THE AMERICAN BALLPARK:
A STRUCTURAL PERSPECTIVE

by

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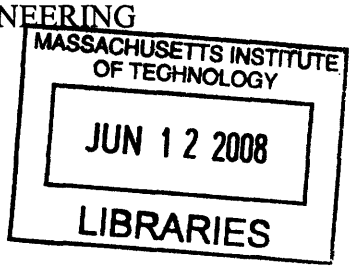

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Abstract

A recent boom in ballpark construction in the last decade has brought great attention to the design of these stadiums. The purpose of this thesis is to examine the history of the American ballpark through the 20th century, and to compare the structural systems of the different ballparks. This evolution is quite evident in the city of Philadelphia, where ballparks of all three major eras have been built in the last century. In the early 1900s, many ballparks were beginning to shift from wood to steel and concrete. The Jewel Box ballparks were considered some of the best of all time, and some are still in use today. However, many of them fell into disrepair and were eventually replaced, often times with a multi-purpose stadium. Initially hailed as great feats of engineering, many of these "cookie-cutter" parks did not age well and quickly fell out of favor. The 1990s would bring a revival of the "retro" ballparks, beginning with Baltimore's Oriole Park. In Philadelphia, the Baker Bowl, Shibe Park, Veterans Stadium, and Citizens Bank Park serve as an excellent indicator of the evolution of the ballpark. There will likely be a lull in ballpark construction in the coming years, just as few stadiums were built in the 1940s and '50s. As the current ballparks age, owners will again be faced with the decision to renovate or rebuild

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"Baseball, it is said, is only a game. True. And the Grand Canyon is only a hole in Arizona. Not all holes, or games, are created equal."

- George Will

1 Introduction

The purpose of this paper is to examine the evolution of the American ballpark. As the business of baseball has grown and changed, so have the structures that house the game. They have evolved from parks with little or no seating to structures capable of seating tens of thousands of fans. As these parks have developed, their structural system has shifted as well. This thesis will examine the structural evolution of the ballpark from the cusp of the 20th century to present times and will provide a prediction of what may be in store for ballparks and baseball fans in the near future. Extended discussion concerning many historical ballparks will be incorporated, and the progression of ballparks in the city of Philadelphia, Pennsylvania will provide the context for the shift in American ballpark design through the 20th century.

2 Baseball's Beginnings

The exact origin of the game of baseball is still disputed today, though most followers of the game have settled upon one history. In what is widely regarded as the first baseball game ever played, Alexander Cartwright's New York Knickerbockers hosted the New York Nine at Elysian Fields in Hoboken, New Jersey. Though it certainly could not be called a ballpark by current standards, Elysian Fields became known as the "birthplace of baseball." (Gershman)

Figure 2-1: Elysian Fields, Hoboken, NJ [1]

A number of other ball fields sprung up, though they too were simply open pastures with enough space for the game. Any spectators interested in seeing a game of baseball stood surrounding the playing field, as there was no seating provided. As the scope of this thesis involves the structural systems of ballparks, these fields provide little discussion. However, a basic knowledge of the birth of the baseball field must be understood as a matter of comparison for what would soon follow. Undoubtedly, nobody involved in these early games could have foreseen the incredible growth of baseball and consequently the ballparks that would house the game.

3 The First Ballparks

As the game of baseball began to grow in popularity, it became apparent that something would have to be done about the limited spectator capacity. At the same time, businessmen were beginning to realize there was money to be made in baseball. Team owners began to charge admission, while at the same time enclosing the ballparks in order to keep nonpaying spectators from viewing the game. The first owner to do just that was William H. Cammeyer when he built the Union Grounds in Brooklyn, New York. Though intended to separate paying and nonpaying spectators, the enclosure helped to provide a boundary for the field. At Union Grounds, Cammeyer also provided seating for 1,500 fans, the first of its kind at a ball field (Gershman). As public interest in the sport continued to grow, admission to Union Grounds increased to the point that the players felt they deserved a portion of the revenue. Ultimately Cammeyer conceded, began paying his players, and started the move towards professionalism in baseball. Many opposed the use of professionals, but in 1871 representatives of the teams met and decided to form the National Association of Professional Baseball Players. With a league formally established, the next step for many of the teams was the construction of their first ballpark.

4 Wooden Stadiums

Each and every one of the nine ballparks of the National Association was constructed from wood, with a wide range of appearances; from a simple set of wooden bleachers to more elaborate structures such as Athletics Park, which included an elevated area for the press. The obvious concern with the wooden ballpark was its susceptibility to fire. The most notable of ballpark casualties occurred in the Great Chicago Fire of 1870, when the Union Base-Ball Grounds, home of the White Stockings, burned to the ground. As teams moved or folded and new teams were added to the league, stadiums continued to grow. Almost all of the ballparks of this era were initially built entirely of wood. While many began with wooden benches behind home plate and along the first and third baselines, the growing spectatorship required owners to expand their parks. At first this required extending the bleachers further down the baselines and possibly behind the outfield fence. Owners continued to add seats, eventually enclosing most of the fields. After that, they had nowhere to go but up, and they started adding second levels to their stadiums. One of the most famous wooden ballparks of this era was the Polo Grounds in New York City.

4.1 Polo Grounds

A number of ballparks in New York City have gone by the moniker of the Polo Grounds, beginning in 1883 with a structure near the corner of Central Park. As the name suggests, this facility was in fact an arena for polo when the New York Giants moved in. When they were evicted by the city in 1888, the team moved to Coogan's Bluff in the Harlem section of Manhattan. A new Polo Grounds was built and would become the iconic ballpark of the time. The Polo Grounds was particularly known for its rather interesting geometry which can be seen in Figure 4-1.

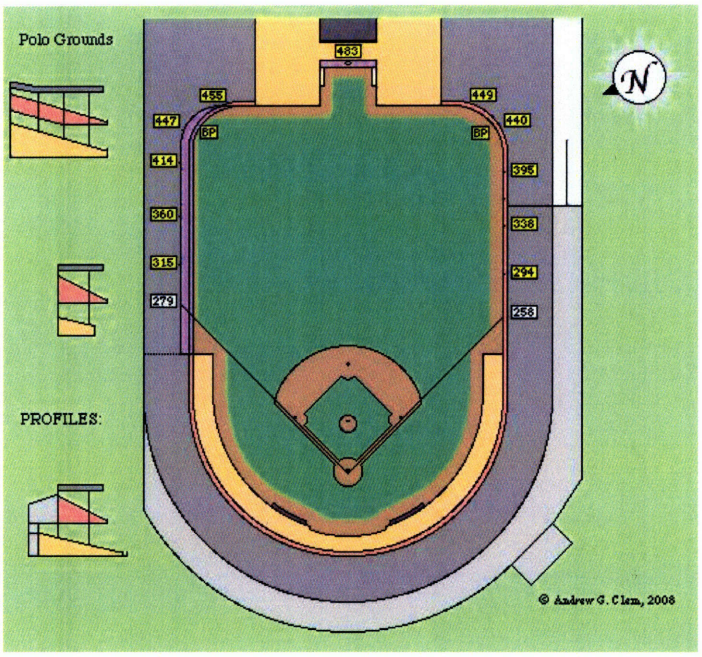

Figure 4-1: Overhead view of the Polo Grounds in Harlem, NY [2]

This was necessitated by the surrounding area, given the topographic nature of the Coogan's Bluff as well as roads and railways that were already in place. Perhaps most notable was the incredible length of 500 feet from home plate to the centerfield fence. The Polo Grounds was a wooden structure with two levels of bleachers circling behind home plate between first and third base. To support the second level of seats and the roof that covered these seats, wooden columns were used as seen in Figure 4-2.

Figure 4-2: Grandstands at the Polo Grounds [3]

At this time the roof almost entirely covered the seating area, with the exception of the outfield seats. Most likely the designers did not do extensive calculations to determine column sizes and spacing. Instead they used oversized columns spaced relatively close to each other to prevent any potential problems. Figure 4-2 shows these columns very close to one another, and one can also see the bracing used at the top of the columns. Unfortunately, the Polo Grounds suffered the same fate as many of the other wooden ballparks of the time when it burned to the ground in 1911. In just over two and a half months, the park was rebuilt in steel and concrete, following the lead of Shibe Park in Philadelphia. Though it opened with a capacity of 16,000, the Polo Grounds quickly grew to hold 34,000 spectators as its second deck of seating was rebuilt during the season (Angle). Further expansion added a second level of seats nearly the entire way around the field, giving the stadium its distinctive horseshoe shape that matched its unique on-field dimensions. After rebuilding in steel and concrete and enclosing the playing field, the Polo Grounds began to fit into a new genre of ballparks, the Jewel Boxes.

5 Jewel Box Ballparks

The Jewel Box ballparks are remembered fondly as some of the best stadiums in all of baseball and the locations of many of baseball's great historic moments. These parks were often enclosed and had varying exteriors. Some were designed with rather ornate façades, while others were meant to be more representative of the surrounding area in terms of appearances. A few of the Jewel box parks are still in use today, and are often considered the best ballparks to see a game in the major leagues. Predominantly, these parks were constructed of steel and concrete, relatively new materials in the ballpark construction business. Many of the Jewel Box ballparks had very unique geometries dictated by the land available to purchase or quirky features necessitated by the ballpark design itself.

5.1 Forbes Field

In Pittsburgh, Pennsylvania baseball began at Exposition Park, a small wooden stadium on the banks of the Alleghany River. Owner Barney Dreyfus decided to build a new ballpark for his team and purchased land near what is now Carnegie-Mellon University. In just a few months, Forbes Field was constructed and ready for the Pirates to begin play. Featuring a red slate roof and terra cotta exterior, Forbes Field had one of the more grandiose façades in all of baseball. Completed in 1909, it was the first ballpark to feature a number of new concepts. While Shibe Park was the first to build in steel and concrete and have multiple levels, Forbes Field was the first to provide three levels of seating as can be seen in Figure 5-1.

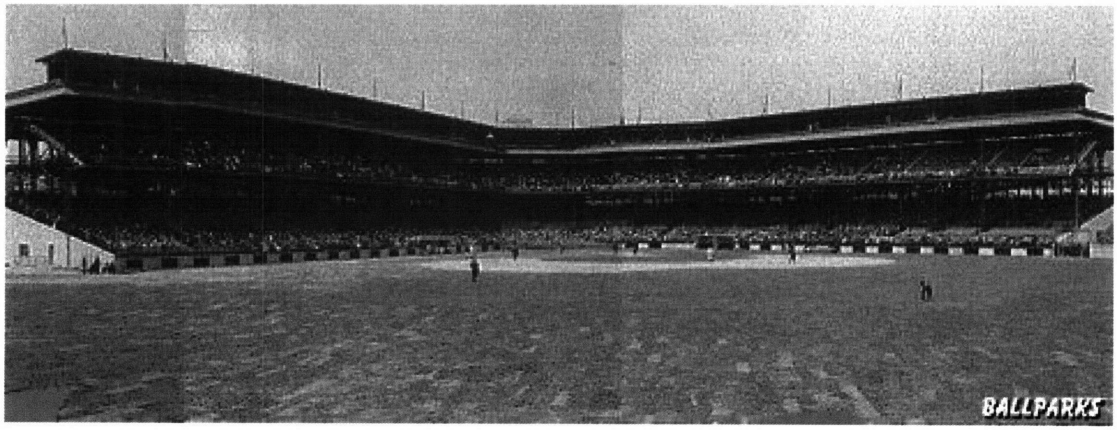

Figure 5-1: Forbes Field as seen from the centerfield bleachers [4]

This third level was home to a number of luxury suites, a new concept at the time, but a feature that would become a staple of the ballpark as baseball moved through the 20th century. Expansion in the 1920s saw the double-decked grandstand extend further down the first base line and into right field, though the park remained open in center and left fields. Figure 5-2 provides an excellent view of the structural system of the ballpark. The long steel columns support steel trusses running both parallel and perpendicular to the playing field in order to support the roof. As with other multi-tiered stadiums, the use of steel columns and beams greatly increased the column to column spans that could be cleared, resulting in a more open view of the field from the seating area. (Angle)

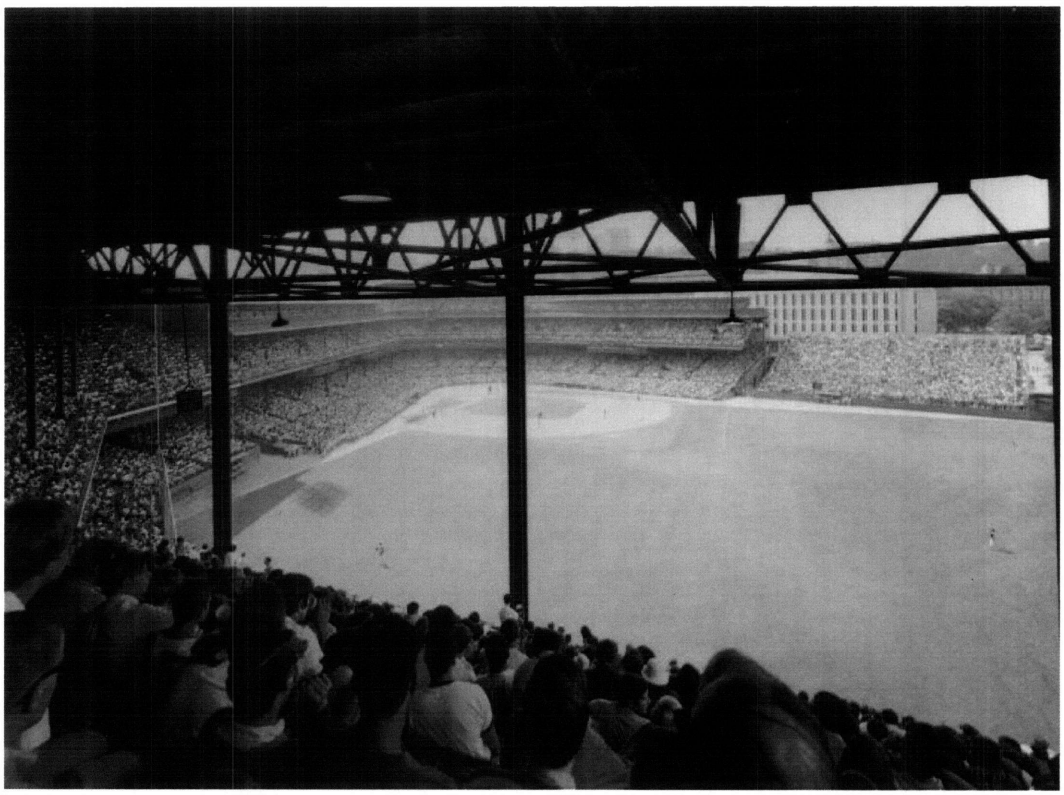

Figure 5-2: Steel columns and trusses supporting roof at Forbes Field [3]

5.2 Fenway Park

Currently Fenway Park is the oldest ballpark in Major League Baseball. Built in 1912, Fenway has some of the most unique and recognizable features of any ballpark. With only one seating bowl when it was first constructed, it wasn't until 1933, when new owner Thomas Yawkey

bought the team, that they added new seating. At the same time they built one of the most distinctive characteristics of the stadium. The 37 foot tall outfield wall ran from the left field line out to center field and would later become known as the "Green Monster." The wall itself consisted of wooden railroad ties covered with tin (Munsey). These ties would often create unusual bounces off the wall, an occurrence that was accentuated by the partial exposure of a concrete pad at the base of the fence. A net was placed above the Green Monster to protect neighboring buildings along Landsdowne Street from baseballs that managed to clear the fence. The Green Monster has a number of features that make playing left field in Fenway Park quite an adventure. A ladder on the wall (allowing groundskeepers to retrieve balls in the net) and the hand-operated scoreboard created some of the trickiest bounces. The roof over the seating area was supported by a steel column and truss system, much like the system at Forbes Field, and can be seen in Figure 5-3 below.

