Chapter 1

Field Design

1.1 INTRODUCTION

In this chapter, we will consider the design of baseball and softball fields from the perspective of the field and surrounding areas. The discussion includes such design elements as contour plans, warning tracks, and access to the field for players, spectators, and equipment. It also considers the design of both skinned and grass infields, and alternative methods of laying out multiple-field complexes.

The chapter begins with the most important single factor affecting the playability of a baseball or softball diamond: contouring. If, for example, a field is not sloped enough to facilitate surface drainage, water puddles will eventually be a problem. On the other hand, if the field has too much slope, playability will be affected by unpredictable ball response and the field will have a disorienting effect on players. If the contours are not uniform, the result will be an uneven surface and heavy rainfall may produce ruts. If the facility is not correctly designed and constructed in the first place, reconstruction will be required to achieve positive surface drainage.

1.2 SURVEY AND LAYOUT

Professionals engaged in the design and construction of athletic fields are frequently called upon to fix fields that are plagued by wet spots, ruts, or other problems. In many cases, a quick examination of the facility shows that it was constructed without the benefit of a thorough survey. Sometimes the original planners just thought it looked level. In other cases, the field started out as a mowed area used for practice or informal play and then was needed for games.

To avoid problems with the field contours, it is essential that any new construction or reconstruction project begin with a thorough survey of the site. Intuition and the naked eye will not provide sufficient understanding of the topography of the area; only a careful survey will accomplish that end.

(Note that the process of surveying includes shooting topographic elevations, measuring the dimensions of the area, and noting such features as streams, structures, roadways, and the like. All are important to the design of a solidly performing diamond.)

In surveying and laying out a baseball or softball diamond, it is best to proceed according to this sequence: First, survey the boundaries of the area, making sure there is sufficient room for the playing field, including foul territory. As a general rule of thumb, it is wise to survey about twice the area of the field itself. Next, using the measurements
taken of the area, make a drawing, on which you will mark elevations. Then establish a
grid pattern on your drawing, and place markers on the ground to match the grid pattern
on the drawing. In designing a new field, it is customary to survey the site using a 50 ft
grid pattern. This is sufficient to establish the existing contours of the site where the field
will be constructed. Shoot elevations and mark them on your drawing, establishing a
benchmark at a permanent point, such as a curb or a sewer lid. (All elevations are stated
in relation to the benchmark.) A computerized surveying instrument called a “total sta-
tion” records all measurements and elevations and allows them to be downloaded to a
computer.

(In planning for the reconstruction of an existing field, it can be helpful to shoot the ele-
vations of the key points on the diamond; simply shooting on a grid pattern will miss the
most important points that are critical to good playability. Be sure to take measurements
to existing backstops, dugouts, fences, and other structures, and include these measure-
ments on your drawing. A surveying worksheet used for shooting necessary elevations for
a reconstruction project is presented in Chapter 5, Figure 5.20.)

Using the information from the survey, make a new drawing of the area to scale, and
mark on it all the measurements, elevations, and other information on the topography of
the area. Then lay out the field or fields, using dimensions such as those in rule books or
given in Chapter 11 of this book.

In laying out the field, it is important to consider its orientation, the relationship of the
field to the points of the compass. Although many fields are simply oriented to the avail-
able space, some official rule books for baseball and softball recommend laying out the
facility so that a line drawn from the tip of home plate through the pitcher’s plate and sec-
ond base points in an east-northeast direction. This orientation prevents the batter and
catcher from looking into the sun as they stand at the plate and positions most of the field-
ers so that their eye line to the batter is not directly into the setting sun. You may want to
establish the orientation for your field based on the time of year and the time of day when
the field is most typically used.

It is also important to reserve space for the dugouts, backstop, surrounding fence, and
other peripheral elements. All too often, a failure to plan for these structures forces the
builders to install them in an awkward and unsuitable fashion, which may compromise
player safety and disturb a well-planned drainage scheme.

