drew up the preliminary plans.)
18. Approval of working plans and specifications by the managing authority and any other approving body, such as the State Department of Education, and Public Works Department.
19. Advertise for bids on construction and equipment.
20. Opening of bids and awarding of contract for construction. One of the steps involved in this process is the legal approval of the contract and the establishment of the schedule of payment.
21. Supervision of construction. There are usually two kinds, one supplied by the agency for which the facility is being constructed and the other by the architect who drew up the plans. In some instances both are used. Supervision by the architect is usually written into his contract.
22. Progress reports to the managing authority on various stages of construction (such as grading of site, excavation, etc.).
23. Inspection and acceptance of facility by the contracting agency (managing authority).
24. Construction contract completed.
25. Insurance arrangements made.
26. Equipment, supplies, and machines brought in.
27. Staff orientation to facility. Instructions in care and use of the facility.
28. Dedication of facility and occupancy of premises.
29. Periodic inspection of facility, checking for operating deficiencies for which contractor is responsible.[7]

The superintendent of schools according to Gabrielsen and Miles[8] is responsible to the school board or commission for the planning of any new facility. Because of the many

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[7] Ibid, pp. 37-38.

[8] Ibid, pp. 39.

duties involved, he will most likely seek help in his planning and will undoubtedly delegate a considerable portion of the responsibility to a member of his staff. The person who has been designated to take charge should prepare a check list to assure that nothing will be overlooked. A typical check list of this type is shown below.

1. Has the actual need for the facility been fully determined?
2. Have the people who will be operating the facility had a part in the planning?
3. Have the operating and maintenance costs been determined and incorporated in the budget, so that when the facility is completed, funds will be available for full operation?
4. Has it been determined that the architect has on his staff specialized technical services, such as site planners, etc.?
5. Have all the legal implications been explored and legal advice sought in connection with bond elections?
6. Has a time schedule for planning and construction been worked out?
7. Have lay and professional committees been established to assist in the preparation of the recreational and educational specifications and requirements?
8. Have all local building codes, state regulations, and laws been considered in the planning?
9. Is the proposed site for the facility the best possible location, adequate for both present and future needs?
10. Is the facility part of a master plan of school or community recreation development?
11. Has it been determined that the contractors who bid on the plans are qualified to handle the job?
12. Has the administrator in charge made a list of all the things that need to be accomplished in a sequential order?
13. Has resource material been provided for individual groups to study in helping to arrive at desirable specifications?
14. Has provision been made for the planning group to visit other similar facilities in the community or adjacent communities?

15. Has the eventual program to be conducted in the facility received consideration in order to help establish size and design of the facility?
16. Has the planning taken into consideration population growth and possible changes in the social structure of the community?
17. Has someone been designated as the "clerk of the works" or inspector who is qualified to do a thorough job of checking the construction with the plans and specifications?
18. Has the expected life of the facility been determined and incorporated into the planning and specifications?
19. Have the equipment needs been included in the cost estimate?
20. Have careful procedures and criteria been established to select the architect?
21. Has a policy been established for effective working relations between such people as the builder, surveyor, etc.?
22. Have the services of professional advisory groups at the local, state, and national level been sought? (State departments, county planning groups, fire departments, safety engineers, and various federal departments.)
23. Has a procedure been established to handle all "change orders" in order to prevent hasty changes to plans which were carefully developed over many months?
24. Has the community interest been placed above personal and political interest in the selection sites, awarding of contracts, and in the general planning of the facility?[9]

The architect is a key figure in the planning and construction of any new facility which makes him a part of the planning picture as soon as the board or managing authority has approved the project. Architects should be carefully selected. The board should establish criteria for the

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[9] Ibid, pp. 38-41.

selection based on local needs and professional architectural ethics. The American Institute of Architects has made up a list of questions that can be used in the selection of Architects for school building projects and Gabrielsen and Miles have made this list available in their book.[10]

The following are general guides used in the selection of architects:

1. No architect should be selected merely because of local residence, friendship, or artistry of his sketches.
2. Once a tentative selection of three or four architects has been made, visits should be made by members of the board to facilities recently completed by the architects in order to see at first hand the kinds of construction they have completed. By talking with the local superintendent it is possible to learn about the ethical and businesslike relations of the architect with the board, contractors, and others involved in the planning and construction of the facility. Other questions that might be raised are: Did he complete the work on time? Were there many "change orders"? Was the final cost more or less than the original estimates? Was he willing to take suggestions?
3. Each architect should be interviewed, individually if possible, in order to obtain necessary information and provide him with the opportunity to explain the services of his office and to demonstrate some of his work.
4. Architects who propose to violate the codes of the architectural profession should not be hired.
5. Because an architect has never constructed a facility of the type desired, it does not hold that he is not competent. The architects who designed the Swimming Stadium at the 1956 Olympic games at Melbourne, Australia, had never before designed a swimming pool. The architect who has creative imagination, a willingness to learn through research and study, and the ability to cooperate can usually overcome any lack of experience.

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[10] Ibid, pp. 41-42

6. It is essential to obtain a clear determination of the services which are to be rendered under the architect's fee. This should be included in the architect's contract. Particular items to watch out for are: The extent of engineering services provided under the fees; the type of supervision provided during the actual construction; and the number of sets of plans and specifications that are to be provided.
7. A time schedule should be agreed upon by the architect and the board in order to establish target dates for completion of various phases of the project.
8. It is best to engage a local attorney to handle the legal problems related to the building program. The cost of legal service should be figured as a part of the cost of the facility.[11]

The architect must be supplied with certain specific information in order to draw up his recommendations correctly. Included in this information should be;

1. The community's conception of what the facility should be like. This is important since it represents the philosophy of the planning group. If it is not adequately set forth the architect will come up with his own conception which might be in conflict with the function the facility is to serve.
2. Location of facility.
3. Topographical survey of the site including the result of borings to determine drainage, type of soil, etc.
4. Availability of funds and the approximate amount to be spent.
5. Suggested size of the facility as related to the number of people expected to use it.
6. The nature of the program and ages of prospective users.
7. Any special design features.
8. Any special features related to lighting, storage, and materials to be used in construction, such as asphalt surface, cinders, drinking fountains, and any other special features.
9. Any special safety features that should be incorporated such as fences, night lights, etc.[12]

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[11] *Ibid.*, p. 42.
[12] *Ibid.*, p. 42.

These requirements and specifications must be carefully laid out and all potential users should have the opportunity to contribute ideas rather than just go along with the suggestions of others.[13] Discussions should be held between the architect and school officials and in many of these instances, the architect will be able to give considerable advice and suggestions, plus the fact the architect might request certain information which is not included in the original specifications.

To most laymen it is difficult to understand why one facility costs twice as much as another facility of comparable size. Gabrielsen and Miles[14] calls to one's attention that there are many factors that influence the cost of a facility and among these would be cost of land and preparation of site for use, cost of labor at time of construction, material cost at time of construction, facility design, cubage space, total square footage of facility being planned, climatic conditions, extent of landscaping, and frills or gingerbread included in the construction. The standard budget items in the construction of the facility usually include the following:

1. Preliminary cost: Acquisition of site; site development; legal fees; cost of bond issue; promotion and publicity; preliminary architect fees (educational or specialist).
2. Architectural fees: Preparation of architectural and engineering plans (working plans); supervision of construction; engineering requirements.

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[13] *Ibid.*, p. 42.

[14] *Ibid.*, p. 43.

3. Construction cost: Building contract and sub-contracts; supervision cost ("clerk of the works"); building permits.
4. Equipment and furniture: (up to fifteen percent of the total budget); For stands, stadium structures, etc.
5. Insurance.
6. Contingencies; (usually up to ten per cent of the total cost).[15]

When the facility is in the pre-planning stage, there are certain phases of the planning that can be overlooked. Therefore a planning guide such as the following should be established.

1. The facility should be planned to meet future demands as well as present.
2. The facility should implement the kind of program desired.
3. The concept of the multiple use of facility should receive due consideration in the planning period.
4. People who will be affected by the facility should have a part in its planning.
5. The location of any facility should be influenced by a master plan of the community or the school system.
6. The needs of the people to be served must be accurately determined at a part of the planning stage.
7. There must be cooperation between educational consultants, planning groups, architects and administrative officials in the planning of facilities.
8. The chief administrative official responsible for construction should have a clear-cut plan of procedure to guide his actions.
9. Facilities should be located where they will receive maximum use.
10. Maximum flexibility of design should be sought in order to easily affect change if future needs so dictate.
11. The facility should be planned to achieve maximum safety of all participants and provide a healthful environment.
12. The facility should comply with all local and state laws and other regulations, including professional standards.

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[15] Ibid., p. 43.

13. The operating and maintenance cost of the facility must be considered in the planning stage.
14. When the cost of rehabilitating a facility exceeds fifty per cent of the cost of replacement, it is more prudent to raze the old facility and construct a new one.
15. The effect any facility may have on adjacent properties and the community and neighborhood as a whole should receive careful consideration.
16. 'A thing of beauty is a joy forever.' This concept should not be lost sight of in planning a new facility. It is often overlooked in the haste to acquire new facilities. The Acropolis in Athens and the Coliseum in Rome are examples of facilities whose beauty has survived the span of time.[16]

Errors in planning may vary, depending upon the local conditions, philosophies, procedures, and purpose of the particular agency for whom the facility is to be constructed.

Some general errors in planning are as follows:

1. Fields are located too far away from the center of the campus to prevent their being used regularly.
2. Drainage is often times poor. The surfaces are dangerous and no provisions are made for all kinds of weather.
3. Failure to eliminate the use of overhead wires.
4. Courts and fields are not situated properly for the needs of the players and spectators.
5. Failure to provide a sufficient number of water outlets for drinking and sprinkling purposes, and failure to have them placed at strategic positions.
6. Failure to provide better materials for construction which would result in considerable saving in maintenance costs are in direct relationship to construction costs.
7. Providing too much subdrainage, which deprives the turf of needed moisture.
8. The failure to take into consideration the following factors in determining the most suitable surface for a given area: (1) Climate, such as freezing, thawing,

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[16] Ibid., p. 44.

heat, and rainfall, (2) Natural soil conditions, (3) Location and size of area, (4) Type of activities to be carried on, (5) Length of the playing season, (6) Intensity of use, (7) Availability of material, (8) Initial costs and maintenance costs.

9. Failure to realize that different climatic and soil conditions necessitate the use of various types of grasses, in different parts of the country.
10. Having the baseball field overlap the football field and running track. Baseball and track seasons overlap resulting in interference; the curbed track is detrimental to ball playing; and the skinned infield is disadvantageous to a good football field.
11. Placing the scoreboard where it cannot be seen by all spectators.
12. Many of the surfaces are abrasive, hard on the participants' feet due to lack of resiliency, slippery, hot or soft in the summer, or they soil participants' clothes.
13. Failure to install water pipes and other plumbing before the area is surfaced. Pipes should be laid while the grading is being done, in order to save expense.
14. Using pipe that is not large enough to serve future as well as present needs. Not having the pipe laid below the frost line if climatic conditions necessitate it.
15. Failure to determine the position of lights in outdoor areas before work is begun, in order that conduits for wires may be laid before surfacing is completed, and poles and other equipment may fit in with the general plans for the area.
16. Failure to have outdoor fields and courts properly orientated in order to make them more comfortable for players and spectators. Field should be constructed so that the sun is at right angles to the flight of the fall from the pitcher to the catcher.
17. Failure to build with consideration for possible future expansion.[17]

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[17]Fred E. Howell, "Common Errors in Planning Facilities," _Athletic Journal_, XXXII (April, 1952), pp. 46-50, 63.

CHAPTER III

CONSTRUCTION

In his article on location, Whited[18] concludes that the topography of the land, size (approximately four acres), future expansion, and soil type are to be considered when establishing the area on which the baseball field is to be built. The location of home plate will depend on what section of the country the field is being constructed, north or south, as does the time of day when most of the games will be played. Primary consideration in regard to the direction (low rays of the sun) must be given to the following in order of their importance: The hitter, catcher, pitcher, other players, and spectators.

On March 27, according to Timm's[19] report, at approximately 6:00 p. m., the sun is straight west and then it moves to the north by small degrees daily. "As a general 'rule of the thumb' the diamond should be set up so that the low rays of the sun should intersect the long axis of the diamond, which is a line drawn from home plate, through pitcher's box and

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[18]Clark V. Whited, "Constructing the Baseball Diamond," Athletic Journal, XL (December 1959), p. 12.

[19]L. C. "Cap" Timm, "Report on The Physical Aspects of Baseball", (unpublished report, Athletic Department, Iowa State College, Ames, Iowa), p. 3.

second base into center field, at right angles at the time of day when those rays are most hazardous."[20] Figure 1 shows four positions for home plate, rating the best position as number 1, second best as number 2, and so on up to number 4 position. Many fields, because of local conditions, are forced to be placed in the southeast and northeast, which are the two worst positions as shown in Figure 1, particularly for the hitter and catcher.