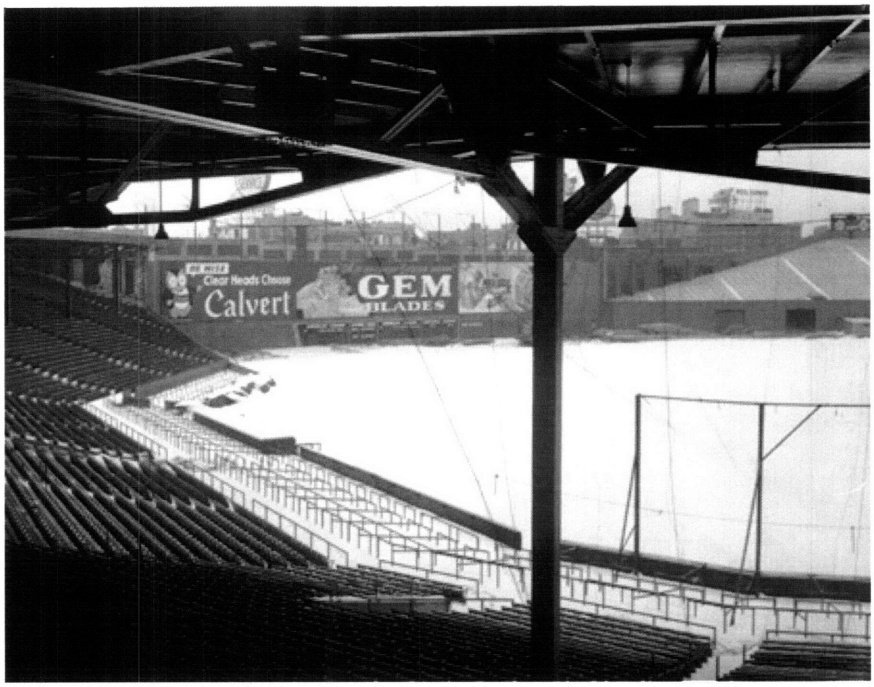

Figure 5-3: Steel columns and roof truss at Fenway Park [3]

A second level of seating in the infield was added around the same time as the addition of the Green Monster. The result was something that became known as obstructed view seating. For the greater part of the century the Red Sox would offer these tickets at a lower price that other seats, though this practice ended not long ago. Small renovations at Fenway Park resulted in a

small upper deck around most of the field and a large press box behind home plate, but the most significant addition to the ballpark was the Green Monster Seats.

5.2.1 Green Monster Seats

In the 1980s and '90s, Fenway Park was aging, and a number of fans were calling for a new ballpark with more modern amenities. A greater number of fans, as well as the city of Boston, preferred to preserve Fenway and perform minor upgrades. Ultimately the new ownership group of John Henry, Tom Werner, and Larry Lucchino chose to keep the existing ballpark. They began looking for places they could add new seats, and in 2003 they built seats atop the Green Monster (Angle). One of the most difficult aspects of the project was the Green Monster's proximity to Lansdowne Street. There simply wasn't enough room between the wall and the street to add support columns to hold these seats. Instead, the seats effectively cantilever out over Lansdowne Street from the top of the wall. A number of braces help to carry the load back to the wall itself (Clem). In addition, the designers were concerned about problems with the seats moving too much under large loads, as may be the case if the fans in the seats are jumping up and down. For this reason they considered installing a number of linear viscous dampers to prevent such motion. A picture of the Green Monster seats during installation is seen in Figure 5-4.

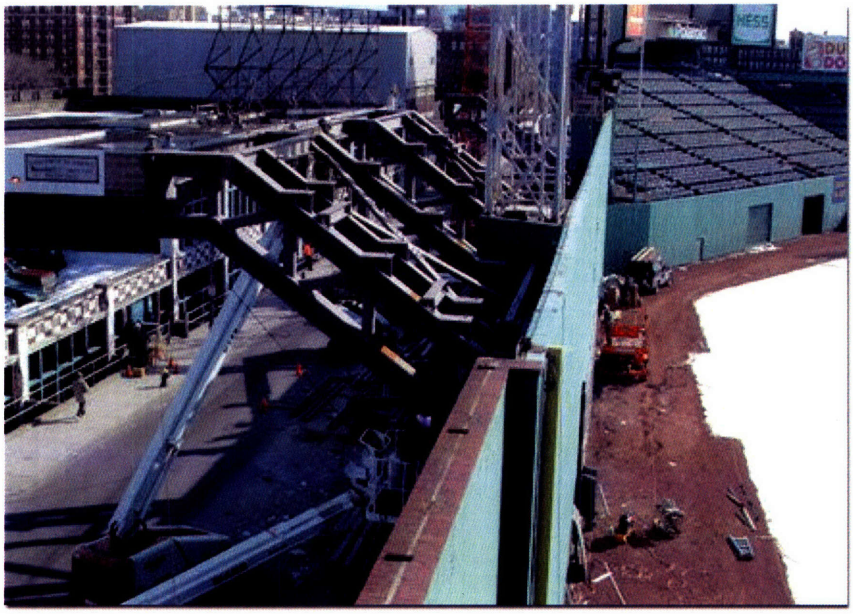

Figure 5-4: Installation of Green Monster Seats [5]

5.3 *Tiger Stadium*

Though it has gone by many names, most remember the stadium at Michigan and Trumbull in Detroit simply as Tiger Stadium. Built in 1912 to replace Bennett Park, a wooden ballpark on the same site, Tiger Stadium initially had only one covered level of seating that extended along both foul lines with a section of bleachers in centerfield and was named Navin Field. An expansion in 1923 added a second deck of seating wrapping behind home plate between first and third base. The stadium's biggest renovation occurred in 1936. The addition of two tiers of seating in right field was limited by the presence of Trumbull Avenue immediately beyond the outfield fence. As a result, the outfield fence was moved closer to home plate, and the upper deck actually extended over the playing field. A few years later the two-tiered seating area was extended down the left field line and along behind left field while double-decked bleachers were added in centerfield with the scoreboard overhead (Munsey). The complete evolution of Tiger Stadium can be seen in Figure 5-5 and Figure 5-6.

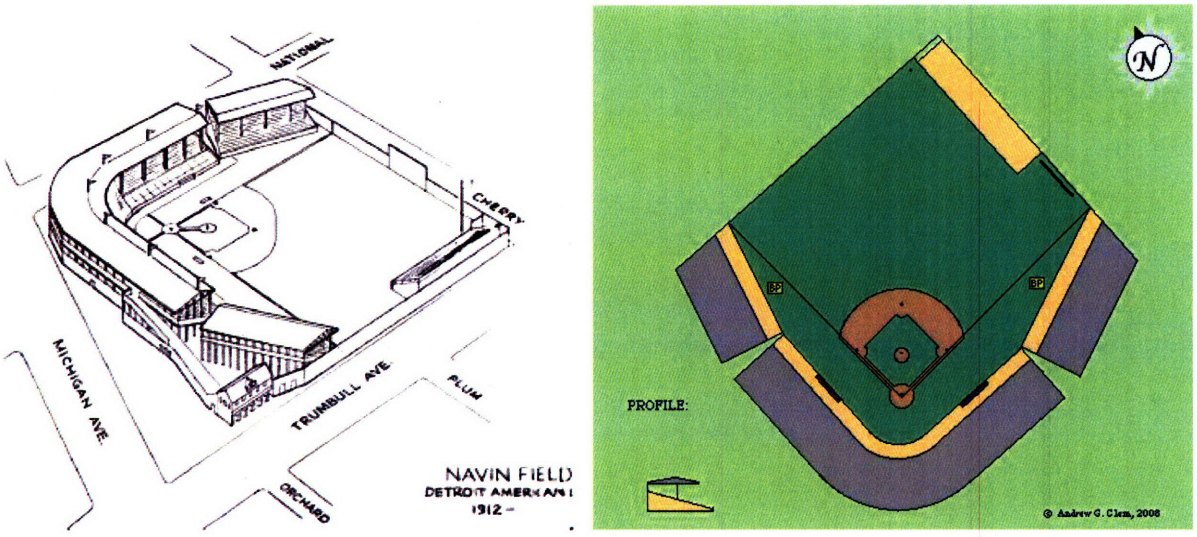

Figure 5-5: Tiger Stadium, 1912 [1, 2]

Following the completion of this construction in 1938, Tiger Stadium remained unchanged save for the addition of lights in 1948 to allow games to be played at night. Tiger Stadium's tenure as home of the Tigers almost ended in 1972 when John Fetzer bought the team and announced plans to build a new multipurpose stadium. Many fans were outraged by this decision and voted to reject bonds to construct the stadium (Angle). The Tigers played their last game at Tiger

Stadum in 1999, and the stadium will most likely be demolished shortly, though a group of fans is attempting to preserve the historic stadium.

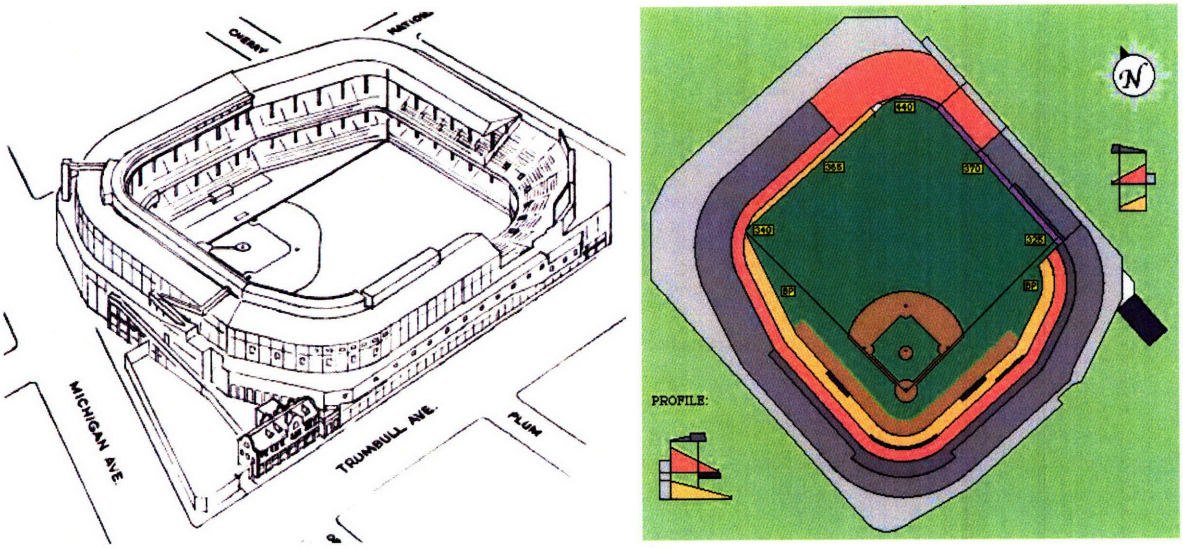

Figure 5-6: Tiger Stadium, 1938-present [1, 2]

5.4 Ebbets Field

Considered by many to be the best ballpark in the history of baseball, Ebbets Field was home to the Brooklyn Dodgers from 1913 until the Dodgers moved to Los Angeles in 1957. Constructed in steel and concrete as many parks of the time, Ebbets Field was possibly most know for its iconic brick façade (seen in Figure 5-7, though black-and-white photos do not do it justice) and arches, as well as a large rotunda of Italian marble.

Figure 5-7: The famous façade of Ebbets Field [3]

A similar rotunda is being constructed at the New York Mets new ballpark, Citi Field in the Flushing Meadows neighborhood of Queens. Initially built with double-decked seating down the right field line and behind home plate, a number of expansions added bleachers in the outfield and eventually extended the second tier of seating into the outfield. Again, steel columns and trusses (Figure 5-8 and Figure 5-9) supported the second level and the roof, blocking the view of many fans.