Table 1.1 suggests minimum space requirements for baseball and softball fields, with

<table>
<thead>
<tr>
<th>Type of Field</th>
<th>Distance to Center Field Fence (ft)</th>
<th>Acres</th>
<th>Sq Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseball:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 ft Bases</td>
<td>400</td>
<td>4.5</td>
<td>195,000</td>
</tr>
<tr>
<td>80 ft Bases</td>
<td>315</td>
<td>2.8</td>
<td>123,000</td>
</tr>
<tr>
<td>70 ft Bases</td>
<td>275</td>
<td>2</td>
<td>90,000</td>
</tr>
<tr>
<td>60 ft Bases</td>
<td>215</td>
<td>1.5</td>
<td>64,000</td>
</tr>
<tr>
<td><strong>Softball:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 ft Bases</td>
<td>200</td>
<td>1.4</td>
<td>60,000</td>
</tr>
<tr>
<td>65 ft Bases</td>
<td>275</td>
<td>2.4</td>
<td>105,000</td>
</tr>
</tbody>
</table>

*aNumbers are rounded to the nearest 1000 sq ft.*
sufficient space around the playing field for fence lines, dugouts, spectator seating, and swales.

Table 1.2 displays the square footage of the skinned area and the grass area for common-size baseball and softball fields, including foul territory.

### 1.3 DESIGN CRITERIA FOR NEW CONSTRUCTION

The criteria that follow are based on the authors’ experience with fields that were not properly designed. They are divided into two groups: the fundamental issues that allow the field to perform well under a variety of weather conditions, and the safety issues that allow players to use the field with minimal risk of injury. Fields may sometimes be built without following these guidelines, but planners should keep in mind that departing from them may compromise the safety or playability of the diamond. Although following the guidelines may seem inconvenient, failure to follow them will almost always cause substantial problems later.

#### 1.3a Fundamental Issues

One of the most important considerations in designing a field, whether a single field, a multiple-field complex, or an addition to an existing sports complex, is to treat each field as an individual drainage unit. No field should be expected to drain away more water than that which falls on it. This is the reason for surveying beyond the playing area itself. Even if a field is built with correct contours, water running onto the field from an adjacent area can seriously compromise playability in rainy conditions.

Second, the infield should be higher than the rest of the field. To keep the infield playable, it is important that no water drains onto the infield from the outfield or the sideline areas.

<table>
<thead>
<tr>
<th>Type of Field</th>
<th>Distance to Center Field Fence (ft)</th>
<th>Skinned Area (sq ft)</th>
<th>Grass Area (sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseball:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 ft Bases–95 ft Arc</td>
<td>400</td>
<td>11,550</td>
<td>120,500</td>
</tr>
<tr>
<td>With Grass Infield</td>
<td>400</td>
<td>18,300</td>
<td>113,750</td>
</tr>
<tr>
<td>With Skinned Infield</td>
<td>315</td>
<td>8,400</td>
<td>74,500</td>
</tr>
<tr>
<td>80 ft Bases–80 ft Arc</td>
<td>315</td>
<td>13,650</td>
<td>69,250</td>
</tr>
<tr>
<td>With Grass Infield</td>
<td>275</td>
<td>6,800</td>
<td>53,550</td>
</tr>
<tr>
<td>With Skinned Infield</td>
<td>275</td>
<td>10,700</td>
<td>49,650</td>
</tr>
<tr>
<td>70 ft Bases–70 ft Arc</td>
<td>215</td>
<td>3,850</td>
<td>39,500</td>
</tr>
<tr>
<td>With Grass Infield</td>
<td>215</td>
<td>6,700</td>
<td>36,650</td>
</tr>
<tr>
<td>With Skinned Infield</td>
<td>215</td>
<td>8,350</td>
<td>31,500</td>
</tr>
<tr>
<td><strong>Softball: (Skinned Infield)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 ft Bases–60 ft Arc</td>
<td>200</td>
<td>8,350</td>
<td>31,500</td>
</tr>
<tr>
<td>65 ft Bases–65 ft Arc</td>
<td>275</td>
<td>9,300</td>
<td>61,450</td>
</tr>
</tbody>
</table>
Third, the highest point on the infield is the pitcher’s mound, and the infield slopes away from the mound in all directions. (The height of the pitching plate, or “rubber,” is specified by the sanctioning body for each level of competition. See Chapter 11 for heights established by sanctioning bodies.)