The dimensions of a baseball field are sufficiently settled by the Official Baseball Rules as far as the infield is concerned and for absolute accuracy the field should be laid out in detail with the use of engineering instruments. Bossard[21] states that whenever a surveyor's transit is used, place a tripod in such a position that the bob points directly at the corner of home plate and run lines out to left and right field for whatever distance has been established as the foul line. Both lines must intersect at the corner of home plate forming a 90' angle or the lines will be out of order. With the transit in the same position, shoot an azimuth to a distance of 127 feet, 3 and 3/8 inches, and that point should establish second base. Using the same line, measure out from the corner of home plate

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[20] Ibid, p. 3.

[21] Emil Bossard, "How to Build and Maintain a Baseball Diamond," Rawlings Roundup, January 31, 1958, pp. 14-15.

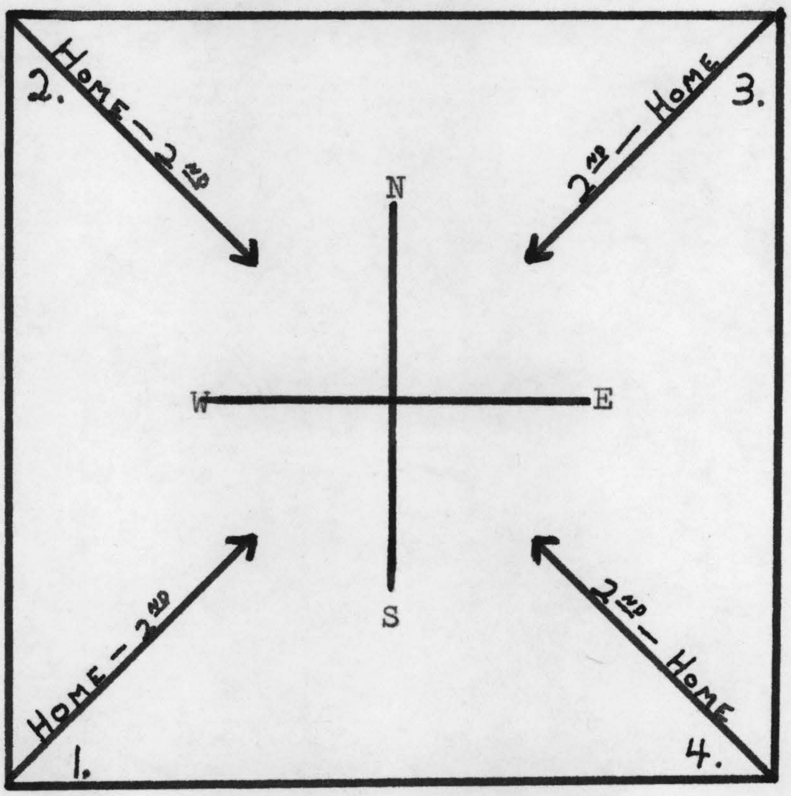

FIGURE 1

RECOMMENDED POSITIONS FOR HOME PLATE

60 feet, 6 inches, which will be the forward boundary line for the pitcher's rubber. Also measure out from the corner of home plate in the same direction 59 feet, which is the center of the pitcher's mound. With the tripod in the same position and the transit now pointing down the first base line, measure 90 feet along the line to establish the position for the first base stake. Next, swing the transit along the left field foul line, measure 90 feet, and this will serve as a spot for the third base stake. A final check of the measurements can be made by measuring the distance from first base to third base via the pitcher's box. This should be 127 feet, 3 and 3/8 inches.

When it is not possible to use engineering instruments, the field can be laid out with the possibility of error reduced to the fractional differences that may be encountered by varying degrees of stretch in the steel tape or twine used in making measurements. Whited[22] listed a 300 foot roll of mason's twine, a 100 or 200 foot steel tape, metal base stakes, a two foot steel rod a quarter of an inch in diameter, two wooden posts two inches square and five feet long, and a large hammer as materials that would be needed for the laying out of the diamond.

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[22]Whited, op. cit., p. 12.

Using the mason's twine, stretch a line from the place where the backstop is to be located, toward a point where second base is to be located. Measure along this line 60 feet from the backstop and place a stake. This stake represents the point of home plate which is the most important point for all future measurements. From the home plate stake measure 59 feet along the mason's twine and drive in a stake. This stake represents the center of the mound and is not to be confused with the front of the pitcher's rubber. From this point measure an additional 68 feet, 3 and 3/8 inches and drive in a stake. This point represents the center of second base. Next, place the end of the steel tape over the second base stake, stretch the tape toward the first base area, and at 90 feet draw the tape tight about six inches above the ground. Hold a stake at this point and scratch an arc three or four feet long on the surface of the ground. With the center still at second base repeat the same operation in the third base area. Take the tape from the second base stake and hook it to the home plate stake, and using the same method, scratch an arc in the third base area that cuts across the previous arc. At this point, drive in a stake for third base. Repeat the same operation in the first base area. Using the mason's twine and steel tape carefully, measure the distance between the first base stake and the third base stake via pitcher's mound. The correct measurement should be 127 feet, 3 and 3/8 inches. If these operations were executed carefully, the error should be less than 3 inches. Split this error and move the third and first base stakes accordingly. Tie the mason's string to the home plate stake and then stretch it past first base on down the right field line. Measure along this line whatever distance has been decided on as the limit of the field. Drive one of the five foot steel posts into the ground at this point. Carry out the same process on the other side for the third base foul line.[23] See Figure 2.

This type of measuring is accurate if the tape is kept tightly drawn and the marking stake is held at right angles.

ESTABLISHING THE GRADING SLOPES

A properly graded field is a great asset, especially in the northern section of the country. It often means that the team will be able to practice earlier in the spring, and be useable much sooner after a heavy rain.

According to Bossard,[24] the main thing to remember when laying out the areas for grading is that the entire diamond should slope away from the pitcher's mound and this includes

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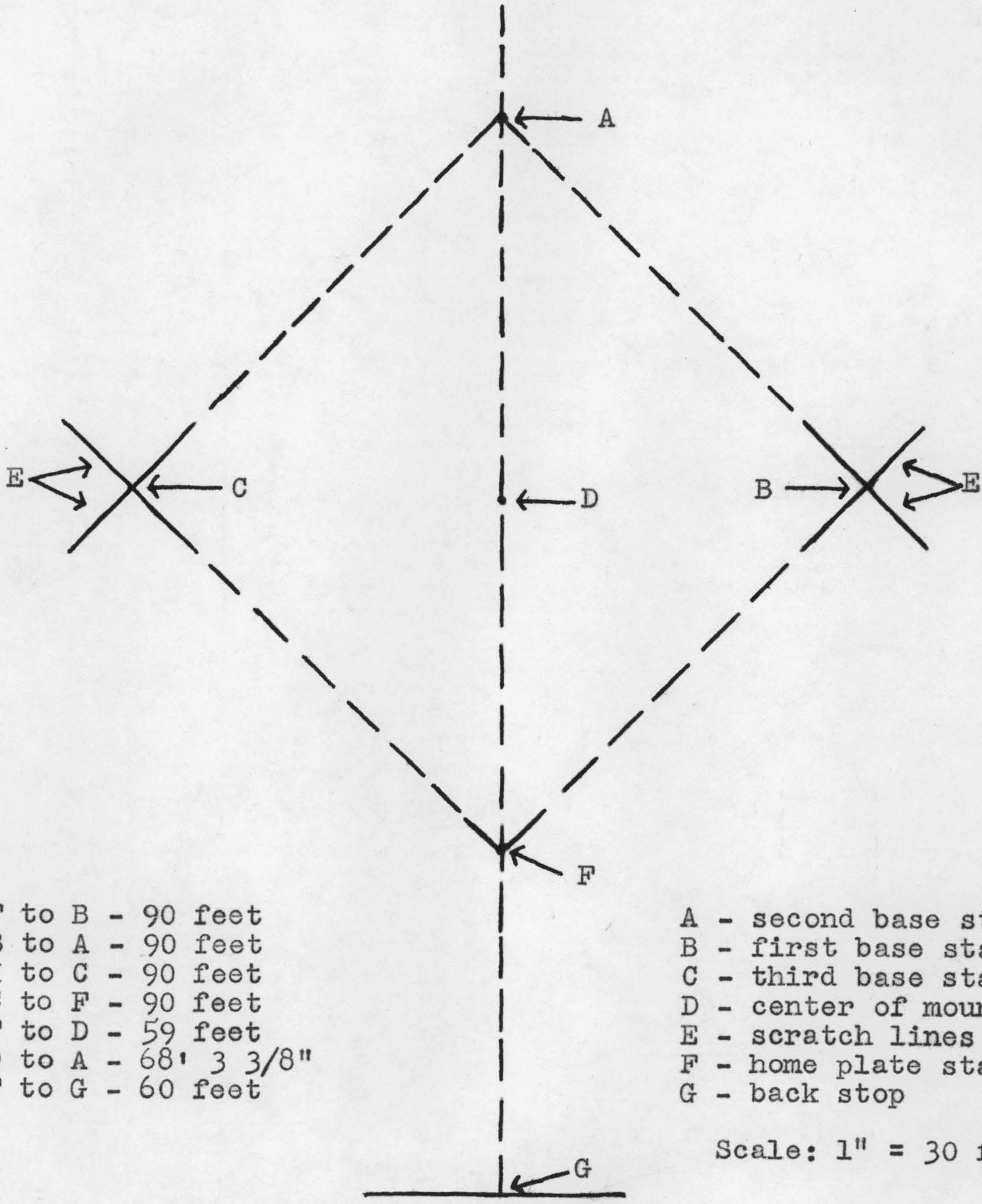
[23]Whited, op. cit., p. 12, 14.

[24]Bossard, op. cit., p. 14.



F to B - 90 feet
B to A - 90 feet
H to C - 90 feet
C to F - 90 feet
F to D - 59 feet
D to A - 68' 3 3/8"
F to G - 60 feet

A - second base stake
B - first base stake
C - third base stake
D - center of mound
E - scratch lines
F - home plate stake
G - back stop

Scale: 1" = 30 feet

FIGURE 2

METHOD AND MEASUREMENTS IN LAYING OUT THE DIAMOND the foul area. The only exceptions are the dirt areas of the infield, baselines, and the home plate area.

Besides the mason's twine, steel tape, and large hammer, other materials needed will be ten stakes about one and one-half feet long, ten stakes five feet long, a mason's line level, and a yard stick.

With the mason's twine tied to the home plate stake, Whited[25] suggests taking and tying the other end to the five foot post located at the end of the left field foul line making sure the line touches the third base stake. Using the yard stick, measure off three feet on either side of the baselines and draw scratch lines parallel to the baselines, on the inside and outside of the baseline. Repeat the same operation down the first base line. These lines represent the edges of the grass line along the baseline. When measuring the baselines between first and second, and second and third, only the inside grass line is scratched. If a dirt infield is used, the lines drawn on the outside of first and third baselines are the only ones needed of this group. With the steel tape held at 13 feet, and the center at the home plate stake, scratch a circle around home plate. At third base,

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[25]Whited, op. cit., p. 14.

using the same radius, make an arc cutting off the corners of the grass lines. Scuff out the grass lines where they are cut off by the arcs. Repeat this procedure at each of the other bases. Remove the steel tape from the home plate stake and place the wire end over the rod at the center of the pitcher's mound. Stretch the steel tape out to 95 feet and at the point where it crosses the third base foul line drive a stake into the ground. Holding the tape tight at 95 feet, walk toward the first base foul line scratching an arc on the ground as you do so and where the arc crosses the first base line drive another stake. This arc represents the inner edge of the outfield grass. See Figure 3.

Measuring nine inches up from the ground on the home plate stake, place a chalk mark. Tie the mason's line at this point and stretch it to the steel rod at the center of the pitching mound. Then place the mason's level on the line and raise or lower the line until the bubble levels. Mark the rod with chalk at this point, which should be nine inches above home plate. Using this point and holding the line at any scratch line will give the correct slope. At this point on the pitcher's mound the stake is nine inches, thus providing a more gradual slope. The pitcher's mound will be completed later when six inches of additional dirt brings the mound up to the required 15 inches.[26]

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[26]Whited, _op_. _cit_., p. 14.