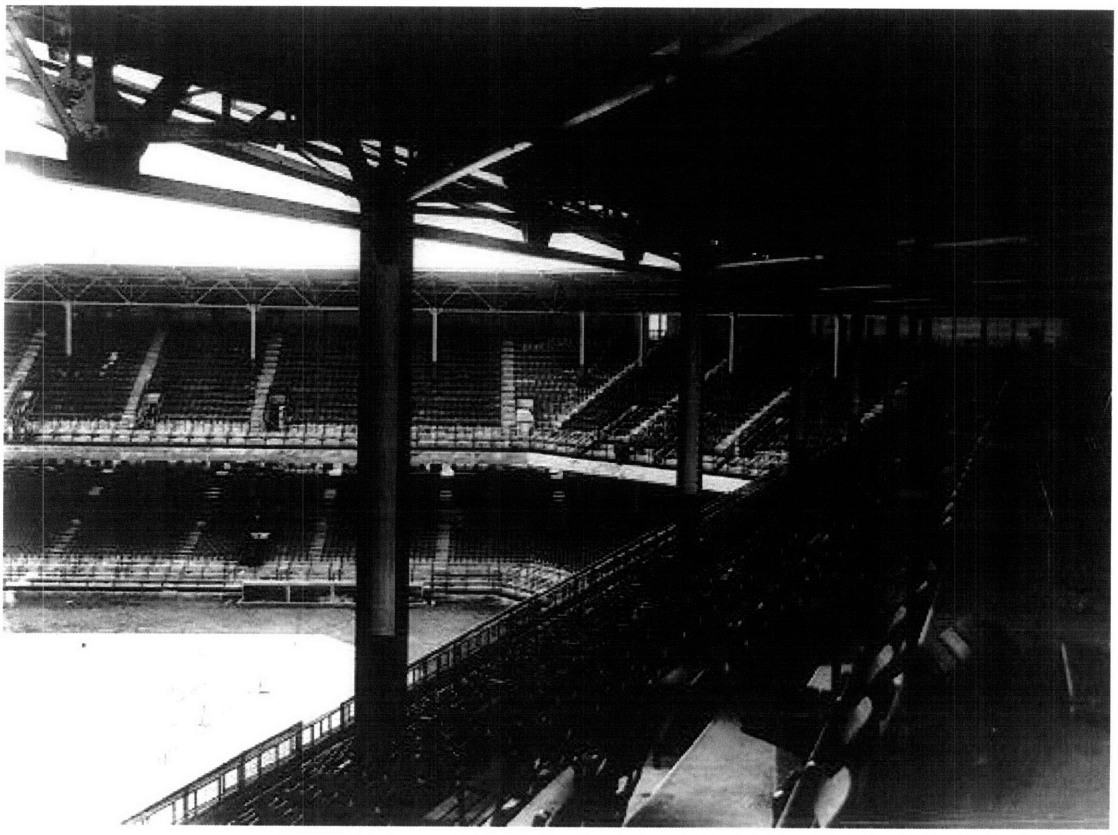

Figure 5-8: Steel supports at Ebbets Field [3]

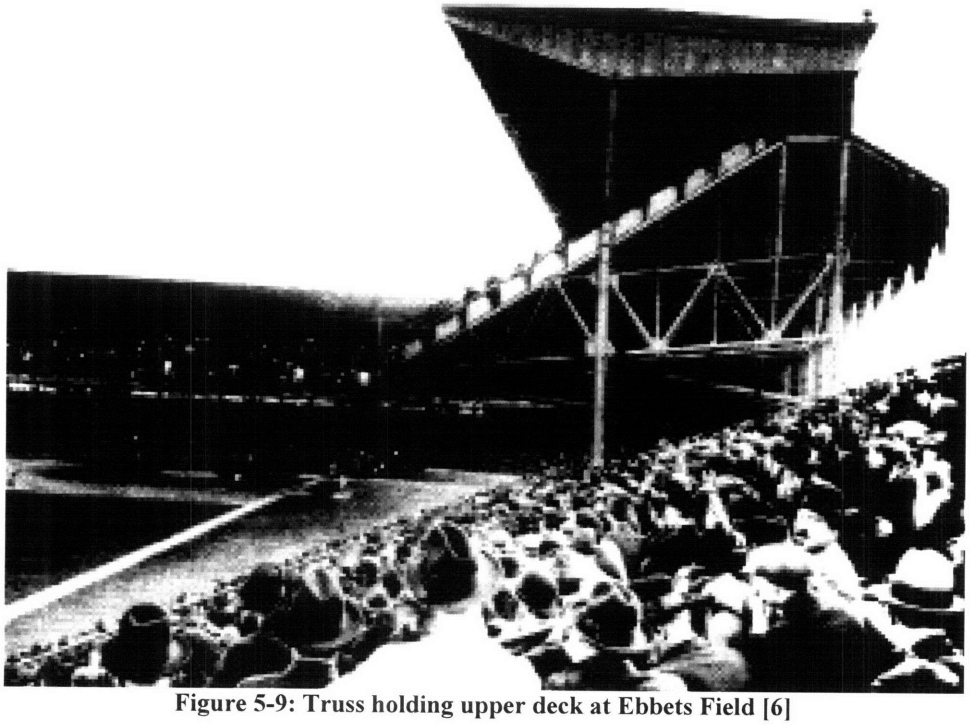

Figure 5-9: Truss holding upper deck at Ebbets Field [6]

Unfortunately, time and a changing era began to catch up with Ebbets Field. Portions of the stadium became structurally unsound and there were problems with the plumbing. The stadium had a capacity of only 30,000 people, and had no room left to expand. As fans began moving from Brooklyn to Long Island, they began demanding more available parking, something that there just was no room for in the surrounding neighborhood. After Dodgers owner Walter O'Malley and New York City Building Commissioner Robert Moses could not agree on a location for a new ballpark, O'Malley moved his team to Los Angeles following the 1957 season (Angle). Ebbets Field, home to nine World Series and the stadium where Jackie Robinson broke baseball's color barrier in 1947, was demolished in 1960, yet is still remembered as one of the most storied ballparks in all of baseball.

5.5 *Wrigley Field*

Another one of America's iconic ballparks is the 'Friendly Confines' of Wrigley Field in Chicago, Illinois, home to the Chicago Cubs. Completed in 1914 with only one seating deck and wooden bleachers in the outfield, Wrigley is currently the second oldest ballpark still in use, behind only Fenway Park, and is the only Federal League ballpark still standing. Wrigley Field was the first ballpark built on the North Side of Chicago, with Comiskey Park, home of the White Sox, on the South Side. As with many of the other ballparks from the era, the wooden design was replaced with steel and concrete. For a number of ballparks, this change occurred in or around the time of the Great Depression. In the late 1920s, a second level of seating was added, with the upper deck constructed using cast-in-place concrete supported by built-up structural steel columns and a steel truss system. A cross-section of the seating area can be seen in Figure 5-10, and a picture outlining the truss locations is found in Figure 5-11.

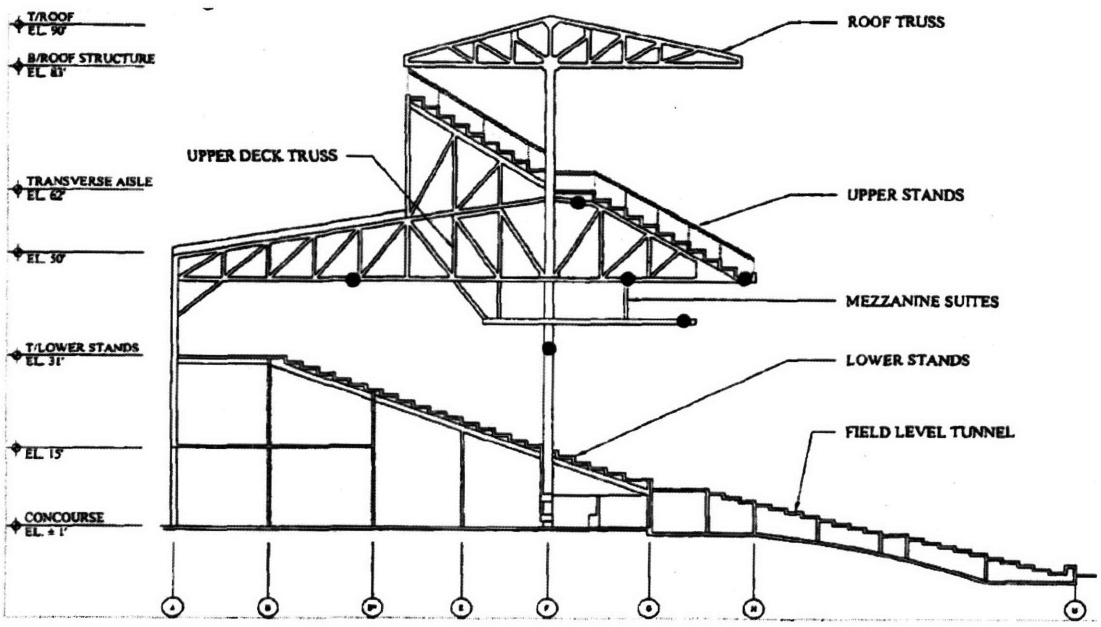

Figure 5-10: Cross-section through grandstands at Wrigley Field [7]

The steel trusses are placed 19 feet apart, but designers did not want this many columns blocking the view of the spectators. To solve this problem, a second truss runs parallel to the playing field between columns, picks up the load of every other truss and carries it to the adjacent columns. In the 1960s, the upper level tread-and-riser system was replaced with pre-cast concrete. (Lewis)

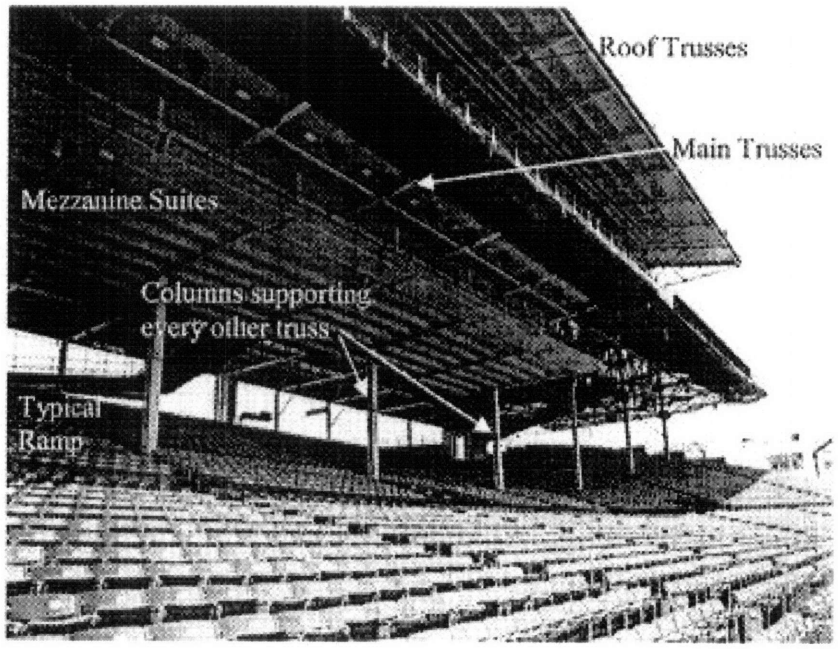

Figure 5-11: Third base side showing upper-deck support columns and trusses [7]

Some of the stadium's most identifiable features are its brick outfield walls covered in ivy and the fully hand-operated scoreboard behind the centerfield bleachers. The exterior of Wrigley Field is also similar to other Jewel Box ballparks in that it features a stepped back façade to provide a less harsh vantage from street level. The two distinct levels can be seen in Figure 5-12.

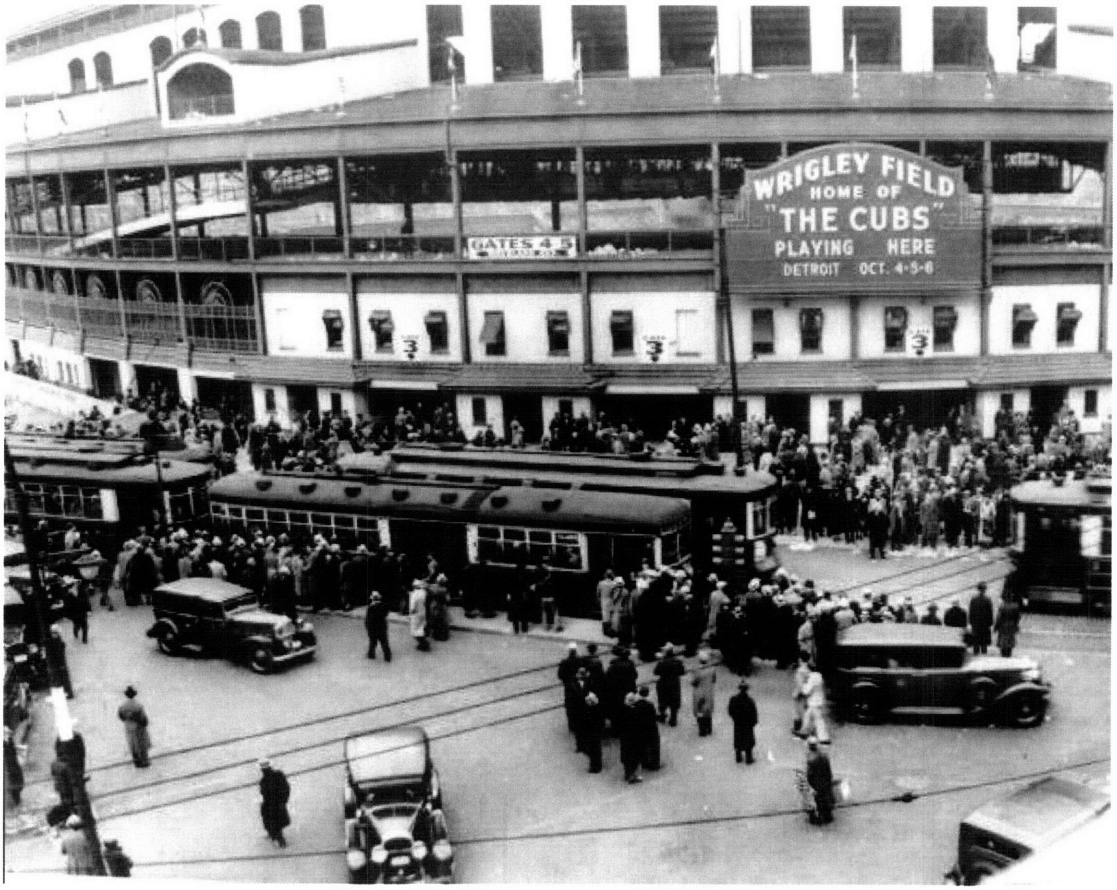

Figure 5-12: Behind home plate at Wrigley Field [3]

Wrigley Field was also the last stadium to add lights, allowing for the play of night games, and has had significant issues with residents of houses along Waveland Avenue and Sheffield Avenue behind the outfield fence. With the low outfield bleachers of the ballpark, residents in these houses were able to see into the stadium from their roofs, something that the owners of the Cubs were fine with until these people started charging admission to watch a game from the rooftops. Ultimately, the differences were settled. Along with Fenway Park, Wrigley Field is one of two ballparks currently being used that still feature obstructed view seats as a result of the columns supporting the upper deck and roof.