Fourth, the base lines should be as level as possible. Although a slight grade may be used on some fields to enhance drainage, sanctioning bodies typically specify level base
paths. When the base lines are not level, the overall contours of the infield can be disturbed, which may result in ineffective surface drainage.

Fifth, differences in grade should be continuous and uniform from contour line to contour line. Ideally, the slope should be set at about 0.5% for the infield, 0.5% to 1.5% for the skinned area, and 1.0% to 2.0% for the outfield. These percentages will allow surface water to run off the playing area and into catch basins or swales outside the boundary lines or to lower-lying areas surrounding the field.

Sixth, to facilitate mowing, areas outside the fences should have a maximum slope of 3:1. That is, for every 3 ft measured horizontally, the grade goes up or down a maximum of 1 ft. The generally accepted maximum slope for pedestrian walkways is 1 in. per foot. (This is, by the way, the maximum slope recommended for wheelchair access under codes related to the Americans with Disabilities Act, ADA.)

Seventh, be sure that sufficient space is left for player and spectator access to the field, in the form of walkways and driveways. Where appropriate, plan for parking at the closest possible point. (This planning will also enhance your ability to get service and maintenance vehicles to the field later.)

Finally, a good field design should take account of two important concepts. “Cutting” refers to the removal of soil when the grade must be lowered, and “filling” means adding soil where the grade must be raised. The best designs balance the amount of soil to be cut with the amount to be filled. This balance minimizes the amount of new material that must be transported onto the site or the amount of existing soil that will have to be trucked away.

1.3b Safety Issues
In designing the diamond, a number of safety issues must be considered. One of the most obvious is the distance from the foul lines to the dugouts, grandstands, and other fixed objects. As a general rule, a minimum clearance of 25 ft is recommended for Little League and softball fields, with twice as much for baseball at the high school level and above. Because players must run through this area looking upward to track foul balls, the greatest possible clear area should be allowed. (However, softball sanctioning bodies recommend no more than 30 ft from the home plate to the backstop and outside the foul lines. See Chapter 11 for the recommended clearance for each level of baseball and softball.)

If possible, catch basins should be located outside the fences surrounding the playing area to prevent player injury. If the presence of grandstands requires the installation of catch basins inside the fences, they should be placed as close as possible to the fences or grandstands. In such circumstances, a flat grid with small openings should be used to minimize the risk of injury.

Obviously, there should be no obstructions in the field of play (including foul territory). Such obstructions include bullpens, although many fields now in use were built with bullpens inside the fences in foul territory.

In designing a competitive baseball or softball field, it is always wise to have the latest copy of the rule book of the organization that governs the particular level of play. Contact the appropriate sanctioning body included in the list of addresses given in Chapter 11.

1.4 FIELD DESIGNS WITH PREFERRED CONTOURS
Baseball and softball diamonds are more complicated to design than any other type of sports fields, largely because they consist of three distinct parts that must be integrated for
the diamond to perform successfully. In discussing field design, we refer to these three parts as the *outfield* (used here as commonly understood), the *skinned area* (the groomed dirt portion of the field where the infielders customarily stand during play), and the *infield* (the area enclosed by the base paths). Even where the infield is skinned, as on a softball diamond, for design purposes the infield is distinguished from the skinned area where the infielders position themselves.

The following drawings illustrate three designs—or “grading plans”—for baseball and softball diamonds. Note that the full-field designs continue past the actual playing field and include some of the surrounding area. This is because failure to properly contour these areas can cause water to run onto the field.

### 1.4a The Outfield

The most important design principle for an outfield is that it must not drain toward the infield. Figure 1.1 shows one of the simplest and most common field designs. The outfield slopes downward from the second and third base lines to the outfield fence at a rate of approximately 1.0%. (We consider this 1.0% slope to be the minimum acceptable slope,

![Figure 1.1. The simplest and most common (good) field design—elevations noted in feet. In order to maintain a consistent slope, remember to include spot elevations for the outfield fence. (See Figure 1.4 for spot elevations of the skinned area.)](image-url)
and we recommend 1.25% to 1.5% whenever possible. Probably, 1.75% is the maximum; a 2.0% slope becomes visibly noticeable.) The most obvious advantage of this design lies is the simplicity of its contours, which makes it fairly easy to build. For instance, in constructing this field, grade stakes can be set on a 50 ft grid pattern, which is easier than finding exact contour lines through the outfield.