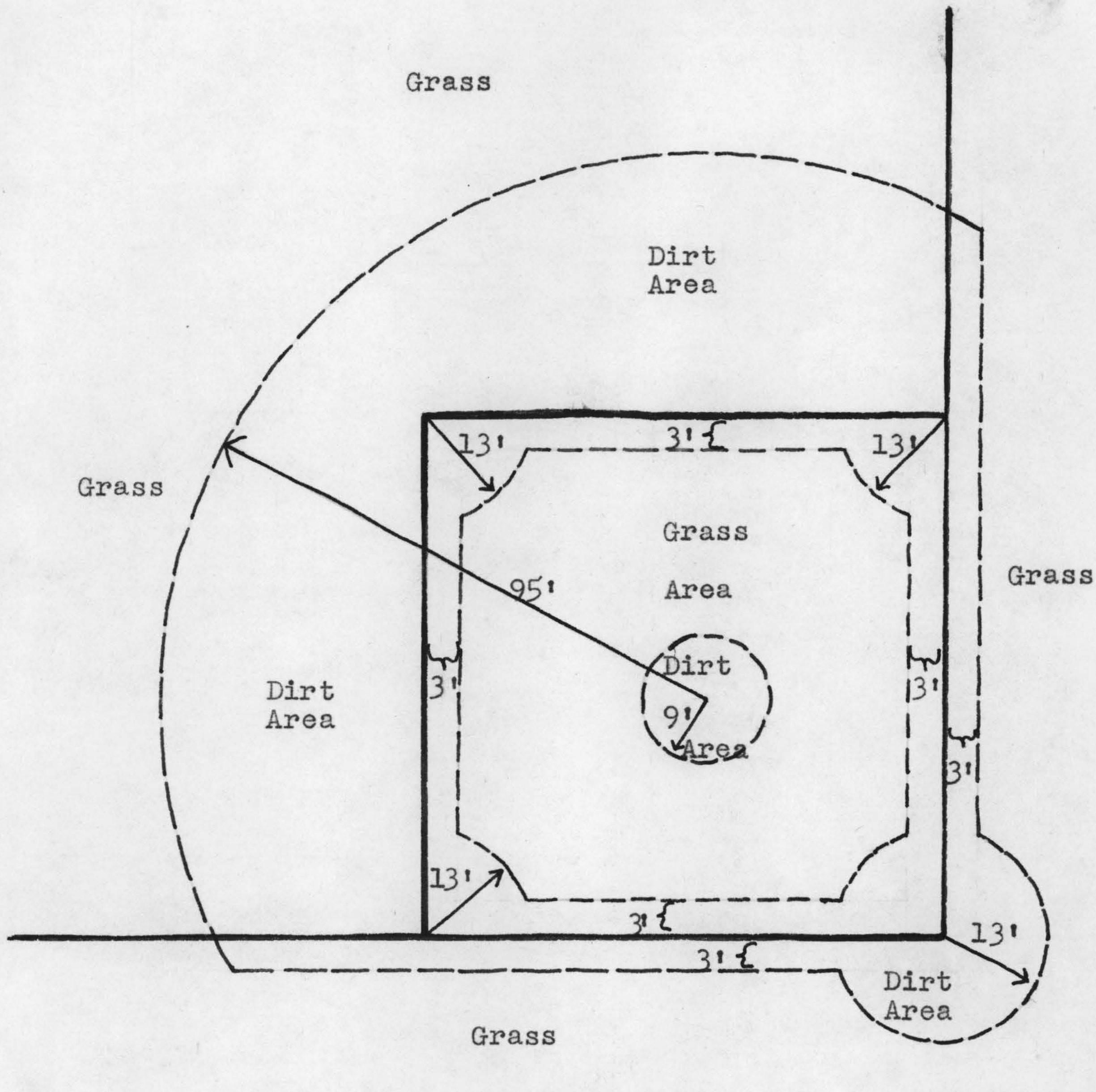

FIGURE 3*

LOCATION OF GRASS AND SKINNED AREAS

* not drawn to scale

In his article on drainage, Whited[27] writes that in order to provide natural surface drainage the outfield should fall away gradually from the dirt areas of the infield. A slope should be set up to fall one foot in every hundred which is a 1 per cent slope. A 1 per cent slope is also needed from the baselines to the backstop and limits of the playing field. From the edge of the dirt areas of the infield to the limits of a 300 foot field is 170 feet, and for a fall of 1 per cent, the farthest point would have to be 21 inches lower than the dirt areas of the diamond. The foul areas on either side of the foul lines will vary in width but they require the same slope as the outfield, 1 foot per 100 feet. See Figure 4.

If it is necessary, or the plans call for excavation, tiling, filling or installation of water system, take off the good topsoil and stockpile it for later fill. Good topsoil is at a premium.

DRAINAGE

It is worthwhile to provide a field with underground drainage. Once in operation, proper drainage will last a number of years and it does not require much upkeep. Many new types of drainage pipe have been established and the

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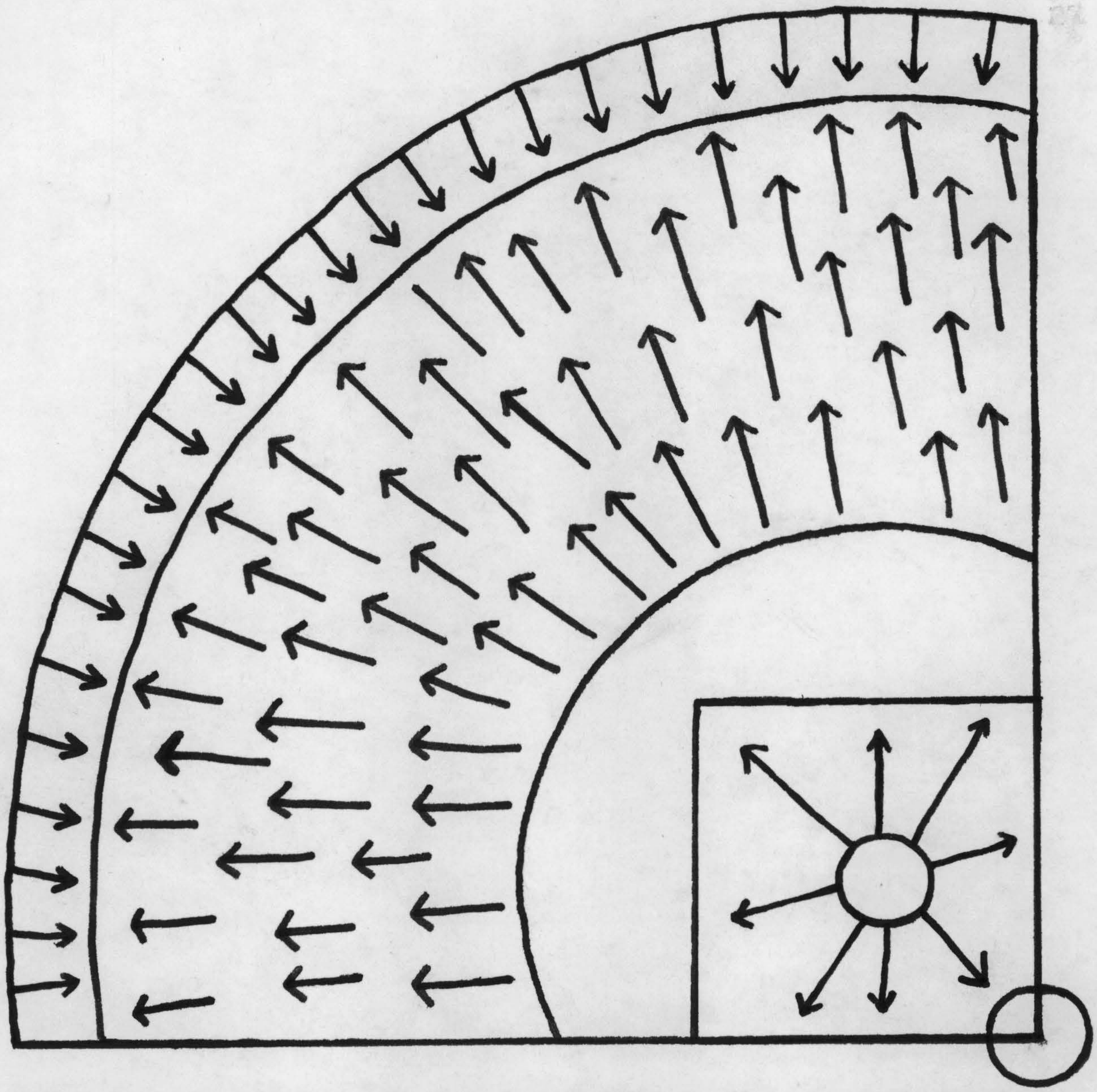
[27] *Ibid.*, p. 14



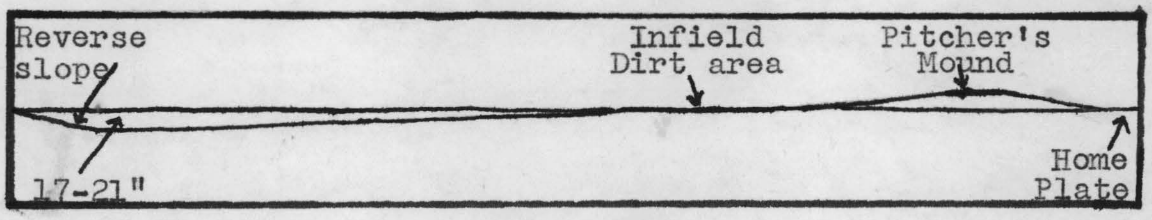


FIGURE 4*

THE GENERALLY ACCEPTED METHOD OF
GRADING A BASEBALL FIELD

* not drawn to scale

one suited to the individual's need should be obtained. The digging and laying of the drainage fields should be done by a contractor who has the proper machinery and experience. However, there are several things about the general plans and special features that the people who are planning the field should know about.

Except for the explanation of Milwaukee County Stadium, there was no mention of a recommended size for the main drain or lateral drains. However, Whited[28] did say that the main line of the drainage system should extend from the backstop area, through home plate and second base, to the limits of the field, and if possible two other drains should run beneath the sidelines of the field. The laterals, which are the smaller pipes leading to the main drains, should run parallel to the baselines in the infield area. One line of laterals is placed near the inside edge of the grass area to drain the water coming off the sloped area of the infield, and another set laid parallel and approximately ten feet beyond the first, second, and third baselines will drain the dirt area of the infield.

The outfield laterals are placed at right angles to the slope and 50 feet apart, starting 50 feet from the dirt area.

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[28] Whited, _op_. _cit_., p. 46.

These laterals can be connected to both the main drain and the sideline drains but if the main drain is the only drain available, it will have to go to considerable depth to allow for proper drainage of all the water. See Figure 5.

In Whited's[29] explanation of the reverse slope, outfield drainage may be increased by using a French drain on the final outfield lateral. In a French drain, the excavation above the pipe is filled with coarse gravel or crushed stone, and as it is filled, the gravel becomes smaller and smaller until at ground level it is the size of a pea. Figure 6 shows a French drain. Gravel or crushed stone cores should be placed along the other outfield laterals every ten or fifteen feet. These can be made by using a sheet metal pipe four inches in diameter. This pipe is placed in a vertical position and is filled with layers of coarse to fine rock as was done in the French drain. When the dirt has been filled in around the pipe, slowly remove the pipe, leaving a core of gravel, as shown in Figure 7. This method can also be used in the infield with one added step. The core should be topped with two or three inches of dirt.

Whited's[30] explanation for infield drainage is to place regular drainage tile upright in the trench with top of the

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[29] Ibid, p. 46.

[30] Ibid, p. 47.