5.5.1 Structural Problems

On three separate occasions in 2004, pieces of concrete have fallen from the underside of the upper deck at Wrigley Field. Fortunately nobody was injured by the falling concrete, and netting was installed to catch any other pieces that might fall. Local officials began investigating the

cause of the concrete spalling, and looked towards crowd-induced vibrations as a possible cause. The final investigation included inspections of the overall stadium structure and a structural analysis of the grandstand frames as a check for structural integrity. The three locations were each inspected visually, with varying amounts of damage and three different causes of spalling. At one point, chloride-induced corrosion of the reinforcement was the cause, while the damage at the other two locations was the result of a typical loading that had shifted from the original design. Damage at one of the sites can be seen in Figure 5-13.

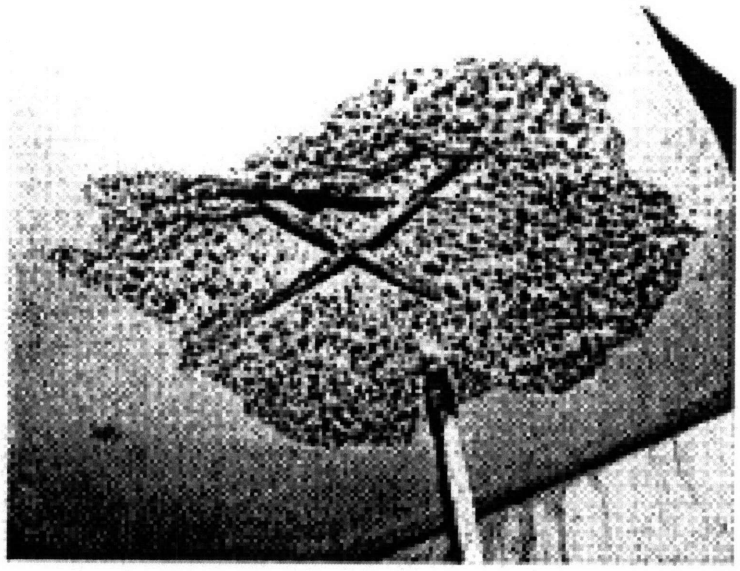

Figure 5-13: Exposed rebar resulting from concrete spalling [7]

An inspection of the steel framing revealed some localized surface corrosion that was being addressed, but there was no serious damage. In order to evaluate the upper deck seating areas, the investigators assumed a 100 psf live load over the entire deck. It was found that all structural members met both ASCE-7 and the Chicago Building code, and the analysis resulted in a maximum deflection of 1-1/2 inches at the end of the cantilevered deck. Ultimately, the investigators concluded that "the distress conditions observed in the upper stands did not impair the load-carrying ability of the precast sections," and "the only safety hazard posed ... was the potential for non-structural pieces of concrete to fall" (Lewis).

5.6 Yankee Stadium

Completed in 1923, making it the 3rd oldest ballpark in use today, Yankee Stadium is one of baseball's most storied stadiums and home to the more World Series champions than any other

ballpark. Having shared the Polo Grounds in upper Manhattan with the Giants for a number of years, the Yankees ownership built Yankee Stadium just across the Harlem River from their previous home. The stadium featured three seating tiers constructed of steel and concrete, with wooden bleachers providing seating in the outfield and opened with a capacity of 58,000 spectators, the largest in the league by far. The Yankee owners, Jacobs Ruppert and T.L. Huston, were confident that their team would be able to fill the seats in the cavernous park as they had actually drawn more fans at the Polo Grounds the previous year than Giants (Angle). The size of the park increased further as the upper decks were extended down the foul line and into the outfield, and the wooden outfield bleachers were rebuilt in concrete. Yankee Stadium became known for its deep left field fence and its trademark façade lining the inside of the stadium room (Figure 5-14).

Figure 5-14: Left field at Yankee Stadium featuring the trademark façade [3]

As iconic as the ballpark was, the 1970s saw the park begin to deteriorate, leading to the debate over whether to construct a new stadium as opposed to performing significant repairs to the existing stadium.

5.6.1 Renovation

After considering a number of locations for possible new ballparks, the decision was made to refurbish Yankee Stadium. In 1972, the city of New York bought the stadium and began repairs following the 1973 season. With the Yankees playing in Shea Stadium in Queens, portions of Yankee Stadium were torn down and rebuilt. Among other things, larger seats replaced the old ones, resulting in a decreased seating capacity. Also, the stadium was redesigned such that the columns supporting the upper seating tiers could be removed, eliminating the inconvenient situation of being seated behind one of these columns. The differences in structure are shown in Figure 5-15 and Figure 5-16.

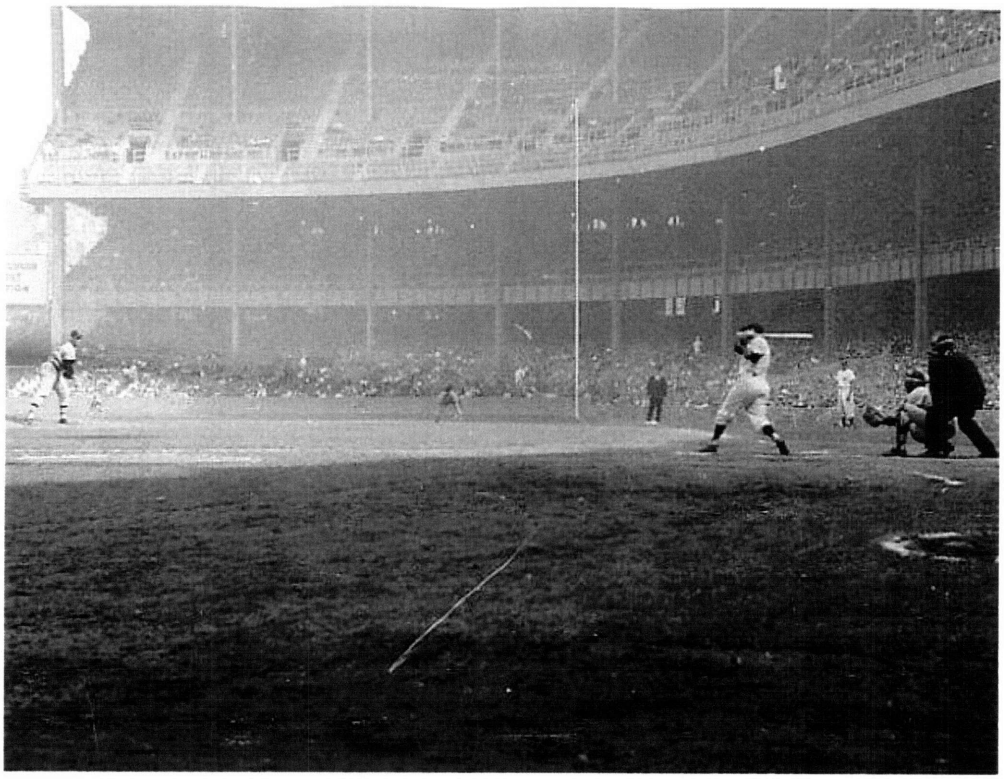

Figure 5-15: Right field at Yankee Stadium [3]

Figure 5-16: Yankee Stadium, post-1975 [8]

The extensive demolition and reconstruction of the stadium has led many people to recognize it as a separate ballpark from the original Yankee Stadium. The summer of 2008 will be the last season for Yankee Stadium as the Yankees will move into a new ballpark by the same name in 2009. This new stadium is currently being built adjacent to the current stadium and will be nearly identical with the exception of more 'modern amenities' that will be available for the fans.

6 Multi-purpose Stadiums

For years, many ballparks were home to other sporting events, often football games or boxing matches. In fact, Yankee Stadium was home to the 1958 NFL Championship, known as "The Greatest Game Ever Played" when Johnny Unitas led the Baltimore Colts to a come-from-behind victory over the New York Giants. In these cases, other sports utilized a ballpark that was designed with only baseball in mind. However, the middle of the 20th century saw the beginning of stadiums designed to house both baseball and football. These multipurpose stadiums were a way to split construction and operation costs between the owners of the two teams, and brought about a revolution in stadium design. Multi-purpose stadiums were being built all across the country, from Veterans Stadium in Philadelphia to the Kingdome in Seattle while Cleveland Stadium is considered the first of these stadiums to be built. Nearly all of the multi-purpose stadiums were praised when they first opened and large crowds flocked to see the stadiums themselves as much as the team on the field. Unlike the Jewel Box ballparks and other predecessors, these stadiums stood out from their surroundings as they were often hulking giants of concrete whose sheer size impressed anybody passing by. The new stadiums certainly had their shortcomings as well. They often possessed a more sanitary feel, and lacked the character and charm of the older parks. Having been designed with two very different playing fields in mind, the seating arrangements were typically a compromise, resulting in less than ideal situations for fans of both sports. As far as baseball is concerned, these stadiums often had very symmetrical dimensions, and many possessed a very similar exterior appearance. As these stadiums aged, the public began to become less enamored with them, and with a few exceptions, many of these multipurpose stadiums are now seen as some of the worst in baseball and all of professional sports. One thing these stadiums did successfully was eliminate the support columns seen in many of the Jewel Box ballparks. In order to cantilever the upper deck and eliminate these columns, the connections became critical and rather large. However, many of these connections were hidden in the enclosed concourses, so there was no need to make them aesthetically appealing.

6.1 Cookie-cutter Parks

In the 1960s and '70s, many cities with professional baseball and football teams decided to construct multi-purpose stadiums. In a number of these cities, the end result was incredibly similar, with large, round, concrete stadiums sprouting up across the nation. Due to the similarities in appearance, these parks became known as "cookie-cutter ballparks" or "concrete doughnuts." These stadiums showed up in Washington, D.C; Atlanta, Georgia; St. Louis, Missouri; San Diego, California; Cincinnati, Ohio; Pittsburgh, Pennsylvania; and Philadelphia, Pennsylvania.

6.1.1 Robert F. Kennedy Stadium

For years, the Washington Senators played at Clark Griffith Stadium until, in 1960, they moved to Minneapolis and became the Minnesota Twins. The following year Major League Baseball awarded a new franchise to Washington, D.C. under the same Senators moniker. At the same time, a new multi-purpose stadium was being built on the east side of the city. The Senators would begin the 1962 season in D.C. Stadium, which would be renamed Robert F. Kennedy Stadium shortly after he was assassinated in June. The Senators stay at RFK Stadium would be short-lived as the team was moved to Arlington, Texas and became the Texas Rangers following the 1971 season. The park would be without baseball until the 2005 season, when the Montreal Expos became the Washington Nationals and moved into RFK Stadium (Angle). They would play three seasons there before moving into Nationals Park in 2008. The stadium itself is a concrete superstructure with ramp access to the upper seating areas located around the perimeter of the stadium as seen in Figure 6-1.

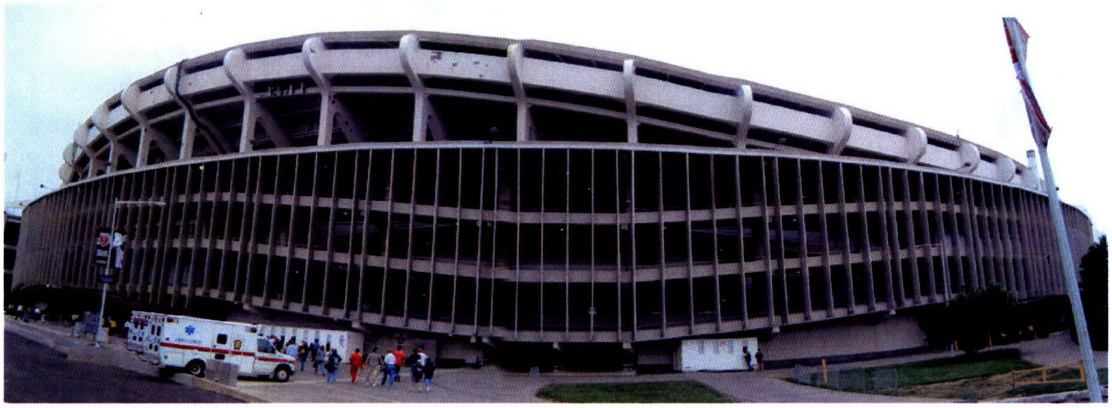

Figure 6-1: Robert F. Kennedy Stadium [9]

The upper seating deck cantilevers over the lower seating bowl for much of the stadium, though there is no lower level seating in the outfield when the stadium is configured for baseball. The interior of RFK can be seen in Figure 6-2.

Figure 6-2: Interior of RFK Stadium [9]

RFK also served as the home of the Washington Redskin's of the NFL, and is currently still home to the D.C. United of Major League Soccer. RFK was the first of the cookie-cutter stadiums, and would become the blueprint for many other stadiums built in the next ten years.

6.1.2 Three Rivers Stadium

Even as a concrete park in a city proud of its steel heritage, Three Rivers Stadium in Pittsburgh, Pennsylvania was very well received when it opened in 1970. Much like the other cookie-cutter parks, Three Rivers Stadium was nearly circular in plan with two seating levels separated by a thin row of luxury boxes. Forbes Field was home to the Pirates for 61 years, but had a number of problems as it aged, and needed to be replaced. The new ballpark location was chosen just west of the point where the Allegheny River and Monongahela River meet to create the Ohio River, and thus the Three Rivers Stadium name was formed. Figure 6-3 shows the construction of Three Rivers Stadium. The concrete superstructure is clearly shown, and pre-cast concrete seating can be seen on the left side of the stadium.