The most common complaint about this design is that it slopes downward from the infield to the fence; with a 1.0% slope, the outfield fence will be about 3 ft lower than the infield. Naturally, if the slope is increased, this difference becomes even greater. Another disadvantage of this design is that the entire skinned area drains into the outfield. That means water must pass through the circle at the grass edge. This edge often becomes clogged with dirt as a result of competitive play, grooming the field, and runoff, creating a “lip”—a sort of dam that retains water on the skinned area.

(Figure 1.4 shows detailed skinned area and infield contours for the full-field design in Figure 1.1.)

Figure 1.2 is an improved design, crowned from second base through center field to the outfield fence. The center crown directs water toward the boundaries and away

Figure 1.2. An improved (better) design, crowned from second base through the outfield—elevations noted in feet. In order to maintain a consistent slope, remember to include spot elevations for the outfield fence. (See Figure 1.5 for spot elevations of the skinned area.)
from the center of the field. The strength of this design is its handling of runoff. There is a shorter path for runoff from the outfield; water flows to the foul lines rather than all the way to the outfield fence. The skinned area also drains toward the foul lines, creating two exit points, behind first and third base. It is easier to keep these exit points draining effectively than to maintain the entire grass edge between the skinned area and the outfield.

The main disadvantages of this design are related to the crown. Because of the shape of the contours, grade stakes cannot be set on a 50 ft grid pattern for construction, because that grid pattern may not locate the crown precisely. The crown will also cause the outfield fence to slope away from center field toward the foul lines; in relation to the batter, the fences will be lower at the foul poles than in dead center.

(The skinned area and infield detail for this design is provided in Figure 1.5.)

The design illustrated in Figure 1.3 draws from the strengths of each of the first two layouts—we have referred to them as “good” and “better”; consider this one our “best.” In this design, a crown has been developed from second base about one-third of the way
to the outfield fence. This crown allows water to run off the heart of the field toward the foul lines. In the outer half of the outfield, runoff is toward the fence. This design sheds water effectively because it establishes the shortest paths for drainage throughout the field. With a 1.0% slope, it also allows the fence lines around the entire field to be nearly level. (With a 1.5% slope, the fences will be lower at the foul poles.)

The main disadvantage of this design is that it is more complicated to build. Grade stakes for construction will have to be placed on each contour line.

(The skinned area and infield detail for this design are shown in Figure 1.5.)

1.4b The Skinned Area

In all likelihood, the most common reason for a field to be chronically unplayable is that its skinned area was poorly designed. It is surprising how often field planners fail to give this portion of the diamond the attention it deserves; at any given moment, all but three of the defensive players are standing on the skinned area. Because of the critical nature of the slope on a skinned area, spot elevations should be included in the design in order for the skinned area to drain properly. Even a small error can have troublesome consequences in terms of playability. Refer to Figure 5.2 for more details of infield and skinned area design.

One reason to pay such careful attention to the contours of skinned areas is that these areas must rely entirely on positive surface drainage to shed water. Installed drain systems are not effective for skinned areas. Although such systems can effectively drain the turf areas of the baseball diamond, they typically work poorly in the sand/clay soil used for a skinned area. Under normal circumstances, water moves too slowly through skinned area soil and into the drain structures. In most cases, positive surface drainage is the only practical way to prevent standing water on a skinned area.

Figure 1.4 is a simple skinned area contour scheme designed for use with the overall field design in Figure 1.1. This design has a downward slope from the second and third base lines to the outfield. The design is relatively easy to build, and it works adequately in medium-to-dry climates.

However, as mentioned in the preceding section, this design has a disadvantage in that infield water must drain into the outfield through the circled grass edge. As that water runs off, it carries loose soil from the skinned area, which is then deposited in the grass edge. The deposited soil forms a sill or “lip,” preventing proper drainage and holding the water in the skinned area. The circled edge must be given constant attention to avoid this problem. (For guidance on removing this lip at the grass edge, see Chapter 6, Section 6.2, “Skinned Area Renovation,” and Chapter 7, Section 7.3f, “Grass Edge Maintenance.”)