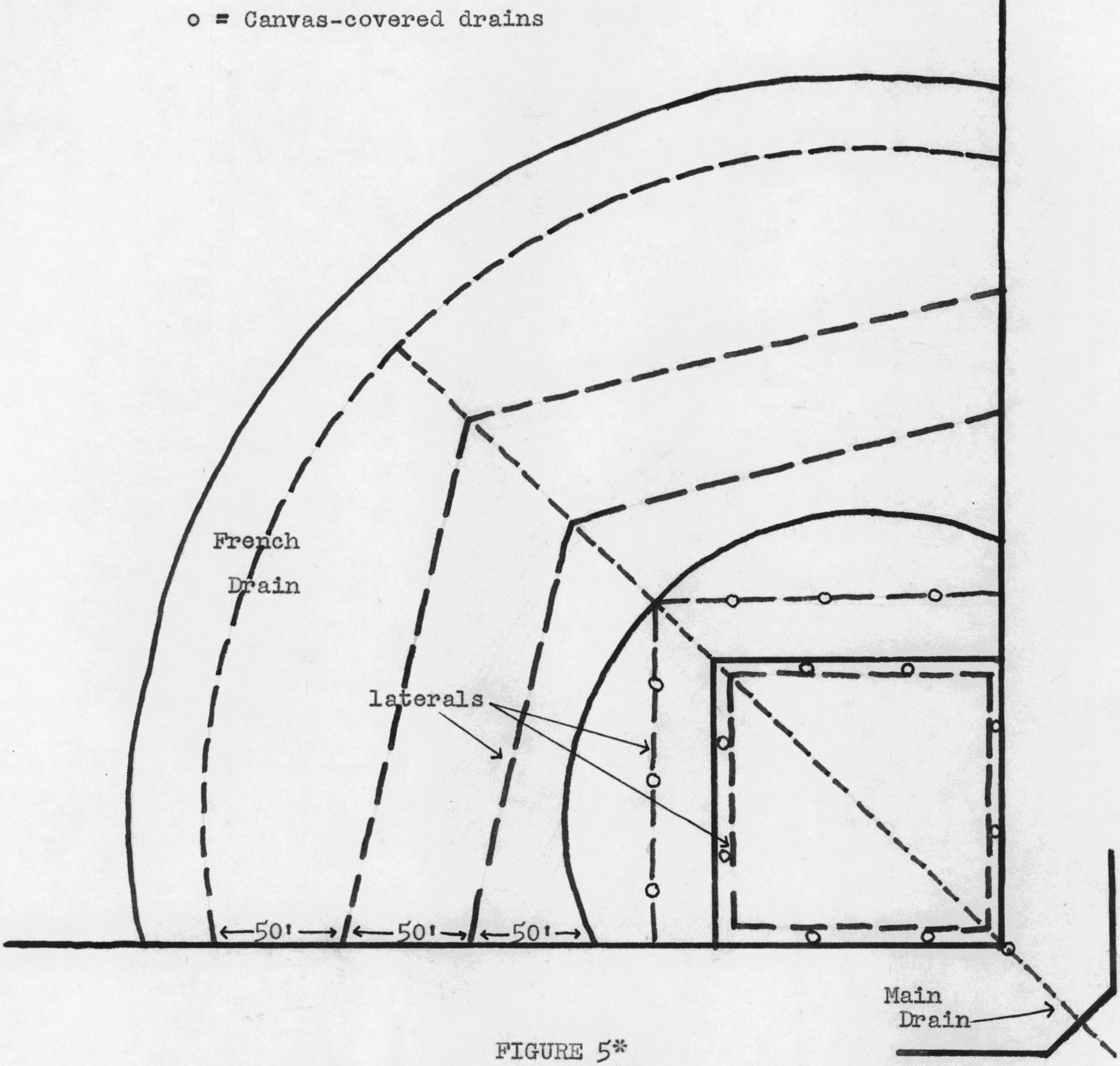

FIGURE 5*

POSITION OF DRAINS ON INFIELD AND OUTFIELD

* not drawn to scale

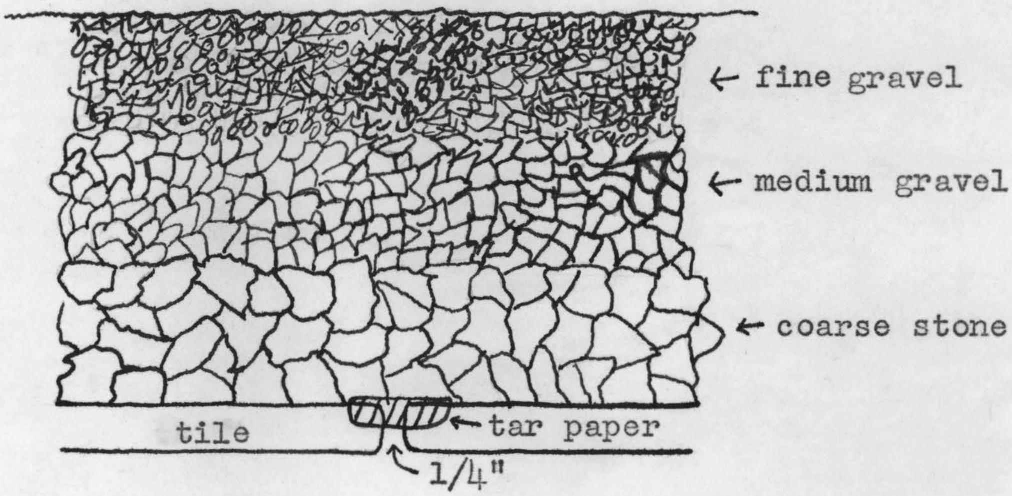

FIGURE 6*

CROSS SECTION OF A FRENCH DRAIN

* not drawn to scale

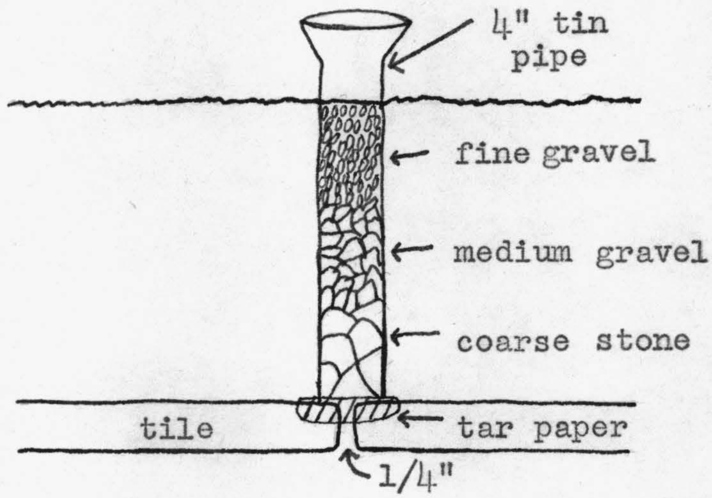

FIGURE 7*

DIAGRAM OF A GRAVEL CORE

* not drawn to scale

tile two or three inches below the surface. The open end is covered with a canvas top that has a wire ring sewn around the edge. Hooked to the ring is a piece of string that will be raked into the surface of the ground when the cap is covered with dirt. See Figure 8. When it rains, the cap can be raised, lifting the surface dirt with it. Then using a rake, small furrows can be made to allow the water to drain. These drains should be placed on the edges of the baselines and near the positions the infielders play because these are the areas which are usually dug up and where water stands. Others should be placed behind home plate, first and third baselines and any other low spots outside the playing area. When all surface water has drained off, the caps are replaced and dirt is raked over the cap making sure the strings stays on the surface.

An example of a complete sub-surface drainage layout is shown in Figure 9 in Appendix, which is a reprint of a blueprint of Milwaukee Stadium drawn up by the Osborn Engineering Company. The diagram shows the location of the main outfall sewer, the tight joint sewer, and the perforated under drains. The under drains are laid in a different pattern known as the herringbone pattern. The under drains are placed in this herringbone position eighteen inches beneath the surface. As shown in Figure 9, the trench is twenty-four inches wide. A six inch perforated corrugated metal pipe is layed in the trench,

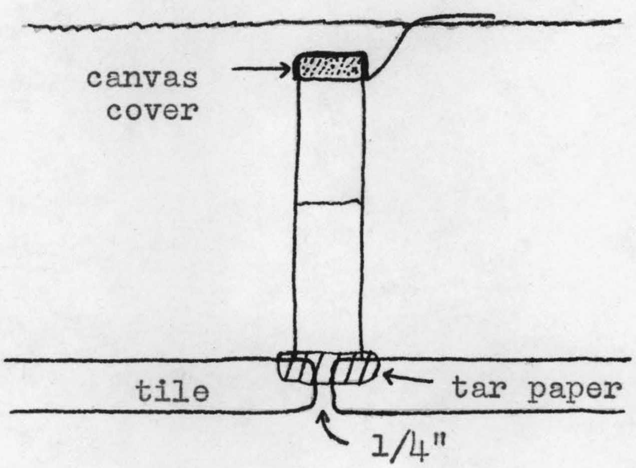

FIGURE 8*

DIAGRAM OF INFIELD DRAIN

* not drawn to scale

allowing four and one-half inches on each side. The drains should be laid with open joints. Each joint should be wrapped with two layers of burlap 10 inches wide. The top half is then covered with a layer of 15 pound roofing felt, 10 inches wide. The pipe is then covered with sand filter material to a depth of six inches at the center of the trench. Six inches of top soil is then placed on top of the sand, making the total depth eighteen inches. The drop for the pipe is approximately one foot per 100 feet.

The tight joint sewer pipes are six inches in diameter and are layed 18 inches below the surface, around the outside of the playing area, and three are laid under the playing field approximately 100 feet apart in a third base-first base direction. The tight joint sewers drain to catch basins, man holes and sewer outlets. An example of a catch basin is also shown in Figure 9. The main outfall sewer, which is a 24" circular pipe, runs through the center of the playing field in the same directions as the tight joint sewers.

This type of drainage system is used in many of the major and minor league parks.

Another job that is worked out by the contractor and coach is the installation of the water system. The pipes must be laid below the minimum frost line. Types of water tubing being used by most of the authors were: (1) copper tubing

$1\frac{1}{2}$ to 2 inches, (2) plastic tubing, (3) cast iron. Some soils in certain areas set up an adverse chemical reaction with the copper tubing, thereby causing it to deteriorate at an early stage. The plastic tubing is light and easy to handle but its permanence has not yet been established. The cast iron is more expensive but best for permanency. There was no mention of the likes and dislikes of galvanized pipe by any of the authors. The outlets should be placed behind first, second, third base, and home plate. Sub-surface outlets should be equipped with stop and waste valves, which are self draining and good insurance against frost damage. Above surface outlets for use in public fountains, dugout fountains, etc., should be equipped with frost-proof hydrants for the same reason. Coarse gravel should be placed below the drain valve at the base of the ditch to allow for excess water to drain away.

FINISH GRADING:

According to Timm,[31] the top soil to be used in the grassed areas of the infield and/or outfield should be a fertile, friable soil of a loamy nature, will crumble with finger pressure, has a good granular structure, and has high infiltration qualities of porosity and permeability

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[31] Timm, *op. cit.*, p. 7.

allowing it to drain easily. This top soil should be put on to a depth of from 4 to 6 inches.

The top soil that is used in the skinned area of the diamond and the base paths should be put on to a depth of six inches. This soil should be screened to eliminate stones. The soil that is used will vary in different parts of the country because of the natural conditions of the soil in that certain geographical area. The following is a report taken from a survey by L. C. "Cap" Timm of Iowa State College which is a summary of a study on soil samples.

1. Reason & Purpose of Study

   I'm sure you all have played on a diamond where the comment ran to "What a rock pile," and "What a sand box," or where a pitcher is working out of a bad hole and striding into a sandy hole with poor footing, or hitter is also handicapped because of irregular shaped holes. I know, too, that you all really appreciate fielding a ball or sliding on good soil well kept. There is a complete void of information on this subject with a reasonable approach. In the past most of it has been done by trial and error or "by guess by Gorry." The real purpose, then, was to approach this study with scientific mechanical aggregate analysis rather than by guess.

2. Method Used for Selection of Samples

   A. Canvas of coaches as to who had the best diamond in their geographical area.

   B. Canvas of selected major leaguers as to who had the best diamonds in two major leagues.

   C. An effort was then made to get samples from ones recommended.

3. Limitations of Study

I fully realize that there were not enough samples analyzed to make this study thoroughly complete. Also, the samples were collected only from recommended "best" and did not analyze samples from worst for comparison. However, from the samples tested, I feel we can draw some reasonable accurate conclusions.

4. Analysis Method

The analysis was done using the Bouyoucas Hydrometer method which was developed at Michigan State University. The analysis and the evaluation was done by B. J. Firkins, agronomist, Iowa State College.

5. Results (Table I in Appendix)

A. Skinned area of infield and baseline.

It is obvious that there is no exact formula of soil percentages that is best. We didn't expect this. However, we are confident that mixture of soils within a limited percentage area are better soils for the purpose than others. We feel that that soil should be a fertile friable loamy nature that when analyzed should be approximately 2/3 sand and 1/3 silt and clay combined.

sand 60 to 70%
silt and clay 30 to 40%

(1) Obvious importance of maintenance

a. The tests impressed upon me and made me realize the importance of good maintenance and good ground shape in having a good diamond.

b. It also made me realize the importance of good soil composition in getting easier and better results from maintenance.

c. Indicative of importance and know how of good groundskeeper, of the two top recommended infields of National League, the father is groundskeeper at one and his son at the other.

d. I was interested in this comment by an infielder in the American League of long standing. "Cleveland and Detroit have the best diamonds in our league. A few years ago Yankee Stadium was the best, but this year it's the worst." I hardly believe that the soil has been changed.

B. Mounds - including catcher's and batter's box. (Table II in appendix)

Footing in these areas should be good, firm and solid where spikes can go in easy, but come out clean. We feel that in these areas that get such concentrated wear and tear, and good footing is so necessary, that the soil should be of a heavy composition. We suggest that the soil, when analyzed, should be a clayloam and have approximately:

Sand	40 to 50%
Silt & Clay	50 to 60% with slightly more clay than silt.

(1) Mound conditioners

a. If soil is too loose and needs more compaction and firmness, you may add as follows:

i) Western Michigan packs blue clay (heavy, tough, plastic clay) in wood forms 2'x2'x4" and control the moisture content. When area in front of the rubber, where pitcher strides, or in batter's box, wears out, they excavate to size of form and replace with new soil.

ii) Mississippi uses a gray clay which is heavier and more plastic than usual run of red clay (much iron oxide). This clay must be dampened or it will chalk up. After area is leveled and tamped, they cover with cotton bagging or burlap and wet to hold moisture. Real good idea.

iii) Iowa State mixes burnt common brick clay dust with sandy loam. Wet lightly underneath and on top, tamp solid, and then sprinkle over area.

b. Ifsoil is too hard, solid and compacted

i) Illinois cuts in some burnt moulders sand as a conditioner.

ii) As a suggestion, you could add some limestone screenings the size of sharp sand to your heavy plastic northern clay (Montmorillonite) or Western adobe. This will flocculate-form granules that will prevent overcompaction and excessive hardness.