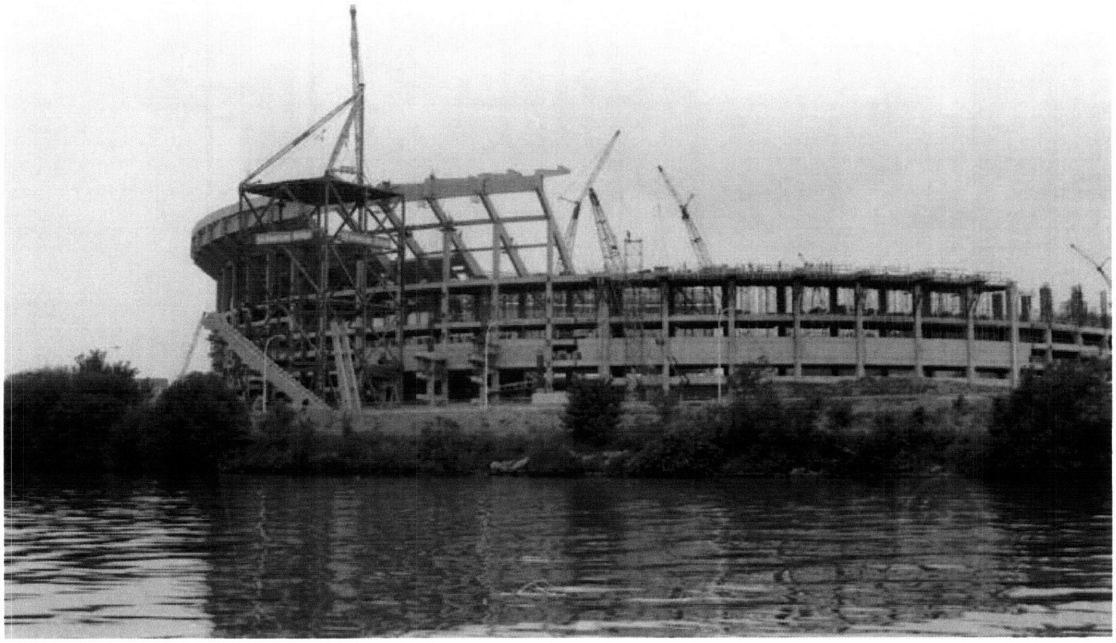

Figure 6-3: Construction of Three Rivers Stadium [3]

Numerous construction problems caused the opening of the stadium to be delayed, increasing the total budget for the project. Three Rivers Stadium proved to be quite a successful venue for both the Pirates and the NFL's Steelers. The Pirates won the World Series in 1971 and 1979, and won National League East division titles in six other seasons while playing at Three Rivers (Angle). While playing at Three Rivers, the Steelers put together one of football's most dominant dynasties, winning the Super Bowl four times in a span of six years (1974-1979). As with many other cookie-cutter stadiums, Three Rivers Stadium was in need of repairs and had fallen out of favor with fans in the late 1990s and into the 2000s. As a result, the city of Pittsburgh decided to build two separate venues; Heinz Field is now the home to the Steelers, and the Pirates now play in the retro designed PNC Park, considered one of the nicest new stadiums in the game.

6.2 Houston Astrodome

In 1960, the city of Houston, Texas was awarded a baseball franchise and the Houston Colt .45s opened the 1962 season at Colt Stadium while a domed stadium was being constructed. The climate in Houston was far too hot for the team to play outdoors, so planners developed the first domed stadium in America. After barely raising the money to finance the dome, construction

was completed in 1965, with a "Lucite" roof to allow sunlight to reach the natural grass playing field. The stadium was nearly circular in plan, with a concrete superstructure and ramp system, much like RFK Stadium in Washington, D.C. Initially called the Harris County Domed Stadium, team ownership changed the name of the stadium to the Astrodome to match the team's new name, the Houston Astros. While many expected the roof would be quite the design issue, the exact reason for the trouble was completely unforeseen. The roof was designed to diffuse light evenly to all parts of the field. Unfortunately, the glare created by these panels made it incredibly difficult for outfielders to see any ball hit in the air. The stadium can be seen in Figure 6-4 with its grass surface, and the glare of the ceiling panels is evident.

Figure 6-4: Houston Astrodome with grass surface [8]

Roof panels behind home plate were painted darker to provide a better background for the fielders, but this caused a large patch of grass to die. After a few quick-fix attempts (including using orange-colored baseballs), a carpet company came forward with a solution; a green synthetic fiber carpet that would require no sunlight at all. Over three acres of the new material was installed and was given the name AstroTurf (Giles). AstroTurf would greatly change the

game of baseball and stadium design. In place of a dirt infield, dirt cutouts were placed around each base and the pitcher's mound, resulting in an infield that looked very little like anything before (Figure 6-5).

Figure 6-5: Astrodome infield with AstroTurf [8]

The surface was much harder and faster than natural grass, and routine ground-balls would rocket through the infield for base hits. Nearly all of the multi-purpose stadiums built in the next decade would utilize AstroTurf in order to ease the conversion between baseball and football configurations. Many coaches and players hated playing on the surface, and it has been blamed for a great number of injuries in both sports. It would become the bane of fans as it increasingly made these stadiums more sterile than those with natural grass.

7 Modern Stadiums

Despite the large movement in the 1960s and '70s towards multi-purpose stadiums, a number of cities chose to build baseball-only parks that became known as "modern stadiums." Though these parks often have much more in common with the multi-purpose stadiums built around the same time, they have managed to retain a character that many of the Jewel Box ballparks held. This is due in large part to the fact that these stadiums were design specifically for baseball, allowing the seating to provide the best possible vantage point from any particular seat. The list of modern stadiums is relatively short, including Dodger Stadium in Los Angeles, Kauffman Stadium in Kansas City, Missouri, Angel Stadium in Anaheim, California, and new Comiskey Park on the South Side of Chicago. These parks have been widely praised for their ability to age well and show no signs that they need to be replaced. Built in 1958 when Walter O'Malley moved his Dodgers from Brooklyn, Dodger Stadium is now the fourth oldest ballpark in use with no plans to replace it any time soon. The Dodgers have done a number of renovations, including replacing some seats, but have maintained the same capacity (56,000 seats) since the day the ballpark was built (Angle). Located in Chavez Ravine, the park was designed to withstand considerable seismic activity and has survived many large earthquakes with little or no damage at all. Home of the Kansas City Royals, Kauffman Stadium was designed and built at the height of the multi-purpose stadium boom. In place of a multi-purpose stadium, two individual stadiums were constructed adjacent to each other as part of the Harry S. Truman Sports Complex (Figure 7-1). Both Kauffman Stadium and Arrowhead Stadium (home to the NFL's Chiefs) were completed in 1972 and are still considered among the best stadiums currently in use.

Figure 7-1: Truman Sports Complex featuring Kauffman and Arrowhead Stadiums [4]

Speaking from experience, this author found Kauffman Stadium to be one of the most pleasantly surprising stadiums to visit. The complete openness of the stadium and concourses creates a very friendly feeling with great views from all over. The Royals have announced plans to enhance the stadium by adding a number of amenities such as a restaurant/bar and other areas for fans to congregate and enjoy the game.

8 "Retro" Ballparks

The next wave of ballparks harkened back to the days of the Jewel Box parks, and, for the most part, were met with great approval among fans and players alike. Fans had become fed up with the aging multi-purpose stadiums, though nobody was certain what direction the new ballparks would head. Built in 1991, new Comiskey Park (now U.S. Cellular Field) opened to fairly negative reviews. The upper deck of the stadium was higher and further back from the field than at old Comiskey in an attempt to avoid the obstructed views created by the upper deck overhanging the lower deck. However, the results were seats that were much further from the action on the field, and the White Sox recently completed a five phase plan to make the ballpark more fan-friendly (Munsey). The difference in height of the two stadiums is seen in Figure 8-1 with Comiskey Park on the left and U.S. Cellular Field on the right.

Figure 8-1: Comiskey Park and U.S. Cellular Field [8]

The following year, the Baltimore Orioles moved into a new retro ballpark named Oriole Park at Camden Yards. In what is widely considered the first retro or neo-classical ballpark, Camden Yards was an instant hit and would end up being the most ground-breaking ballpark of the 1990s, setting a precedent that would be followed by nearly all future stadiums. These ballparks

almost exclusively feature wide concourses, seating that does not completely enclose the ballpark, and are predominantly steel structures.

8.1 Oriole Park at Camden Yards

Designed by HOK Sport, Oriole Park at Camden Yards ushered in a new era of ballparks. A stark contrast to the concrete stadiums on the 1970s, Oriole Park brought back a number of features that hadn't been seen since the Jewel Box parks. For one, all of the seats were dark green in color, a color almost exclusively used in the older parks, but abandoned in favor of more vibrant colors in parks such as Dodger Stadium and Veterans Stadium. Also, the field itself is below grade, and the lower level of seating has a much lower rake, or slope, than other ballparks. Both of these aspects prevent the stadium from towering over neighboring buildings, creating a much more welcoming ballpark. The open outfield allows for an excellent view of Baltimore, creates a number of areas for other amenities, and provides areas for fans to congregate along Eutaw Street. The old, brick B&O Railroad warehouse behind the right field fence corresponds well with the design of the stadium and has become a defining feature of the ballpark. Figure 8-2, a view from behind home plate, provides an excellent view of the entire stadium.

Figure 8-2: Oriole Park at Camden Yards [9]

Especially in comparison to the ballparks of the 1970s, Oriole Park at Camden Yards is a stadium that achieved near perfection in its design. In fact, Oriole Park continues to draw large crowds, even in years where the team is out of contention relatively early in the season.

8.2 Washington Nationals Park

The newest ballpark in Major League Baseball belongs to the Washington Nationals. In 2008, the Nationals moved out of RFK Stadium and into their new ballpark, Washington Nationals Stadium on the south side of the city. The park's exterior is slightly more modern than the other retro ballparks, with a large glass façade behind home plate as seen in Figure 8-3.

Figure 8-3: Exterior façade of Nationals Park [10]

However, once inside it is apparent that the inspiration for this stadium is very much similar to the other stadiums on the 1990s and 2000s. A wide open outfield pavilion actually provides access to the majority of fans, and the seating bowls provide excellent views from all parts of the stadium. In order to deliver the project on time, a design-build agreement was reached. The park uses a steel superstructure, which greatly decreased construction time on site in comparison to concrete. However, the foundations and sub-grade construction, consisting of concrete, could begin while the steel was being fabricated. Another method to decrease construction time was to divide the stadium in sections that would be joined by expansion joints. This allowed each section to have an independent structural system, each comprised of a combination of two systems. Cantilevered trusses were used to support the seating decks, which were pre-cast concrete. The concourses are supported by a mix of moment frames and braced frames, while four belt trusses tie the sections together to provide lateral stiffness to the building. As many of the moment connections as possible were shop welded, which helped to eliminate gusset plates and provided cleaner connections. The cantilevered roof supports can be seen in Figure 8-4. (Tamaro)

Figure 8-4: Cantilevered roof at Nationals Park [10]

9 Retractable Roof Stadiums

One of the predominant trends in recent stadium design has been the inclusion of a retractable roof. Often these stadiums are located in climates that are known for weather that is not conducive for playing baseball. In Toronto, the early spring weather is far too harsh for baseball, as much for the fans as for the athletes themselves. Similarly, it would be unbearable to withstand the summer heat of an afternoon baseball game in Phoenix, Arizona. By placing retractable roofs on these stadiums, fans can comfortably watch their teams play when outdoor temperatures are less than ideal. These stadiums vary slightly from their fully-domed relatives in that they allow for the roof to be opened in nicer weather, providing openness and a more pleasant experience at the ballpark. The design of these stadiums has varied a bit through the years, with a few different styles being built. The first retractable roof stadium was the SkyDome in Toronto, Ontario, Canada.

9.1.1 SkyDome

When the city of Toronto was awarded a Major League Baseball franchise in 1976, Exhibition Park was the only available stadium. Though initially a football stadium, it was retrofitted to house baseball, and was the home of the Blue Jays until 1989 when the SkyDome was built. The SkyDome (now the Rogers Centre) was the first retractable roof stadium in North America and was revolutionary in the field. The structure itself is a round, concrete stadium with an artificial turf playing surface. The roof consists of four large panels that stack over one another at the southern end of the stadium. When the roof opens, the first panel rotates around the stadium and provides the roof on the northern-most portion of the stadium. Next, two large panels slide out and run along straight rails to meet the first piece. The fourth piece remains in place and closes off the southern end of the roof. Images of the roof in both an open and closed position can be seen in Figure 9-1 and Figure 9-2.

Figure 9-1: SkyDome/Rogers Centre with roof open [8]

Figure 9-2: SkyDome/Rogers Centre with roof closed [11]

In total, the roof weighs approximately 22 million pounds, and is moved into place with 72 motors (Lewis). The steel arch panels span nearly 700 feet over the playing field, and move

along railroad tracks into position. The construction of the SkyDome has turned out to be a financial nightmare for the city of Toronto. Initial estimates of CA$150 million were quickly overrun as a result of the innovative technology involved in constructing the retractable roof. Ultimately the total cost of the stadium was CA$578 million, causing a good deal of controversy over the funding of the project and who was responsible. Ultimately Rogers Communications bought the stadium for CA$25 million, less than five percent of the construction costs (Lewis). While the SkyDome was certainly innovative, the large boom in retractable roof stadiums would not occur for another decade, likely a result of the financial struggles associated with the SkyDome.

9.1.2 Minute Maid Park

Home to the Astrodome, the city of Houston was no stranger to covered ballparks. By the 1990s, the Astrodome was beginning to show its age and team owners were threatening to move the team if a new stadium was not built. In 2000, Minute Maid Park (initially Enron Field) opened with a retractable roof. Much like the SkyDome roof, the roof consists of a set of panels that span the width of the stadium and stack upon one another when the roof is open. However, the roof at Minute Maid Park runs only in a straight line as opposed to rotating like at the SkyDome. The roof consists of tapered box trusses which are very light and keep the entire weight of the roof less than 5500 tons. In an effort to maintain an open feel to the park even when the roof is closed, the roof is actually supported by a glass wall that moves with the roof. The construction of the roof-wall system is seen in Figure 9-3.