Figure 1.5 shows a skinned area design that includes a crown, for use with the full-field designs in Figures 1.2 and 1.3. As mentioned earlier, this design channels runoff to exit points at the foul lines behind first and third bases, rather than toward the outfield. Because water does not have to flow through the circled grass edge to leave the infield, the puddling and maintenance headaches associated with the dirt lip in the grass edge are eliminated, making this a preferred design for moderately rainy and very rainy areas.

1.4c The Infield

Keep in mind that for design purposes, the term infield refers only to the area inside the base paths. The pitcher’s mound is the highest point of the infield (in fact, of the entire field), with the rest of the infield sloping away in all directions toward the base paths, as
shown in Figures 1.4 and 1.5. Spot elevations for the top and bottom of the mound, as well as for the bases, must be included for an infield to drain properly.

A problem with this design should be noted. The height difference between the pitcher's plate and home plate is fixed by sanctioning bodies. In Figures 1.4 and 1.5, because the entire infield slopes away from the pitcher's mound, the bottom of the mound is already 3 in. above home plate, so the height of the mound itself will seem 3 in. shorter. This is a matter of perception; the height difference between pitcher and batter will remain the same, but the pitcher may feel that the mound is lower than it should be.

Figure 1.6 is an alternative infield design that eliminates this perception. By raising both the pitcher's plate and home plate by 3 in., this design creates the illusion of a higher pitcher's mound, restoring the perception of the correct mound height and helping to keep the heart of the infield as dry as possible. It is important to note that this alternative design does not change the relative height of the pitcher and the batter. On the other hand, it is somewhat more complicated to build, because a number of critical elevations must be taken.
The design shown in Figure 1.6 can be used to replace the grass infield design in Figure 1.4 or Figure 1.5 to create a field that is superior in both aesthetics and performance. This crowned infield design is also well suited to softball, as the pitcher’s plate and home plate are level.

1.4d The Pitcher’s Mound
According to the *Official Baseball Rules*, published by the *Sporting News* and followed for professional, collegiate, and high school play, the regulation pitcher’s mound is a circle 18 ft in diameter. The mound itself is to have a flattened top area that is 5 ft wide and 34 in. from front to back. This flattened area extends 6 in. in front of the pitcher’s plate, or rubber, and is elevated 10 in. above home plate. From the point 6 in. in front of the pitcher’s plate, the mound is to slope toward home plate at the rate of 1 in. per foot for the first 6 ft, then gradually slope the remaining 4 in. The center of the mound is 59 ft from the white point of home plate and 18 in. in front of the pitcher’s plate. Figure 1.7 shows...
the appropriate slope for a pitcher’s mound. (A simple tool for achieving the correct slope on a pitcher’s mound is shown in Chapter 5, Figure 5.6.)

1.5 SKINNED INFIELDS

Many baseball and softball fields still in use (especially in parks) feature skinned infields (which are sometimes called “dirt infields”). These infields have a continuous skinned playing surface all the way to the grass arc where the outfield begins. Skinned infields are recommended for softball fields and are required for some softball tournament play. When correctly maintained, skinned infields can also work well for baseball fields and under some circumstances may be preferred to grass infields, which require more maintenance and more involved renovation. If the facility has a limited maintenance staff, a skinned infield is easier to keep playable, because it requires less attention to matters such as lip buildup and removal.
A skinned infield that has grass in foul territory has greater visual appeal than a skinned infield that has a dirt surface all the way to the dugouts. This is especially obvious in a completely skinned regulation (90 ft bases) baseball field, which has some 25,000 sq ft of skinned surface, better than half an acre. Figure 1.8 shows an example of the typical skinned infield (without grass in foul territory) and an alternative and superior design with grass in foul territory, which allows for improved appearance and playability. The grading plan is the same as shown in Figures 1.4 and 1.5. For softball, use the infield grading plan shown in Figure 1.6 to keep the pitcher’s plate level with home plate.

Figure 1.7. The regulation pitcher’s mound. The diameter of a regulation pitcher’s mound is 18 ft, with the center of the circle 18 in. in front of the front edge of the rubber.

Figure 1.8. Skinned infields, typical design (left) and superior design (right).