Conclusion--

This study had its limitations and was not as extensive as should be. However, it shed enough light upon the resulting evidence to convince one that soil testing is superior to existing guessing methods. If you have a good groundskeeper and has the knowhow, you're lucky. Most of them need help and possibly this will help you to help him.[32]

Having left the pitcher's mound approximately nine inches above home plate, Timm's[33] report explains how to build the mound up to its legal height of 15 inches. Many mounds are built like a large pimple that comes to a peak. So it should be kept in mind that the mound is not a perfect cone, but is flat-topped and longer in front than it is in the back. The mound shall be built on a nine foot radius, starting from a point eighteen inches in front of the pitcher's rubber, which is 59 feet from the home plate stake. This will allow for $10\frac{1}{2}$ feet in front of the rubber and $7\frac{1}{2}$ feet behind as shown in Figure 10. The top portion should be left flat from 12 inches behind the rubber to 30 inches in front of the rubber and 18 inches on either side. From there to the edge of the 9 foot radius is a gradual slope.

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[32] Ibid, pp. 7 & 9.

[33] Ibid, pp. 7 & 9.

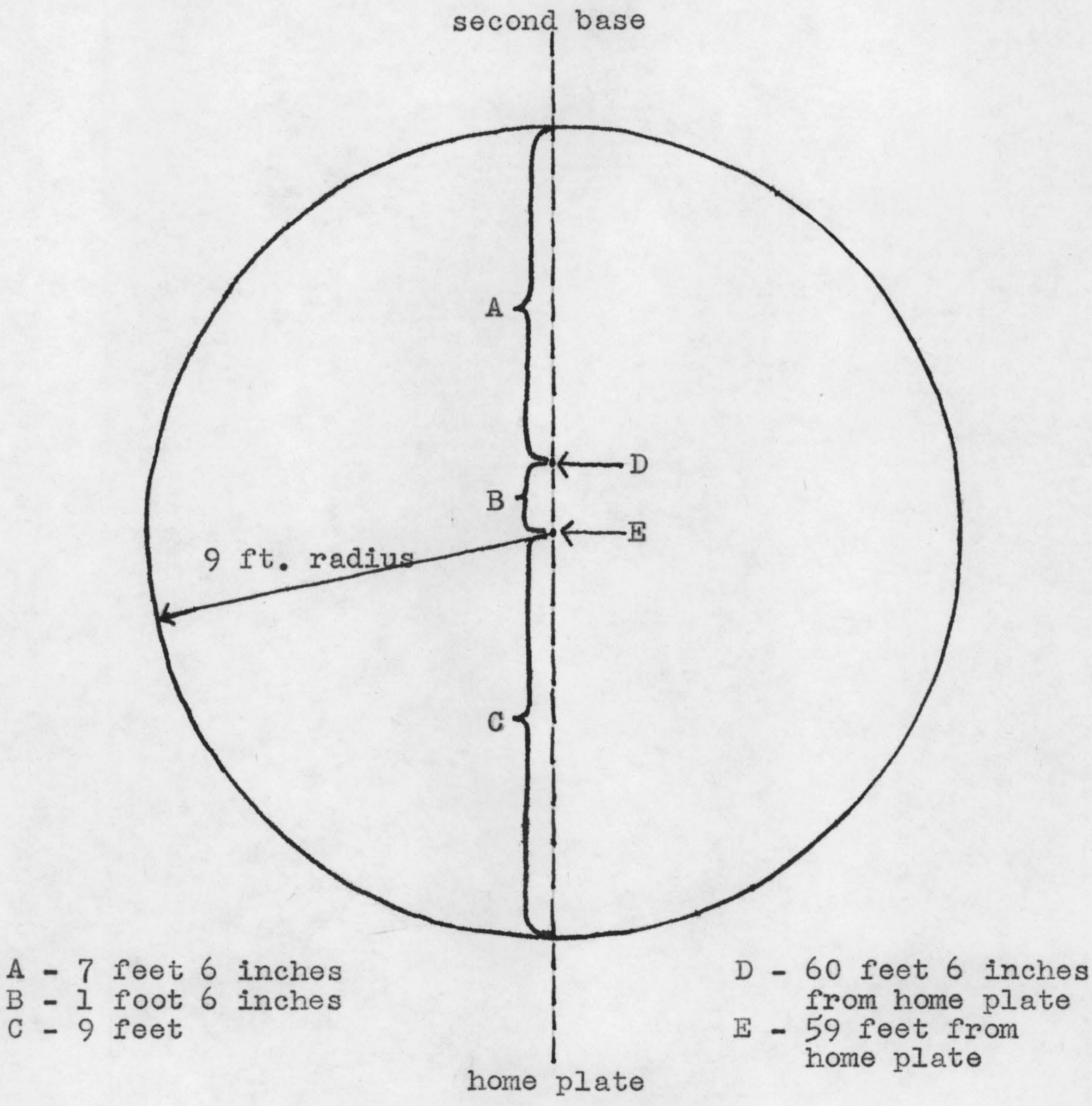

FIGURE 10*

THE PROPER METHOD OF LOCATING THE PITCHING RUBBER

* not drawn to scale

The pitcher's mound should be anchored in a concrete block. A form the size of the rubber should be made and placed just below the level of the top of the mound. When putting the rubber in its final position, grease the spikes so that it may be removed or replaced easily, and use a large carpenter's square, aligning it along the mason's line to get it perfectly square.[34]

Home plate can be anchored in the same manner. To get the proper alignment, place the mason's twine along first and third base foul lines.

The way in which you anchor the other three bases will depend on what type of bases you purchase. One type has a built-in anchor that fits into a hollow tube driven into the ground, and another type has straps that fasten to the base and then these straps are slipped through an eyelet that is fastened to the end of a spike that has been driven into the ground. Bossard's[35] experience has shown that the built-in anchor is easier to place in its proper position and will withstand the wear longer than the others.

TURFING THE FIELD

Schools, colleges, and recreation committees are often faced with the problem of establishing turf on a brand new

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[34]Whited, *op. cit.*, p. 48.

[35]Bossard, *op. cit.*, p. 15.

field, or on older ones that are going to be plowed over and re-seeded. Before deciding which plan is the best to meet the situation at hand, certain questions must be answered. The following questions were answered by Geoffrey Cornish, C. O. Brown, and Robert Schery who are specialists in the field of grasses.

1. Is it advisable to plow over poor turf and re-seed?

> Many times it is possible to convert the shabby grass into a beautiful turf by carrying out a careful plan of fertilizing, liming, aeration, and mowing. This can be accomplished at a lower cost that the construction of a new turf. Furthermore, after costly new construction, the turf may be little better than it was on the old field because the cause of its poorness in the first place was inadequate maintenance rather than constructional defects. Still there are instances when a re-seeding job is necessary. The field should be re-seeded if (a) the turf is more than 60% weeds, (b) there is less than 3 to 4 inches of topsoil, (c) extensive subdrainage is needed, (d) the surface is bumpy and uneven with inadequate pitch for surface drainage. Even if the field is going to be plowed and re-seeded, it is often possible to salvage quantities of good sod, and by using a sod cutter, this sod can be stripped inexpensively and used to advantage on the new field.[36]

2. What is the ideal time span for building a new field?

> Though not always possible, about six months is a good period to allow for building a new baseball diamond. North of the Bermuda grass area (explained in question 6) the most successful program includes completion of topsoiling together with incorporation of peat, sand, superphosphate, and lime by early May. The area is then cultivated periodically over the summer months. Finally, graded, fertilized, and seeded.[37]

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[36] Geoffrey S. Cornish, "Turfing New Fields", Scholastic Coach, (January, 1955), pp. 52.

[37] Ibid, p. 53.

3. What depth and type of topsoil are needed?

A depth of at least six inches is needed, but to allow for settling eight inches of loose soil should be added. If it is not possible to provide this much top soil, cuts should be made on practice area, surrounding strips, and outfields with the full depth allowed on the infield.

When purchasing top soil remember the physical condition of the soil is more important than the chemical content because plant food elements can be added through fertilizing. The type of dirt best for your situation was discussed earlier in this report but no matter what type it is, it should be reasonable free of stones, clay lumps, and other debris. Screening the soil can be done if the equipment and time is available.

The method of distributing the top soil will depend on the equipment that you have. Light farm tractors, bulldozers, and graders are used in most instances. Care must be taken not to crack or disrupt the tile lines. If they have been carefully laid and backfilled, most of the danger has been eliminated.[38]

4. What care is needed after seeding?

Watering the new grass, if the weather turns dry, is required. This may involve quite a bit of work if the seed is not sown when there is nearly always a sufficient natural precipitation. When the new grass has grown to about three inches high, it should be clipped down to two inches. Any areas where seed did not grow should be re-sown at the time of the first mowing. In September following the spring seeding or in April following September seeding, the new field should be fertilized and from then on it should be maintained as outlined later in this report.[39]

5. Is a grass infield better than a dirt infield?

On the perennial skinned vs. grass infield question, Cincinnati, Ohio's ball parks are skinned because they can be maintained in top condition more economically than the sodded areas at the same playing level. Having the infields skinned also makes it possible to use the field for both softball and baseball since baselines can be shifted easily to the required distance.

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[38] Ibid, p. 53.
[39] Ibid, p. 54.

T. E. O'Halloran, superintendent of the landscape division of the Chicago Park District, says:". . . . both have merit because much depends upon the degree of use and quality of soils. A well established sodded infield used exclusively for baseball can be maintained with a minimum of attention if only a normal number of games are played on it each week. This is not possible on diamonds used a number of times every day, or where baseball and softball are played on the same diamond, because grass is worn bare across the center of the diamond and holes or depressions are being made by player activity. The skinned infield increases the dust problem, but it also eliminates the hazard of personal injuries from crazily bouncing baseballs, and makes for better played games."[40]

Other reasons in favor of the grass infield were that it provides color that increases the esthetic value of the area, forms a safety cushion that helps protect players from injury, and eliminates the nuisance of mud and dust.[41]

6. What are the best grasses?

The best turfgrass for your athletic field? Simple. Its the one which will grow best, look best, and endure best under your climate and soil, your use, and your understanding of its needs. 'Best' becomes a matter of momentary opinion, varying with the season, with care, or even with the psychology of the moment. As one writer stated, doesn't the grass look greener to a winner? When deciding on the grasses, the best way to begin is to narrow the field of candidates by eliminating first those which are obviously unsuitable. What are some of the factors which remove a grass from consideration. First, if the seed is not readily available, it would be an unwise choice. Because of this reason, only the proven lawn species need be generally considered. Plus being readily available, they are attractive and durable as well. Second, prima donna grasses are not wanted for the athletic field. A sports field is home for the rugged,

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[40]C. O. Brown, "Conditioning and Maintenance of Baseball Diamonds," Recreation, (April, 1956), p. 168

[41]Ibid., p. 169.

whether athlete or grass. Grasses that need pampering are not the most suitable. Grasses of this type are annual bluegrasses, creeping bentgrass gems, putting green, shallow-rooted Poatrivialis, and short-lived annual species often dignified by the appellation 'nurse grass". Rye grasses, redtop, and other impermanent sorts are left out of the mixtures. The use of legumes is not recommended because they become slippery underfoot. Third, grass that requires special attention or expensive tastes would be an infrequent choice. A grass of this type is Colonial bentgrass which requires frequent watering, thatch thinning, and disease control. It is also short rooted, not the best footing. Fourth, grasses that are slow to heal or recuperate are doubtful candidates, since scarring of the turf will be inevitable. Grasses that spread by runners such as Kentucky bluegrass and creeping fescues in the north, or Bermuda grass in the south are more satisfactory than bunch grasses such as ryegrass. And by the same token, slow-growing species, even if forming an excellent turf, are hardly fit candidates. Lack of fertility or water should not be much of a consideration. Fertilizer and water should be available. Because of the beating the athletic field takes, overseeding and repair are accepted parts of normal upkeep. Finally, all grasses have seasons of at least partial dormancy. Grasses that are actively growing at the time the turf is being used should be selected.[42]

Bermuda grass can be used in the middle latitudes during summer, but it would not prove satisfactory from the Ohio valley northward because of its early dormancy and lack of durability when dormant. In the south, athletic fields thrive upon grasses which thrive during the relatively long growing season. In the north, grasses which thrive in cooler weather are the obvious choice, even if in summer the field must endure some thinning of turf and an influx of weeds. In the middle zones, pains must be taken to treat northern species with consideration during summer; or trying to keep southern grasses hardy, in fields receiving extensive use only in the summer.[43]

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[42]Robert W. Schery, "The Best Turf For Athletic Fields," <u>Scholastic Coach</u>, (January, 1960), p. 44.