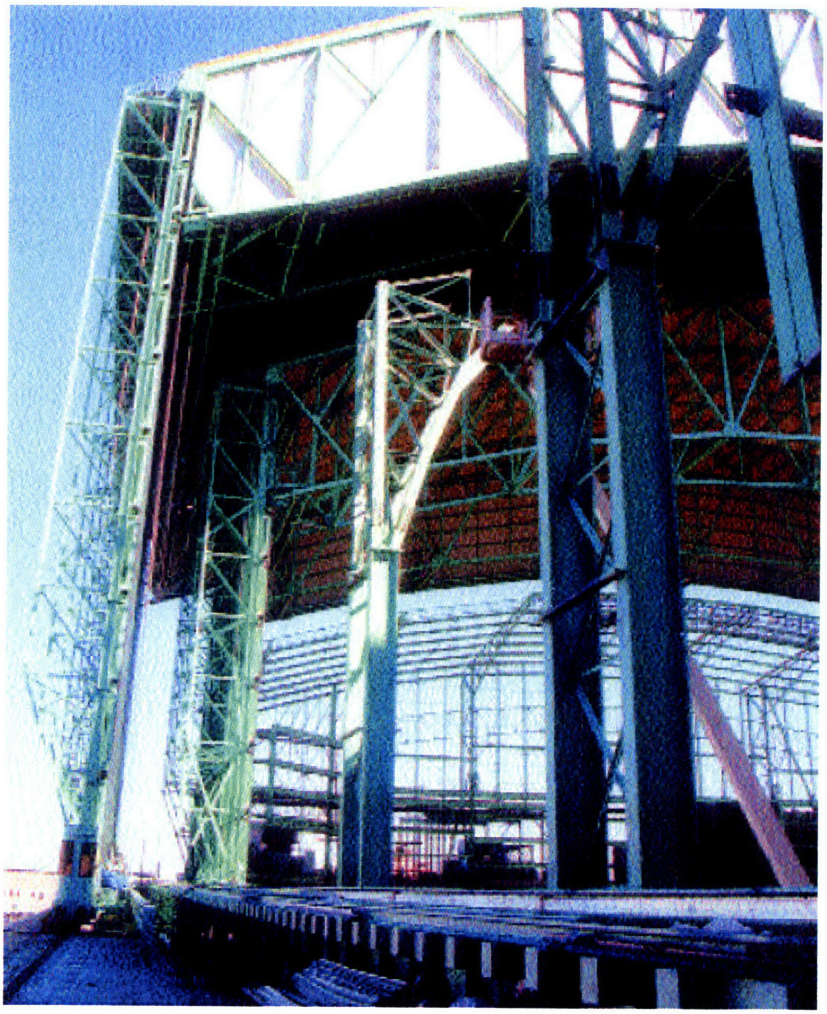

Figure 9-3: Movable roof and wall of Minute Maid Park [12]

While providing a view of downtown Houston, this creates an interesting challenge as a result of the asymmetry of the moving structure. By creating a pinned joint at the intersection of the roof and wall, lateral forces at the supports are minimized. Also, hydraulic dampers were used to help combat lateral wind loads, as Houston is in a hurricane prone region. A diagram of the forces in the structure is seen in Figure 9-4, which also shows the location of the hydraulic dampers.

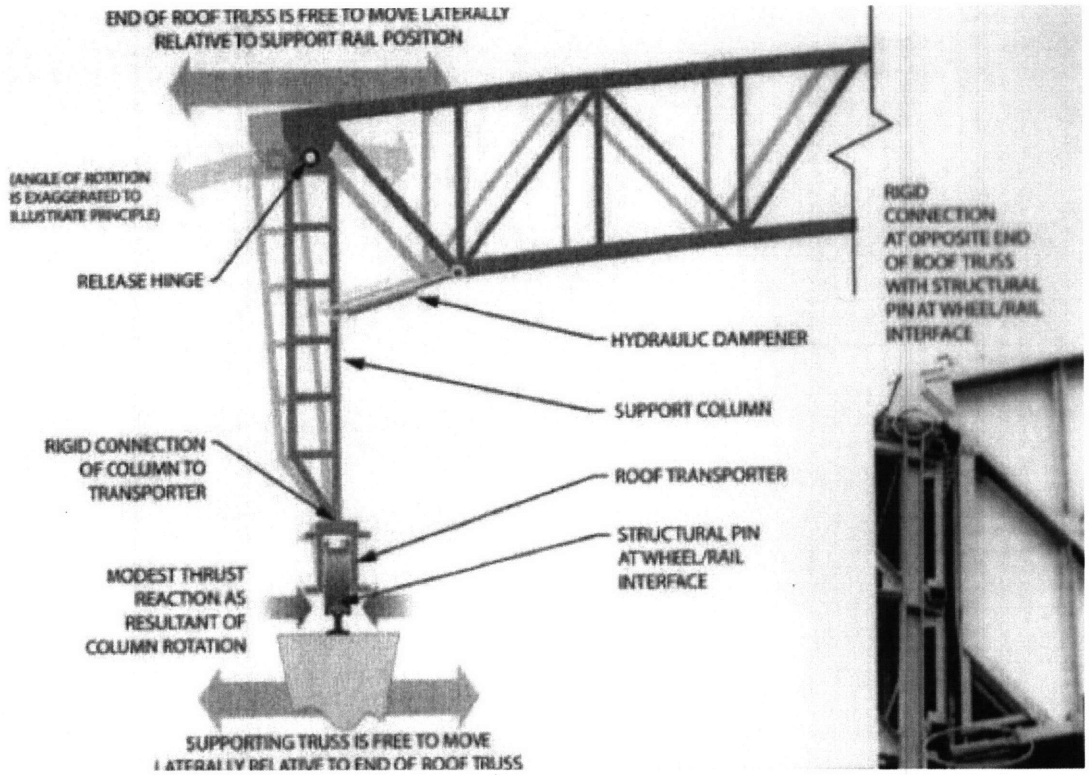

Figure 9-4: Deflection and forces in Minute Maid Park roof-wall connection [13]

9.1.3 Miller Park

The Milwaukee Brewers needed a new stadium in the 1990's and the decision was made to construct a retractable roof stadium due to the harsh climate of Milwaukee, Wisconsin. The design of this roof was different from other retractable roof stadiums in recent years. Rather than sliding in a straight line to cover the field, the five roof panels actually rotate around a single pivot behind home plate, creating a fan arrangement. This unique design allows the ballpark to retain a more traditional shape, as opposed to the more rectangular stadiums in Houston and Seattle. The new design did come with some new problems. When closed, the connection of the roof panels was not entirely water-tight, and the roof has been known to sprout a few leaks, causing problems 300 feet below on the playing field. Also, an initial miscalculation in the roof load resulted in the necessary addition of significant reinforcements. This increased the weight of the roof and has caused problems with overloading of the roof wheels and motors.

10 Ballparks of Philadelphia

As one of America's first cities, Philadelphia has seen its fair share of history. It has also been witness to nearly every type of baseball stadium. In fact, no other city better exemplifies the evolution of the American ballpark than Philadelphia does. Therefore the ballparks of Philadelphia will be analyzed in order to provide a view of this progress in ballpark design. As a whole, the four ballparks that have been built in Philadelphia since the turn of the 20th century have all opened to rave reviews and outstanding support. The Baker Bowl and Shibe Park were both revolutionary in their design, and Veterans Stadium was loved when it opened in 1971. As they aged, each fell into disrepair and would ultimately be demolished. In 2004, Philadelphia's newest ballpark, Citizens Bank Park, opened and fans have once again been treated to the experience of an open-air ballpark with natural grass.

10.1 Baker Bowl

Built in 1887, the Baker Bowl was a wooden ballpark that was home to the Philadelphia Phillies, and was considered to be quite innovative for its time. The ballpark was located on the north side of Philadelphia, near what is now Temple University. However, in 1895 the ballpark burnt to the ground, and was completely reconstructed. The new park was built of steel and brick, with double-decked seating extending between first and third bases, with single level grandstands continuing to the foul pole on each side. Later the second level was extended to the foul poles on each side and a single level grandstand wrapped around into left field (Figure 10-1).

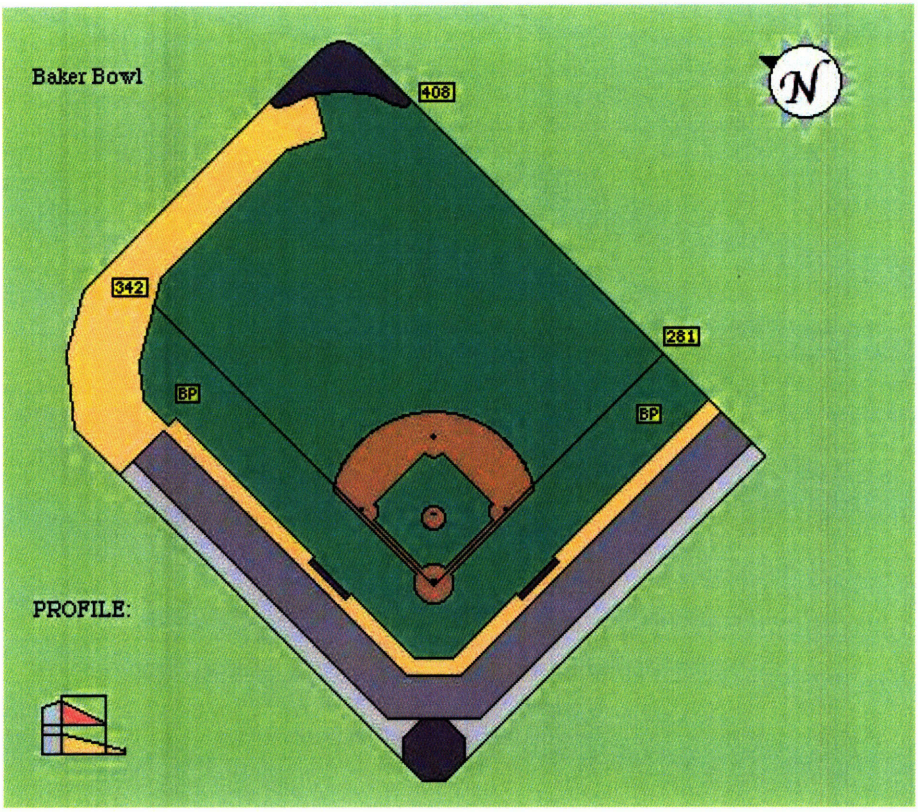

Figure 10-1: Baker Bowl [2]

The short distance to right field was negated by a 40 foot tall fence that ran from the right field foul pole to centerfield, which would later be adorned with a large scoreboard and an advertisement for LifeBuoy soap (Angle). After a number of years, the Baker Bowl began to fall into disrepair, and the Phillies eventually left for Shibe Park in 1938. Though a few events were held at the Baker Bowl following the Phillies' departure, it never received the attention it deserved and was demolished in 1950.

10.2 Shibe Park / Connie Mack Stadium

With the Phillies playing at the Baker Bowl, the Philadelphia Athletics (A's) played in a small, wooden ballpark called Columbia Park, from their inception in 1901 until 1908. After winning the American League Championship in 1902 and 1905, team owner Ben Shibe decided the team needed a new ballpark. Completed in 1909, Shibe Park was the first ballpark constructed entirely of steel and concrete, and was located just down Lehigh Avenue from the Baker Bowl (Figure 10-2).

Figure 10-2: Shibe Park (foreground) and Baker Bowl (upper right) [14]

When first completed, the ballpark at 21st and Lehigh had a two-tiered seating grandstand between first and third base with bleachers further down the foul lines on both sides. The most recognizable feature of the ballpark was the brick façade and cupola at the main entrance behind home plate. A number of renovations thorough the years resulted in the grandstands being extended into left field and center field, and eventually a second level of seating was added to all of the grandstands. In right field, the outfield wall stood at 12 feet tall, and fans often flocked to the rooftops of homes along 20th Street to watch the game for free. This was brought to an end in 1935 when Connie Mack built the 60 foot tall "spite fence" to prevent these non-paying fans from enjoying the ballgame (Munsey). Shibe Park had a structural system that would be mimicked often in the following years. The upper decks were supported on steel columns and trusses. Though it is not clear, Figure 10-3 shows that the columns were comprised of back-to-back channel sections that were separated and joined by cross-bracing. The steel roof truss is also shown, and fans on the rooftops of homes can be seen in the background.

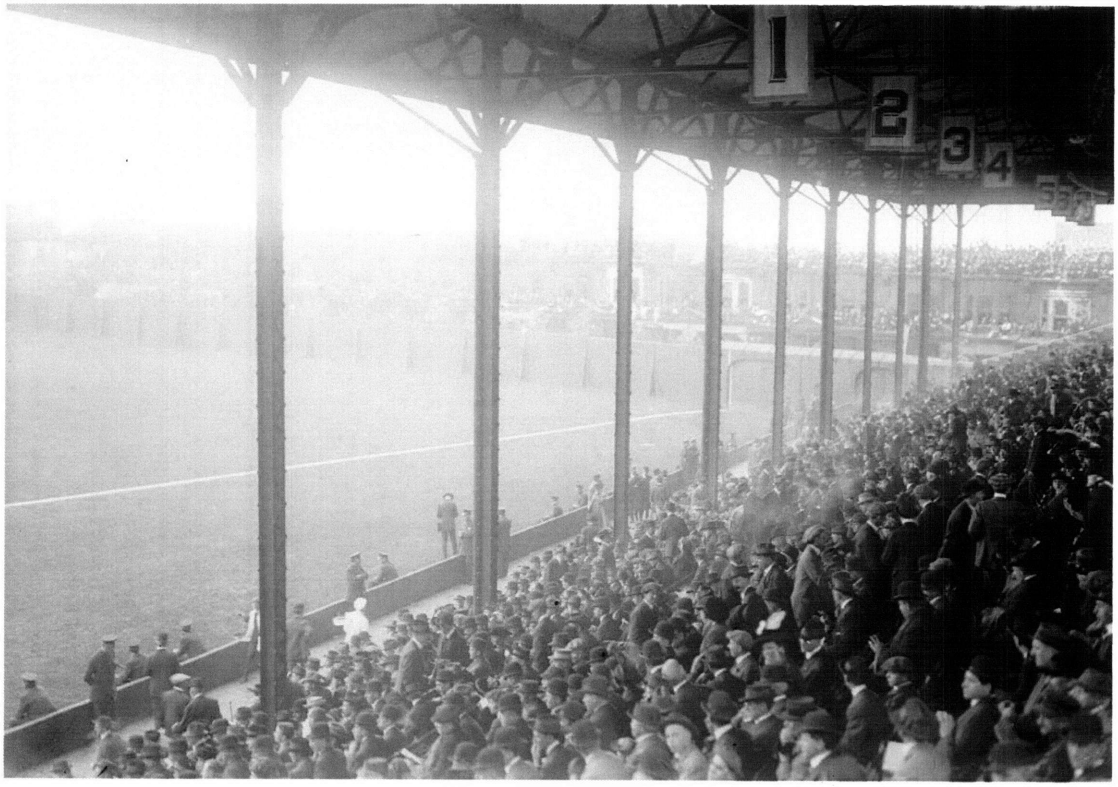

Figure 10-3: Right field grandstands at Shibe Park [3]

In 1938 the Phillies moved from the Baker Bowl to become co-tenants of Shibe Park, while the NFL's Eagles played at Shibe Park from 1940 to 1958, before moving on to play at Franklin Field on the campus of the University of Pennsylvania (Angle). Following the addition of lights in 1939, the stadium would undergo no major structural changes. In 1953, the ballpark was renamed Connie Mack Stadium in honor of the A's long-time manager. The following year the A's would move to Kansas City, leaving the Phillies as the sole tenants.

By the time the 1960s rolled around, members of the Phillies ownership (particularly Bob Carpenter) were looking to build a new stadium. The neighborhood around the ballpark had slowly deteriorated, attendance had dropped, and Carpenter was pushing to build a new multi-purpose stadium (Kuklick). Shibe Park limped through the '60s and the last game was played on October 1, 1970. Many fans at the game that day brought tools with them and began removing seats and other memorabilia. When the Phillies won on a base hit in the bottom of the 10th inning, fans stormed the field for anything they could get their hands on. Following the game, home plate was ceremoniously moved into Veterans Stadium in South Philadelphia (Giles).

After the Phillies moved out, the ballpark was entirely neglected. In a matter of a few years, the grass became overgrown with weeds and shrubs and portions of the roof and seating decks had collapsed as a result of a 1971 fire. Demolition began in 1976, and the iconic tower was the last portion of the ballpark standing before being completely razed (Figure 10-4).

Figure 10-4: The cupola of Shibe Park shortly before demolition [14]

10.3 Veterans Stadium

With the construction of multi-purpose stadiums across the country, the city of Philadelphia joined the trend in the 1960s. Planning would take the better part of a decade, as there was great debate over the location and financing of the stadium. Ultimately, a site at the intersection of Broad St. and Pattison Ave. in South Philadelphia was chosen, and a groundbreaking ceremony was held in the fall of 1967. The construction of Veterans Stadium was then fraught with

problems. In 1969 the contractor and structural engineer were indicted by a grand jury on charges of "false pretense and conspiracy in connection with construction." These charges were based on information that the steel and other materials being used were lighter and cheaper than the specified material. Labor strikes halted work completely, vandals defaced portions of the stadium, and construction costs wound up coming in at nearly twice the initial budget estimates (Westcott). The ballpark itself consisted of a concrete superstructure (87,000 cubic yards in total) with two main seating decks separated by a row of luxury boxes. In plan, the stadium was an "octorad" – a term coined by the architects to describe the rounded rectangular shape – with large concrete ramps circling the stadium to get fans to the upper deck. A concrete tread-and-riser system held the pre-cast concrete seating in place. Figure 10-5 provides an excellent view of Veterans Stadium during construction. The concrete clearly begins to define what would become the two seating bowls. Simple steel trusses were used to support the portion of the upper deck that cantilevered over the lower deck.

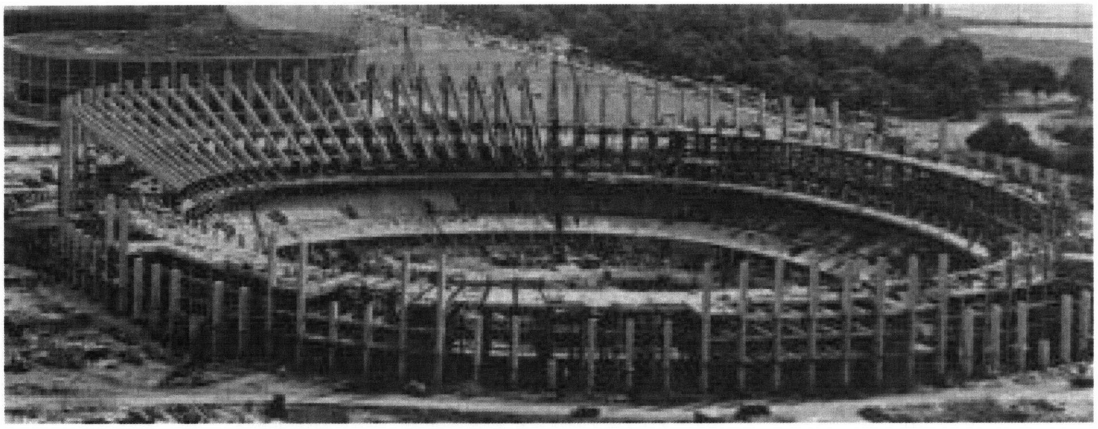

Figure 10-5: Veterans Stadium during construction [15]

When it finally opened in 1971 (Figure 10-6), Veterans Stadium was considered one of the most state-of-the-art ballparks around, and the Phillies set a Pennsylvania record for attendance on opening day.

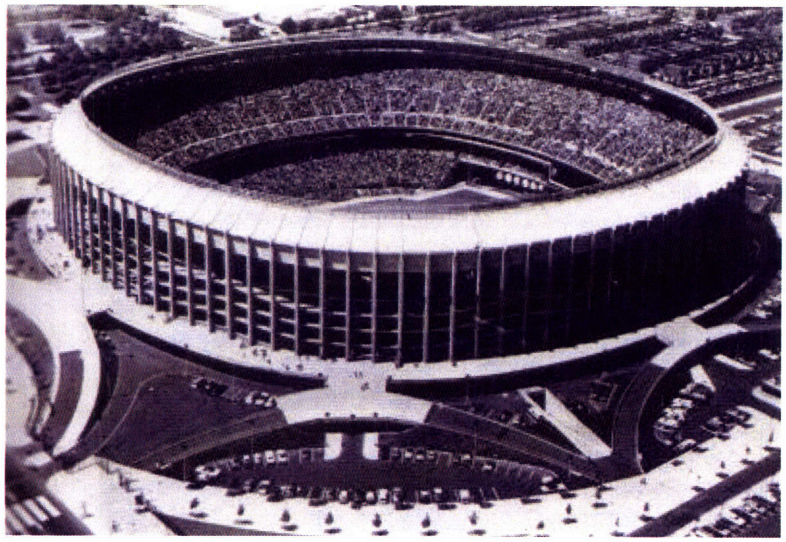

Figure 10-6: Veterans Stadium, Opening Day, 1971 [15]

Both the Phillies and the Eagles would enjoy relative success at The Vet, as it became known. The Phillies won six National League East Division titles (1976-78,'80,'83, and '93), and they won the first and only World Series in franchise history in 1980. While the Eagles had their most successful seasons in the last few years at The Vet, their win over the Dallas Cowboys in the 1980 NFC Conference championship game sent them to the Super Bowl. Both the interior (Figure 10-7) and exterior of the stadium were very similar to other "cookie-cutter" ballparks built in the same era.

Figure 10-7: Interior of Veterans Stadium [8]

The high praise for the new stadium began to wear off and soon turned quite negative. By the mid-1990s, The Vet was consistently named on of the worst stadiums in sports for a number of reasons. The exposed concrete architecture had gone out of style, and new ballparks like Oriole Park at Camden Yards showed where ballpark design was moving. The AstroTurf surface (later replaced by NexTurf, a similar product) had numerous problems. When the field was configured for football, turf patches covered the dirt cutouts used for baseball. Often these seams became serious hazards, as did the extremely hard playing surface. It became clear the The Vet's years were limited and in 1999, the state of Pennsylvania announced it would build two new, single-sport facilities in Philadelphia, as well as two in Pittsburgh to replace Three Rivers Stadium (Giles). With that, the design of Citizens Bank Park began.

Veterans Stadium would see its final baseball game on the afternoon of September 28, 2003. Following the game (a loss to the Atlanta Braves), Phillies greats paraded onto the field and the top Veterans Stadium moments were remembered. Among the many former players and coaches were Tug McGraw and Paul Owens. McGraw was on the mound when the Phillies closed out the 1980 World Series, and Owens was a former General Manager and bench manager for the Phillies. Both men would pass away in the next few months after hard-fought battles with terminal illness. While Shibe Park was left in ruins for years with no activity, Veterans Stadium was quickly, and some say mercifully, demolished in January of 2004. For many fans (this author included), it was a bittersweet moment.

10.4 Citizens Bank Park

After the state of Pennsylvania approved the financing for the stadium, the design was underway. Immediately, the idea of a retro ballpark was settled on. Erected during the Phillies final season at Veterans Stadium, Citizens Bank Park consists of a steel superstructure with pre-cast concrete seating decks. The façade is a combination of brick and stone, and the use of architecturally exposed steel is prevalent throughout the stadium. It features four landscaped entrances, and has a large number of unique concessions (cheesesteaks, of course) and family amenities. In its first few years, Citizens Bank Park has been widely lauded for providing excellent viewing angles and an all-around superb ballpark experience. One reason Citizens Bank Park has been

commended is the closeness of the seats to the playing field. Figure 10-8 shows a comparison of the seating cross-section at Citizens Bank Park versus Veterans Stadium.

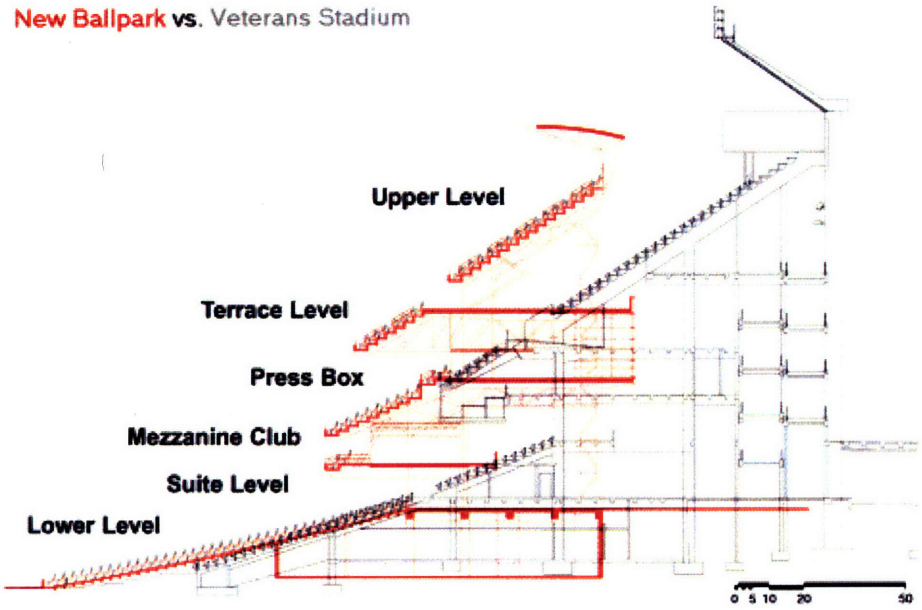

Figure 10-8: Cross-section of seating at Citizens Bank Park and Veterans Stadium [4]

By designing a stadium for only one sport, the design can be optimized to allow fans the best possible view of the game. This results in seats that are much closer to the action on the field. Figure 10-8 also shows the steel truss system used to support the upper seating levels as well as the cantilevered portion which can be seen in Figure 10-9, below. In comparison to Veterans Stadium, Citizens Bank Park features a slightly lower rake, in the lower level and a similar rake in the upper level. The only thing left to see is how well the ballpark will age in the next few decades, and whether Citizens Bank Park can avoid the same fate of Philadelphia's earlier ballparks.

Figure 10-9: Citizens Bank Park from left field [8]

10.4.1 Sustainability

In recent years, the focus on the environmental impact of structures has come to the forefront. In the case of stadiums, many point to parking areas as areas creating large amounts of water runoff. Most often criticized is the amount of electricity used to light the playing field and run all of the other facilities at a ballpark. In April 2008, the Phillies announced that they would purchase 20 million kilowatt-hours of Green-e Energy Certified Renewable Energy Certificates. The purchase is the "largest single purchase in professional sports, and is equivalent to the planting of 100,000 trees" (Phillies).

11 Design Considerations for Ballparks

As with other structures, the nuts and bolts are not the only things that go into the design of a ballpark. These other factors can sometimes be determining aspects in whether or not a ballpark is built.

11.1 Location

Outside of financing the construction of a new ballpark, more often than not, finding a location to build a ballpark is the largest hurdle to overcome. Predominantly, owners consider two options; a downtown ballpark or a stadium on the outskirts of the city. A number of factors determine where a ballpark is built, and opinions vary among local residents and fans who will be attending games. For example, residents often do not want a ballpark nearby, as noise from construction and everyday use of the stadium may be quite disruptive.

11.1.1 Land Availability/Cost

Ultimately, team owners are trying to turn a profit, and one of the easiest ways to do this when building a new stadium is to find the cheapest land on which to build. In the early 20th century, land in the cities was relatively cheap in comparison to today, and many stadiums were built closer to downtown. As the cost of land near downtown increased, many owners began looking elsewhere. Also, the fan base may factor into the location. That is, if many of the fans live outside of the city or somewhere without easy access to public transportation, more parking may be needed at the stadium site. Conversely, in a city with a large portion of its fan-base living nearby, a downtown ballpark may be a possibility.