[43]<u>Ibid</u>., p. 46.

Figure 11 shows the recommended turfs for five major zones. In the north, Kentucky bluegrass and red fescues best serve year-around need. A number of bluegrass varieties are on the market.

Merion is a low growing, and slow sprouting grass that requires extra fertilization, and is especially subject to certain diseases. Natural Kentucky bluegrass, by contrast, prefers higher mowing which is normal for most athletic fields. Other varieties include Arboretum, Cascade, Delta, Newport, Park, and Troy. Natural bluegrass seed comes from unpampered sods, some of which have existed since colonial times.

Fescues is a somewhat larger seed than Kentucky bluegrass, and provides a good initial coverage; yet they are not so repressive of slower grasses as would be nurse grasses, ryegrass and redtop. Some fine fescue varieties include Chewing, Illahee, Rainier, and Pennlawn, in addition to the parent creeping red.

For the northern athletic fields, mixtures based upon Kentucky bluegrass are suggested, with some fine fescue.[44]

For the middle latitudes which would involve the Mississippi valley as far north as St. Louis and the lower Ohio valley, summers are especially difficult on bluegrass

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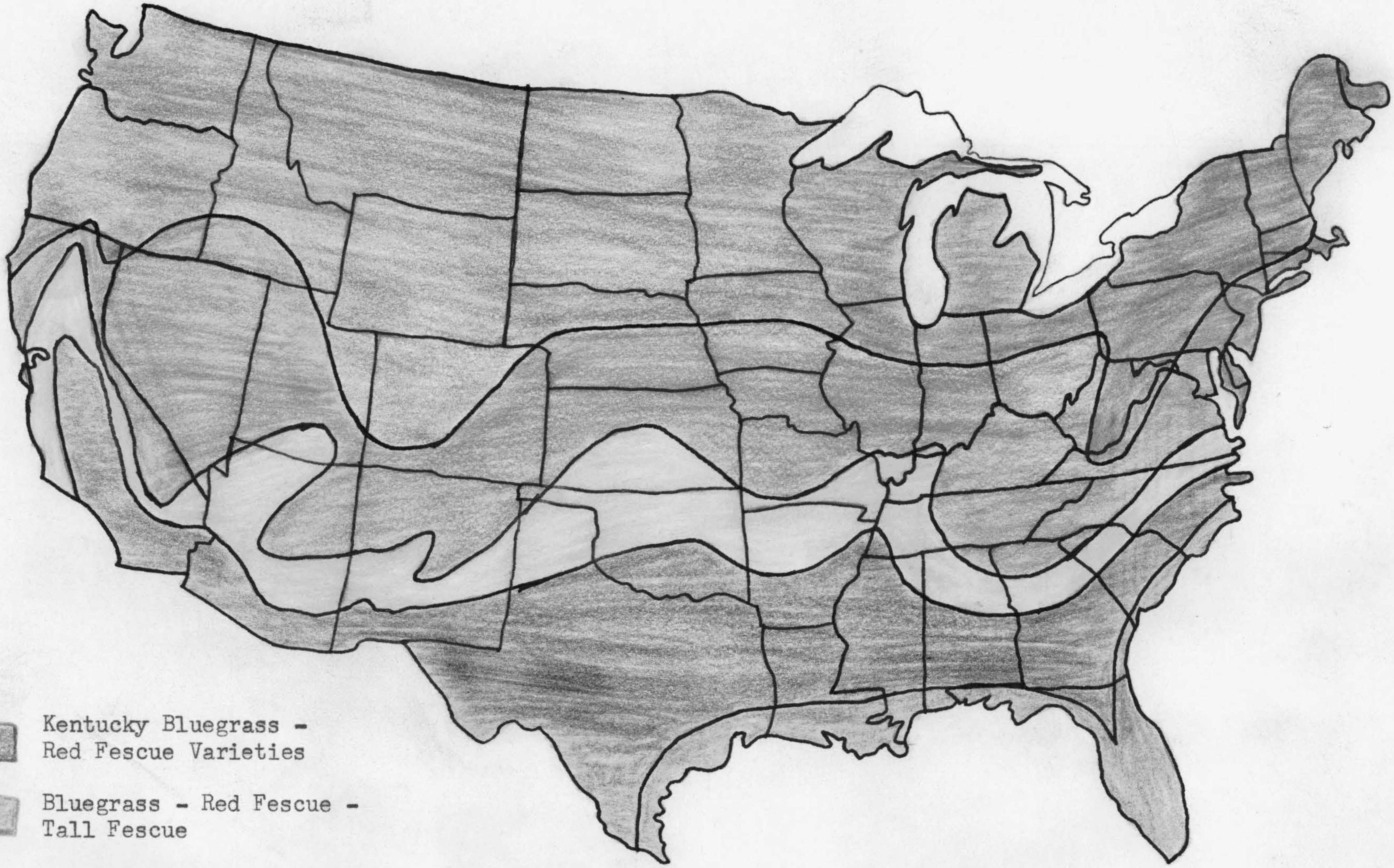
[44]Schery, op. cit., p. 70.



- Kentucky Bluegrass - Red Fescue Varieties
- Bluegrass - Red Fescue - Tall Fescue
- Bermudas (Summer use) or Bluegrass and Fescues
- Bermudas (and "Annual Wintergrass" where desired)
- Bahia - Bermuda

FIGURE 11

RECOMMENDED TURFS FOR FIVE MAJOR REGIONS unless it is given consideration of high mowing and fertilization in autumn rather than summer. Tall fescue first, seconded by the bluegrasses and red fescues will make a good field in this area. Another approach is to use hardy bermuda grasses for fields being used predominately during the summer. Bermuda can be overseeded with winter grasses in autumn, or winter grass can be alternated with annual Bermuda sown each spring.

In the south bermuda grass best fills the athletic field needs. The most economical is common Bermuda seed which can provide an attractive field if provided ample fertility, water and frequent mowing. An alternative to the bermuda grass in the deeper south, available as seed, is Bahia grass. It is often mixed with tall fescue.

In the West, a great deal depends on whether or not the land is irrigated. Under limited rainfall, buffalograss may prove satisfactory for summer use, as might some of the crested wheatgrass farther North. Neither of these is a really tight turf.

When irrigation is used, maintenance is less troublesome in arid climates than in the humid East, for the same grasses used in the East. Where watering is possible, bluegrass should give excellent service in the more northernly plains, and bermudas should provide excellent service south of Albuquerque-Wichita.[45]

BACKSTOP AND FENCING

The back stop should be sixty feet behind home plate as the rule book suggests. It should be at least 20 feet high, 40 feet wide with extension wings running part toward and parallel to the first and third base lines. These wings need to be only 10 to 12 feet high. This height will give ample coverage for overthrows on the first and third base lines.

Timm[46] recommends three inch pipe securely anchored in concrete for the frame work, with one and a half inch pipe being used to tie the frame together at the top. The entire surface should then be covered with woven wire or cyclone type fence. The wire should be placed on the diamond side so that erratic rebounds do not occur. The screen and posts should be painted; preferably with an aluminum paint first followed by a coat of dark green paint. Woven wire fences have a bad feature of curling upward along the ground from repeated rebounds. To overcome this obstacle, place two 10-inch planks, well creosoted, on edge along the base of

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[45]Ibid., p. 71.

[46]Timm, op. cit., p. 15.

the backstop. These can be fastened to the posts by using clamps which are sold by most fencing firms. Then staple the wire to the planks. A little dirt with grass seed may be placed along the bottom edge of the planks. This will in turn cause the balls to curve upward when hitting the bottom of the screen.

If the outfield is to be fenced in, the type of fence will depend on the location and other uses of the area. Permanent board fence would be most desirable. This isn't usually possible because most fields must be used for multiple purposes. A woven wire fence is also a good outfield fence but reasons for not using it are the same as the wooden fence. A snow fence that can be purchased quite reasonably seems to be the best solution if the fence has to be taken down. Most of these are four feet high and slatted without sharp pickets on top. Metal posts should be purchased that a flange to hold it solidly in the ground. The posts should be driven in so that the top is below the level of the top of the fence. Posts should be spaced about fifteen feet apart.

MAINTENANCE

Most baseball coaches at the high school and college level are aware of the importance of having a well-kept field for their players to play and practice on. This is the job of the grounds keepers or maintenance crew. Areas that will be discussed are the grassed areas, dirt part of the infield, pitcher's mound, home plate area, base paths, marking of field, watering, fertilizing, and mowing.

The preparation of these areas is not as difficult as most grounds keepers and coaches believe. Some schools do not have more than one man available for the maintenance of the field, making it necessary for the coach to help with some of the duties.

Lee Carey's[47] experience has shown that every ball field, regardless of the nature of the soil, should have a fresh layer of dirt mixed with sand to form a layer between one-half and three-quarters of an inch thick. This should be on the skinned areas of the infield, with the exception of the pitcher's mound and home plate area. To keep this soil mixed thoroughly, it should be disced or plowed up at least once every three years to a depth of about 3 inches.

The next step is to drag this turned over soil thoroughly with a nail drag made of three or four rows of 2 x 4's or 2 x 6's, 3 feet long. Between twenty and thirty 16 penny nails should be driven into each board and spaced so that

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[47] Lee M. Carey, "Maintaining the Baseball Diamond", <u>Athletic Journal</u>, (January, 1960), p. 64.

they will cover the underside of the drag thoroughly. This should be pulled around on foot because a vehicle tamps down dirt before it is ready to be packed. Besides leveling the field, this dragging process also brings many rocks to the surface where they can be easily disposed. After the field has been leveled, it must be packed in order to keep rain or any other water from standing on the field. This packing closes the pores in the soil and allows for a run-off of water, and also provides a hard foundation so that spike or cleat marks will not dig up holes or pits which give a baseball bad bounces. By mixing sand with dirt and putting it on the dirt areas, a cushion will be provided and it will also keep the field properly proportioned. This cushioning can be accomplished by wetting the field thoroughly and letting it dry enough so that the nail drag will penetrate through the sand and mix with a thin layer of dirt without becoming muddy. The field will be damp but when it dries, it will be ready for play.[48]

The skinned area should be dragged immediately after practice and after games. Any places where dirt has been dug out should be filled in. A stockpile of dirt placed nearby for filling in these holes should be covered with a canvas so that dry dirt will be available when needed.

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[48] Ibid., p. 65-66.

When the grass areas are to be mowed, Schery[49] stipulates that a reel type mower should be used. The outfield grass can be cut the same length as the infield grass which will leave an even cushion on both the infield and outfield; or the infield can be cut shorter than the outfield if you want a fast infield. Kentucky blue grass should not be cut any shorter than one inch. In the northern part of the bluegrass zone, a thickness of two inches is recommended. Bermuda grass in most areas can be cut to one inch without presenting a problem. Greater leafage enhances energy reserves, results in deeper rooting, and the denser foliage lessons weed invasion. Fertilizer should be applied when it will have the greatest influence on the type of grass you have planted. For bluegrass turfs, the main season for feeding would be autumn. This builds strength into the turf at a favored season and carries over into the following year.

In the more northern regions of the bluegrass zone, fertilization is appropriate the year round. But in the South, the reverse holds. Bermuda grass flourishes during summer, and needs ample fertility from spring until autumn. Fertilization can taper off as cooler weather begins, so as to prevent

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[49]Schery, _op_. _cit_., p. 73.

lush growth that may lack winter hardness, and to withhold fertilizer from the winter feeds that frequently become prominent in dormant turf.[50]

Most agronomists agree that a standard commercial fertilizer should not be used as an all-purpose fertilizer. By having the soil chemically analyzed for nitrogen, phosphorus, and potash a proper fertilizer can be added to meet the required needs of the soil.

In his studies on grass, Schery[51] found that rainfall is seldom adequate for the establishment of new turf, therefore making it necessary for frequent watering. As the roots grow deeper, frequency of watering can be lessened.

There are differences of opinion as to the need for watering athletic fields once the turf has been established. In its first year, grass will incapable of enduring more drought, and should be watered anytime wilting starts. But once the turf is fully established, it will withstand a period of dryness. Fields not in play during summer months can very likely service drought-induced dormancy without harm. The

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[50] Ibid., p. 73

[51] Ibid., p. 73

field should be watered a few weeks before the field is to be used, if ample rain has not fallen within this period. Bluegrass and fescue in the North and bermuda and bahia in the South, are quite drought tolerant.[52]

The marking of the field is an important process, in that it helps the appearance of the field, helps the players and umpires, and according to the Official Baseball Rules, the foul lines and all other playing lines shall be marked with wet lime, chalk, or other white material.[53]

White paint is a good material for painting the two posts that should be placed at the end of the foul lines. White paint is also good for marking lines on the grass area of the field. With the grass cutter shorter on these lines than the rest of the field, take a paint brush or paint sprayer and paint the foul lines, coaches boxes, and any other lines that may be necessary. One application will last for a season and enough of it will remain from year to year so that it can be followed again without remeasuring. The lines on the dirt should be chalk dust, dry or wet lime and they should be applied before each game. The baselines

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[52]Ibid, p. 72.