11.1.2 Access

A ballpark must be located in an area with easy access for its fans, and for stadiums that can house tens of thousands of spectators, this can become quite a chore. In deciding where to place a ballpark, the available access must be considered. If at all possible, it is best to locate a stadium near an existing station of the public transportation system (Geraint). Fenway Park and Yankee Stadium are two excellent examples of ballparks with a subway stop in close proximity to the stadium. For fans without access to public transportation, access to the stadium via interstates and highways is vital. If it becomes too much of a hassle for the fan to reach the

ballpark, he may choose to watch the game on TV. Once at the stadium, there must be ample parking available for these commuting fans.

11.2 Architecture

Though ballparks are unique in the sheer number of spectators they serve, and thus their overall size, they still may serve as architectural landmarks. In fact, the structure of a stadium is quite often driven by the architectural aspiration. The architecture of a park may also be determined by the surrounding area. For downtown ballparks, the design of the stadium may attempt to mirror, or at least fit in with, the neighborhood. This may also involve setting the upper portion of the stadium back from the street to prevent the ballpark from towering over its neighbors. However, stadiums in large, open spaces can be designed to stand alone without trying to conform to nearby buildings. (Geraint)

11.2.1 Sight-lines

Once inside the stadium, the ability of the fans to see the action on the field provides another design challenge. The angle of the seating tiers can be varied, as can the distance and height from the playing field in order to provide the best viewing experience. Figure 11-1 shows how varying these criteria will change the design of the seating area, where C is a variable relating the distance between the sightline of a person and the height of the person in front of them (see Figure 11-2).

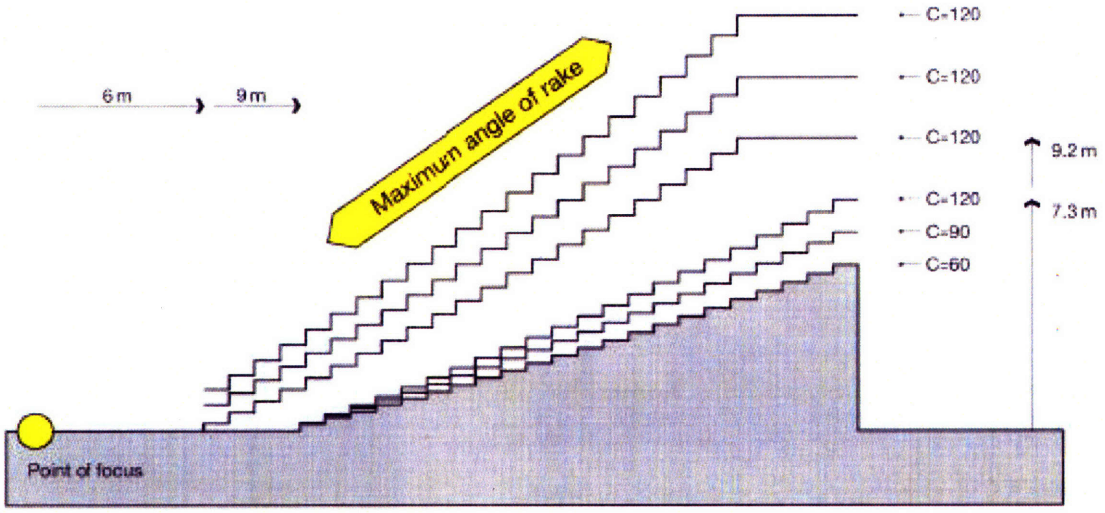

Figure 11-1: Variation in rake as seats are moved higher or closer to the field [16]

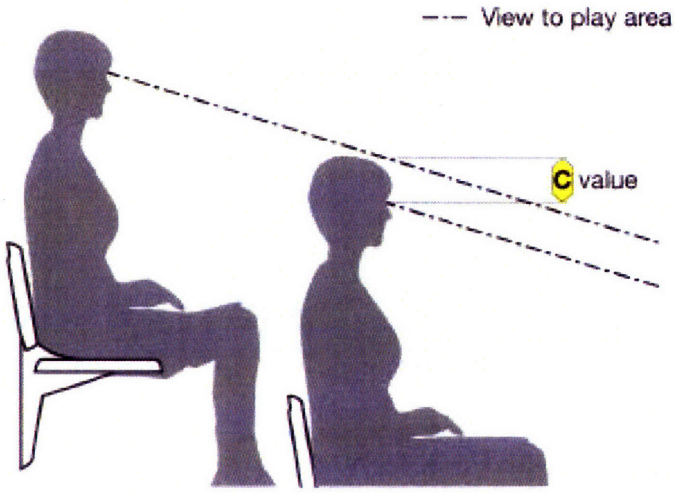

Figure 11-2: C-value [16]

11.3 Amenities

Of late, it has become increasingly important to provide certain amenities for spectators. Among these amenities are concessions, restrooms, souvenir stands, and various other activities. Some new stadiums have areas designed for children to attract more families to the games, and many have a unique feature or gimmick to help the stadium stand out from others.

12 The Future of the Ballpark

Baseball continues to be an incredibly large and growing business, as evidenced by the outrageous salaries of players on the field, as well as the number of stadiums built in recent years. Team owners would not have pushed to have these stadiums built if they did not foresee making their money back in ticket sales, concessions, etc. The history of the baseball stadium has seen a wide variety of stadiums throughout its many years, and will likely see more in the years to come. This section will give a brief overview of the stadiums currently being built, those that have been proposed, and an expectation of what to come in the near future.

12.1 Stadiums Under Construction

New York City will demolish two history-filled ballparks and will welcome two new ballparks on the horizon to begin the 2009 season. In the Bronx, Yankee Stadium II is being built adjacent to the current Yankee Stadium, and will be very similar in design. Meanwhile, over in Queens, the Mets will move into Citi Field, a new retro ballpark whose design will feature an exterior reminiscent of Ebbets Field. The brick façade and large rotunda behind home plate (Figure 12-1) are nearly the same as the now-demolished stadium in Flatbush, Brooklyn. Inside the stadium, new facilities will cater to the fan's every need and will have certain areas dedicated to family entertainment. Figure 12-1 also shows the steel superstructure supporting the pre-cast concrete seating deck.

Figure 12-1: Entrance to Citi Field behind home plate [9]

In Oakland, CA the Athletics have announced plans to move from McAfee Coliseum, a multi-purpose stadium currently shared with the NFL's Oakland Raiders, to Cisco Field south of Oakland. This move will place the A's in the smallest stadium in the major leagues, something that is more appropriate than the monstrous McAfee Coliseum for a small market team like the A's. Currently, Cisco Field is on track to open in 2012. In 2010, Minneapolis will see its first baseball-only ballpark since the Metrodome replaced Metropolitan Field in 1982. One of the most interesting features of the stadium will be the fact that it will not have any sort of roof, so games could become chilly in early April, or if the Twins ever make it to October. (Angle)

12.2 Proposed Stadiums

The Florida Marlins have announced designs for a new ballpark, but are currently in limbo over financing for the park. In 2005 the team and Miami-Dade County agreed on a financing plan, but the Florida House Legislature repeatedly turned down requests for funding. Recently, a number of new proposals have been put forth with funding from the Marlins, Miami-Dade County (including tourist tax money), and the City of Miami. In this proposal, the new stadium (Figure 12-2) would be a retractable-roof stadium capable of seating approximately 37,000

spectators and would open in 2011. Contingent on this proposal the Florida Marlins team name would be changed to the Miami Marlins.

Figure 12-2: Marlins Ballpark [8]

Up the road a bit in Tampa, Florida, the Tampa Bay Rays are considering moving from Tropicana Field. The plan has the Rays refurbishing their current spring training site, Al Lang Field, in St. Petersburg, and turning it into a park (Figure 12-3) seating 34,000 fans, with air conditioned concourses, and the most unique roof in professional baseball.

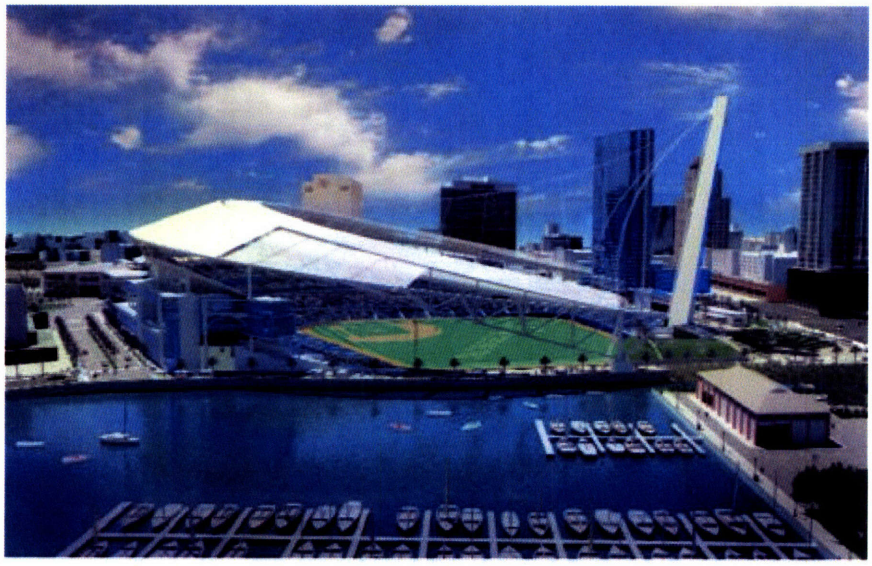

Figure 12-3: Rays Ballpark [8]

The retractable roof (Figure 12-4) would consist of a fabric that would be hoisted over the field by the large tower in center field. Unlike other retractable-roof stadiums, the design would not need to include a large area to store the roof when not in use. (Angle)

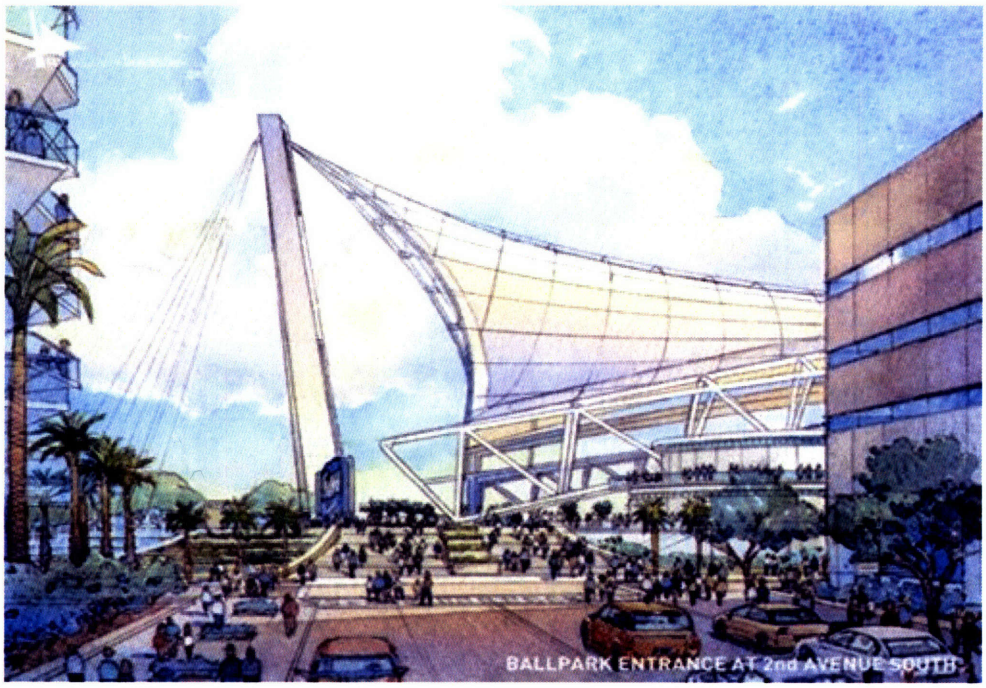

Figure 12-4: Rays Ballpark with roof covered [8]

12.3 Ballparks of the Future

At the opening of the 2009 baseball season, 20 of the 30 teams in Major League Baseball will be playing in a stadium built within the past 18 years. If all of the proposed stadiums make it off the drawing board in the next few years, a staggering 24 stadiums will be less than 20 years old. With such a large boom in ballpark construction of late, and considering that these ballparks have all been well-received and have no reports of being structurally unsound, it is unlikely that the coming years will see nearly as many new ballparks being built. The owners of the oldest of ballparks (Fenway Park, Wrigley Park, and Dodger Stadium) have all made it clear that they will continue to renovate rather than rebuild their parks. There will likely be a dearth in ballpark construction in the near future, just as there was in the 1940s and '50s following the completion of a great number of ballparks between 1910 and 1930. For the new stadiums that will be designed, a few things are clear. Any ballpark will be designed to accommodate baseball first

and foremost. There is a reason all of the multi-purpose stadiums are being replaced with single-sport venues. It has proven to be wholly impossible to accommodate two sports with incredibly different playing fields in the same stadium without seriously compromising the viewing experience of the spectator, the person who ultimately drives the business of baseball.

Of late, there have been a large number of stadiums built with retractable roofs. While the technology in retractable roof design and construction has improved greatly, the market for baseball stadiums that require them is dwindling. With the exception of the current proposals in Miami and St. Petersburg, there simply are not any other cities whose climate would necessitate and justify the cost of a retractable roof. Ballparks in the near future will have to provide a new level of amenities to the fan. In recent years a trip to the ballpark has become less and less about the game played on the field, and more about what else there is to do at the stadium. Understandably, owners will continue to enhance these features in an effort to draw family crowds to the games. However, nothing would please this author more than to see a team owner take the money earmarked for a useless amenity and put it towards putting a better product *on* the field.

It will be interesting to see where ballpark design in general will be in the more distant future. All of the ballparks built in the past few years will most likely need to be replaced around the same time. Will there be mass shift back towards multi-purpose stadiums or a more futuristic style, or will the design ideals of the Jewel Box ballparks and the current "retro" approach remain intact? As for the future of the actual structure, most likely steel is here to stay. The ability to span distances between columns or to clear large cantilevers is vital in the design of baseball stadiums, and steel has a distinct advantage in that regard. In areas where motion constraints limit the design, high strength steel would not be of use, but could become critical for long spans whose design is controlled by strength. That being said, the introduction of pre-stressed concrete could become an option in regions where it may prove more economically viable than steel.

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