[53]Ibid, p. 72.

and the three foot lines may be put on the morning of the game, and the batter's and catcher's boxes just before the game.

The maintenance or grounds keepers may also be involved with setting up and taking down the bleachers, and also the setting and taking down the fence which has been placed in the outfield. If dugouts are not in your plans, benches should be provided for the players. These benches are placed along the edges of the playing field and there should be at least twenty feet of bench space available for each team.

CHAPTER IV

SUMMARY

The construction of a new facility involves unified and long-range planning by the school administrator and others who are going to use the facility. This group should establish a general outline to be used in the development of the facility. The architect is an important member of the planning group and should be selected after careful consideration. Whenever facilities are being constructed, errors may occur which may have been omitted if the proper planning procedure is not employed.

The position of home plate must be determined, and the field laid out preferably by engineering instruments, before the construction can begin. If natural surface drainage is going to be used, the grading slope of the infield should slope away from the pitcher's mound, and the outfield should slope away from the infield to the limits of the field at a slope of one foot per 100 feet.

In subsurface drainage, the main line should run through the middle of the diamond with smaller laterals leading to it. Types of drains that can be used are French and canvas covered. Milwaukee County Stadium uses a herringbone pattern when laying their drains.

The type of soil and grass that is used will depend on the geographical area in which the field is to be constructed. Good top soil should be put on to a depth of four to six inches. The dirt that is placed on the pitcher's mound and home plate area is different than that placed on the rest of the dirt areas of the infield. When discussing what are the best grasses in the United States, there are five different zones where different grasses are grown.

A good backstop with extension wings is important because of the number of balls that are saved, safety features, and general appearance of the area. Woven wire or cyclone type fence make the best backstop and a snow fence is the best for the outfield.

Even though the procedures in the construction of the baseball field are carried out carefully, it is important for the field to receive good maintenance. A good groundskeeper or maintenance crew will take pride in working up the soil, dragging the field, mowing and watering the diamond, putting on the proper fertilizer, and establishing good field markings for each game.

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APPENDIX

I. INFIELD SAMPLES (SKINNED AREA)

II. MOUND AND BATTER'S BOX SAMPLES

III. BLUEPRINT OF MILWAUKEE STADIUM

TABLE I

INFIELD SAMPLES (SKINNED AREA) - MECHANICAL AGGREGATE ANALYSIS

Sample From	% Sand	% Silt	% Clay	Textural Classification*	Comment
College					
Yale U.	80.76	12.00	7.24	Loamy sand	Well granulated, well drained-not enough clay to bind very well for good footing. Probably blows a lot when not watered.
Mississippi U.	55.12	30.00	14.88	Sandy loam almost loam	Soil contains Kaolinite clay which does not swell or get sticky when wet. Lots of free iron oxide (red color). Would need water to keep it from chalking. Sand % low but would be OK with kind of clay. River sand topping accounts for high silt %.
Minnesota U.	77.12	14.00	8.88	Sandy loam almost loamy sand	Seemed artificial with much sharp sand mixed in. Would drain well, but be loose footing & blowy when dry.
Fresno State	62.56	24.72	12.72	Very fine sandy loam	Wind blown adobe soil-good mixture-however very fine particles-may compact easily-need spiker often.
Illinois U.	38.20	46.08	15.72	Silky loam almost clay loam	Very heavy soil which should compact easily, yet Lee Eilbracht says they never need to use spiker. Only logical answer is their wonderful drainage. It has coarse aggregate fill underneath coupled with a circular drainage system and diamond is considerable higher than outfield.
Iowa State	65.44	20.68	13.88	Sandy loam	Surface sail from alluvial terrace-containing considerable coarse sand which was screened and ground.
Professional					
Cleveland Indians	82.40	13.44	4.16	Loamy sand	Very fine sand-low organic matter-would drain well. Believe needs more clay for binding quality, blowy when dry.
Detroit Tigers	78.20	12.08	9.72	Sandy loam	Fine particles-loose, blows when dry. Need rolling for compaction-will take water readily.
Cincinnati Reds	62.20	23.08	14.72	Sandy loam	Very good mixture-added fine slag-inert material as a conditioner-drains well-will not compact too much.
Chicago Cubs	75.68	10.00	14.32	Sandy loam	Coarse sand, medium organic matter, Krilium added as a conditioner, 10 lbs. per 100 square feet. Roto-tilled to depth of $1\frac{1}{2}$ inches. +

*Textural classification based on triangle guide - U.S. Department of Agriculture.

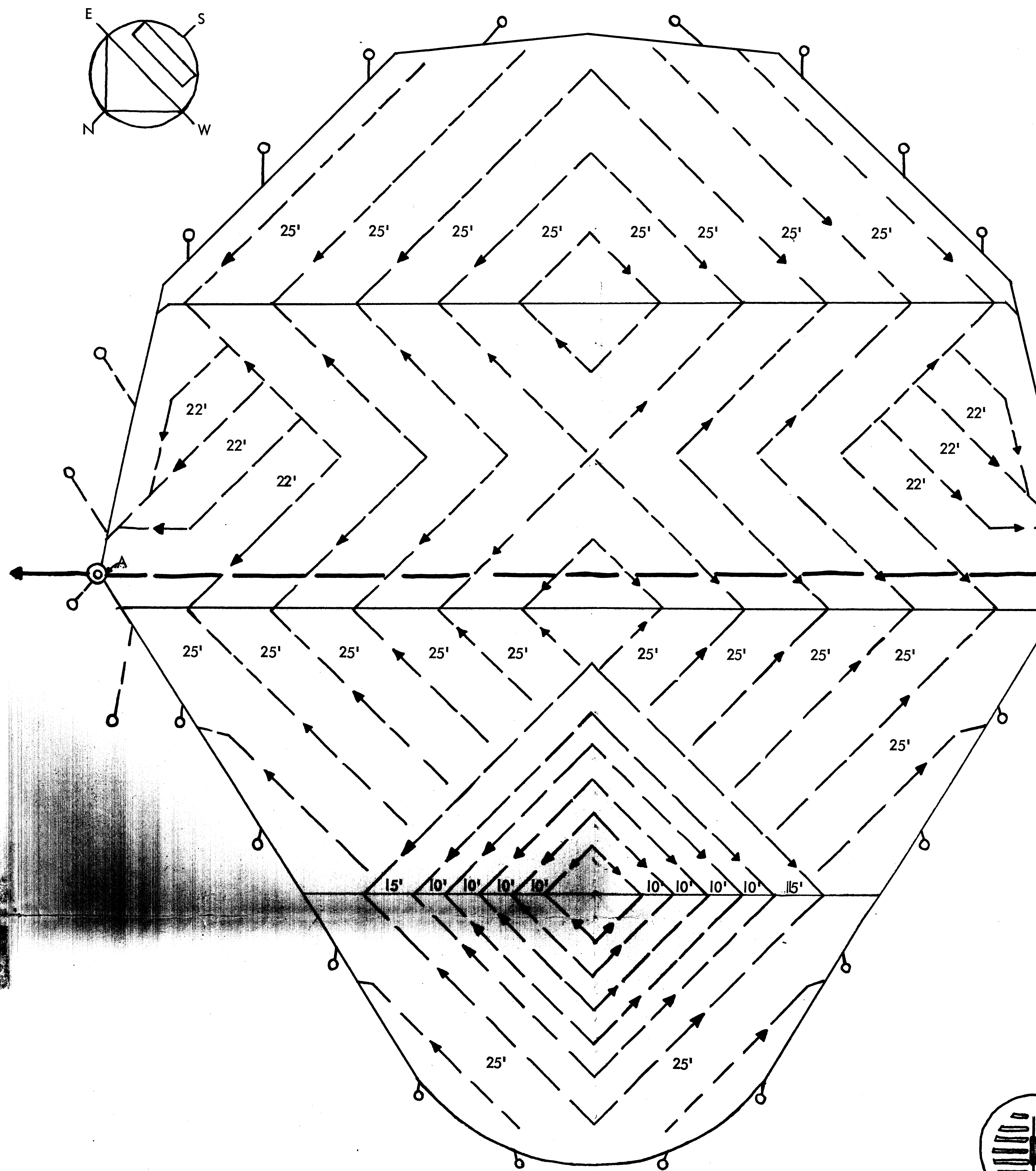
+L.C. "Cap" Timm, Report on the Physical Aspects of Baseball, (unpublished report, Iowa State College, Ames, Iowa) p. 8.

TABLE II

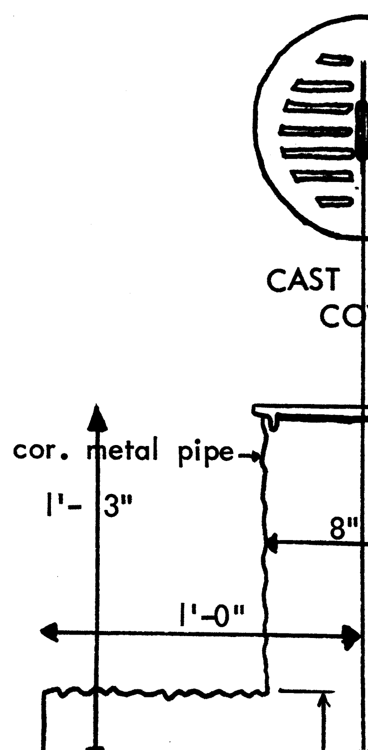
MOUND AND BATTER'S BOX SAMPLES - MECHANICAL AGGREGATE ANALYSIS

Sample From	% Sand	% Silt	% Clay	Textural Classification	Comments
College					
Yale U.	75.12	14.00	10.88	Sandy Loam	Obviously too much sand-no binding qualities. Needs conditioner for binding.
Mississippi U.	49.12	24.00	26.88	Sandy, Clay, Loam	Gray clay (Kaolinite) low plasticity. Does not shrink or swell on wetting-drains quite well. Will chalk up unless dampened.
Fresno State	41.28	30.72	28.00	Adobe Clay Loam	Fine wind blown particles (adobe). Compacts easily. Greasy when wet-like concrete when dry. Water regularly-allow plenty of time before use.
Illinois U.	44.20	31.78	24.02	Almost loamy clay	Burnt moulders sand added-granular-many inert particles. Will keep heavy soil from binding too much.
Iowa State	45.30	28.20	26.50	Sandy clay loam	Burnt brick clay added & mixed-wetted and tamped in front of rubber, stride position & batter's box.
Professional					
Cleveland Indians	65.88	11.00	23.32	Sandy Clay loam	Light gray clay-low plasticity. Believe too much sand for good binding quality.
Detroit Tigers	30.20	39.08	30.70	Clay loam	Heavy-hard plastic clay-will compact easily. Need plenty of water so as not to get too hard. Cut in some crushed, screened limestone or sand.
Cincinnati Reds	45.68	19.00	35.32	Clay loam	Many granular & sand particles-help drainage and wouldn't pack too hard.
Chicago Cubs	45.68	19.00	35.32	Clay loam	Clay a very heavy, plastic type. Would get very hard on drying. Cut in some crushed, screened limestone or sharp sand such as burnt moulders sand.+

+L.C."Cap" Timm, Report on the Physical Aspects of Baseball, (unpublished report, Iowa State College, Ames, Iowa) p. 8.

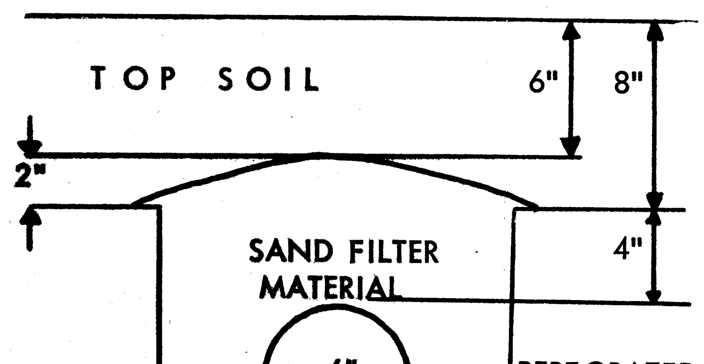


DRAINAGE PLAN
scale 1" = 40'



LEGEND

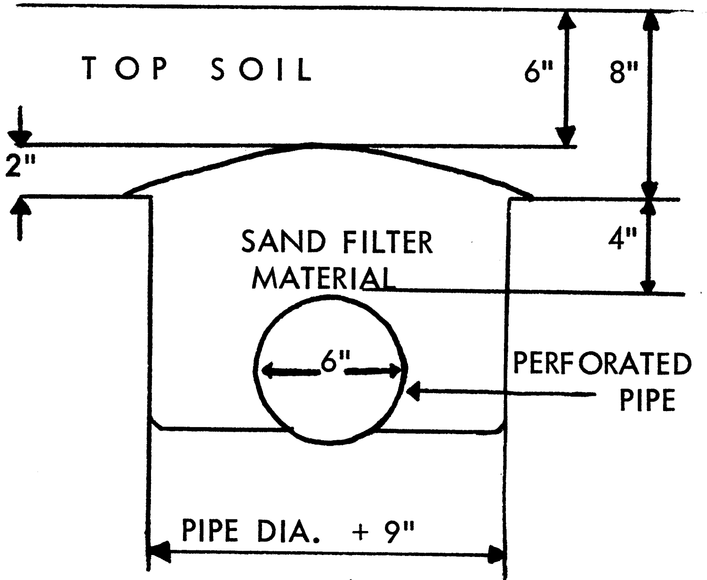
▬▬▬	outfall sewer (24" in dia)
———	tight joint sewer (6" in dia)
— —	perforated under drain (6" in dia)
-◎-	manhole



D R A I N A G E P L A N
scale 1" = 40'

L E G E N D

(thick solid line)	outfall sewer (24" in dia)
(solid line)	tight joint sewer (6" in dia)
(dashed line)	perforated under drain (6" in dia)
(manhole symbol)	manhole
(catch basin symbol)	catch basin
A to B	410 feet



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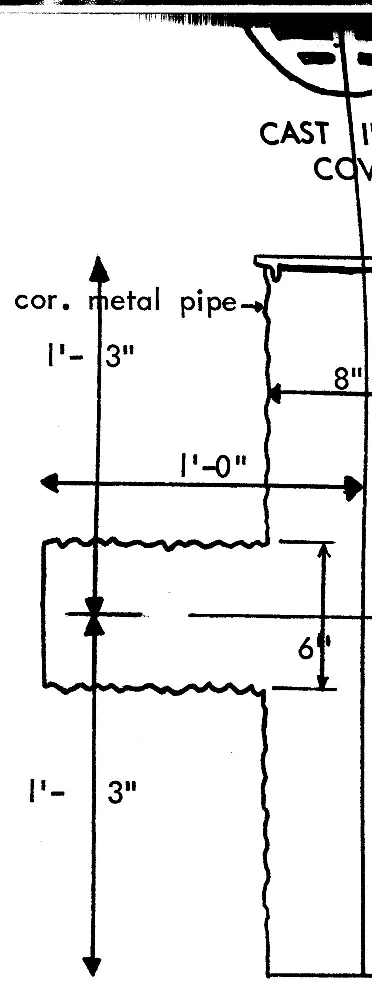
T Y P I C A L - U N D E R - D R A I N



1 CU. FT. BROKEN STON

scale 1

T Y P I C A L D E T A I L

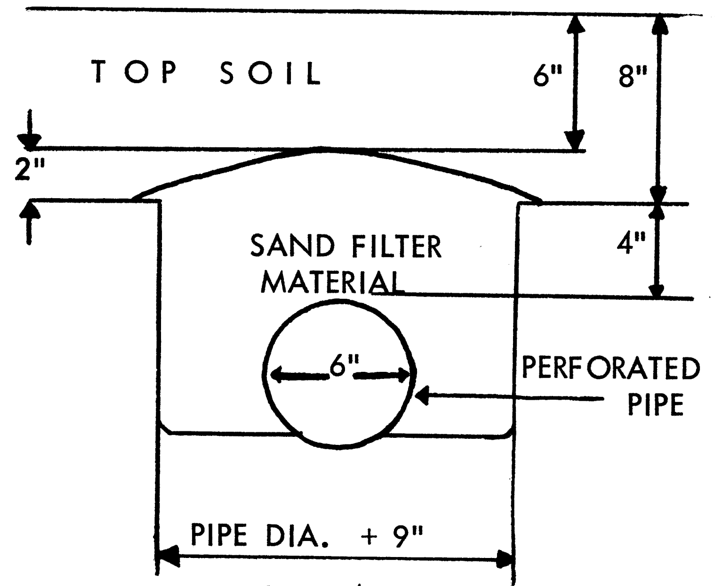
FIGURE 9+

+Blueprint of Milwaukee County Staduim, Drawing no. 6505-9 (Drainage Plan & Details) The Osborn Engineering Co., Cleveland, Ohio.

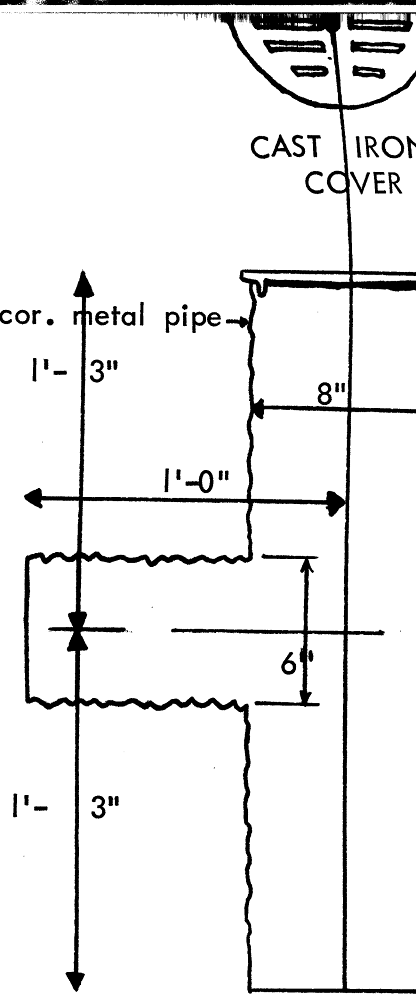
DRAINAGE PLAN
scale 1" = 40'

LEGEND

(thick solid line)	outfall sewer (24" in dia)
(solid line)	tight joint sewer (6" in dia)
(dashed line)	perforated under drain (6" in dia)
(manhole symbol)	manhole
(catch basin symbol)	catch basin
A to B	410 feet



scale 1 1/2"= 1'-0"
TYPICAL-UNDER-DRAIN



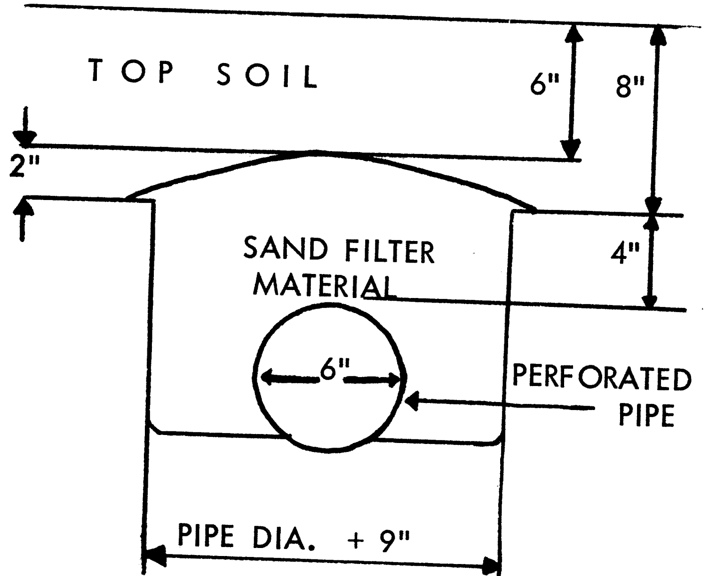
1 CU. FT. BROKEN STONE O
scale 1 1/2"
TYPICAL DETAIL C A

FIGURE 9+

DRAINAGE PLAN
scale 1" = 40'

LEGEND

(heavy line)	outfall sewer (24" in dia)
(line)	tight joint sewer (6" in dia)
(dashed line)	perforated under drain (6" in dia)
(manhole symbol)	manhole
(catch basin symbol)	catch basin
A to B	410 feet



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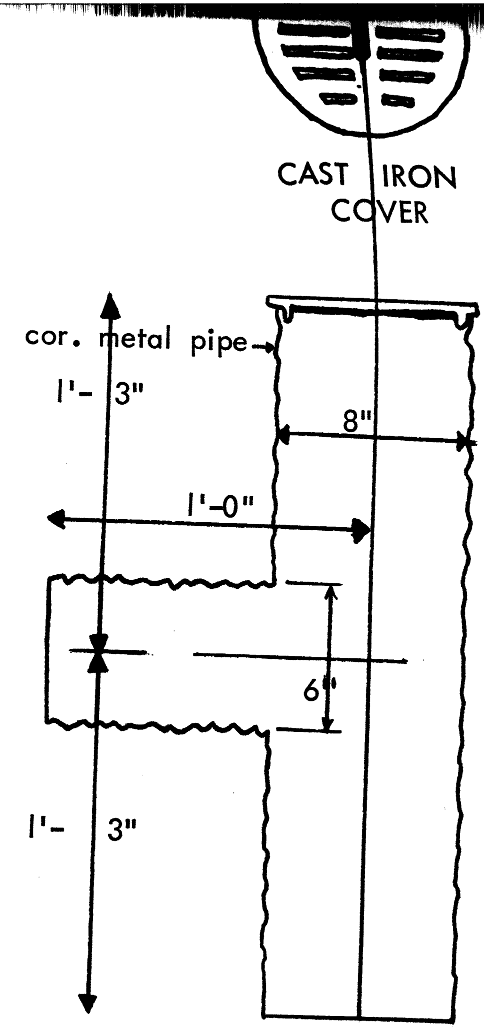
TYPICAL UNDER-DRAIN



1 CU. FT. BROKEN STONE OR G
scale 1 1/2"= 1"

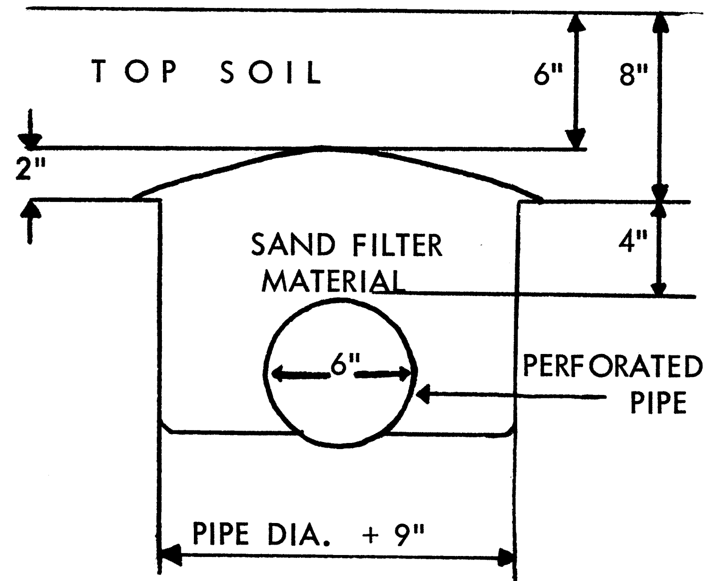
TYPICAL DETAIL CATC

FIGURE 9+

DRAINAGE PLAN
scale 1" = 40'

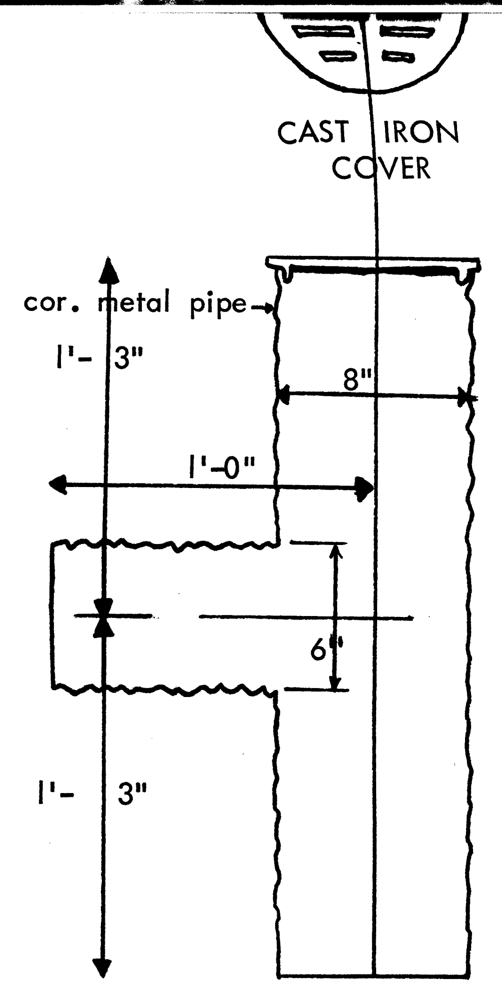
LEGEND

- outfall sewer (24" in dia)
- tight joint sewer (6" in dia)
- perforated under drain (6" in dia)
- manhole
- catch basin
- to B 410 feet



scale 1 1/2"= 1'-0"

TYPICAL-UNDER-DRAIN



1 CU. FT. BROKEN STONE OR GR
scale 1 1/2"= 1"-

TYPICAL DETAIL CATC

FIGURE 9+