A FIELD HOUSE FOR KANSAS STATE COLLEGE

by

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INTRODUCTION

Desiring to study a problem approaching as closely as possible one which might be encountered in the practice of the profession, and also one which presented a little more of a structural problem than is usually encountered, I have selected for study and design a Field House suitable for Kansas State College.

Fully realizing the vast need for a structure of this type and hoping, perhaps, to stimulate interest in one, I shall make my solution just as practical and economical as possible for this college.

After consultation with members of the architectural and athletic departments, and a study of some of the requirements fulfilled by structures of this type already erected at other institutions, it was decided that a field house should be designed to meet the requirements set forth below:

Statement of Problem

It is assumed that a Field House is to be erected at Kansas State College, the primary function of which shall be to provide a place for indoor athletic events. The structure shall be so located as

to be easily accessible, not only to the general public, but also to the athletic units now in use, and shall be in harmonious design with the architecture of the rest of the campus.

It shall provide specifically:

(1) Ample seating for 5,000 people, of which at least 2,000 shall be permanent seats, the balance to be of the bleacher type.

(2) A 220-yard running track, 6 lanes wide.

(3) Ample entrance and exit facilities, ticket offices, etc.

(4) Provision for dressing rooms, toilets, showers, etc.

The structure shall be designed to be as flexible as possible, permitting it to be used for many varied functions; and it shall be kept as economical as possible.

Since a great amount of study and thought must be given to any building before the most economical and efficient design for it is reached, it shall be the purpose of this thesis to present a discussion of the results of such a study.

In approaching this problem, a great many studies were made of different partis. Various arrangements of public facilities were studied; plans for various locations

developed; side entrances and end entrances were tried, all in an endeavor to find what the author believed to be the best practical solution.

Out of these many studies emerged seven definite and distinct schemes, any one of which might be developed into a Field House for Kansas State College. These are by no means all of the possible solutions of the problem, nor does the author so claim; but they comprise, perhaps, most of the more conservative plans which it was thought applicable to a field house for this college--mainly because of economies and site factors involved, and the requirements to be met by the structure.

The first part of this thesis, then, shall present these seven different schemes, illustrated by blue prints. They will be discussed with respect to advantages and disadvantages. The second part of the thesis will consist of a description of the fully developed design of one of the above schemes, the scheme selected being the one which the author believes affords the best solution to the problem. This design will be fully developed with respect to framing, etc., and in general the design will be carried up to that point where one could immediately start on full working drawings.

The material and information for this research were

gathered by becoming familiar with all the information that could be found regarding structures of this type, and studying the requirements fulfilled by them. Books, periodicals, and correspondence with engineers familiar with this type of structure were resorted to.

STUDIES IN PARTI

Early in the study of the problem, and after consulting such campus plans as could be found, it became evident that there were only about three campus sites available for a field house which would be accessible to both the public and to existing athletic units. These are:

1. The plot of ground just north of the stadium, which has since been converted into practice fields. This suggested two possibilities:

   a. With the building placed at the south end of the plot, and the main entrance on the end and from the east.

   b. The building placed at the north end of this plot, with main entrances on the sides, from the north and south.

2. The site occupied at present by the tennis courts.

3. The site just south of the stadium, thus doing away with the necessity for completing the stadium as a "horse-shoe".

The slope directly south of the engineering building and the site now occupied by the baseball field were also considered, but were discarded.

In studying field houses erected at other institutions, the author was early impressed by the large number which used end entrances. Those at the Universities of Nebraska,

Missouri, Michigan, and Minnesota are a few of this type. It was immediately thought that the end entrance could be used here and an improvement made by keeping most of the public off of the field house floor. This could be accomplished by entering at a second floor level (see Plates Nos. I, III, IV, and VI), thus taking advantage of the natural slope of sites 1-a and 1-b; so Scheme No. 1 (Plate No. I) was among the earlier plans developed.

It is the most elaborate plan of those presented, showing full-length balconies down each side, and a half balcony across the entrance end. It would not, of course, be necessary to construct this amount of balcony space initially, or at all, if not desired. Public circulation is accomplished by means of a passage under the balcony but above the field house floor. A maximum amount of locker rooms, toilets, and other facilities are provided in the two-story and basement wing on the east end.

This scheme was discarded because it was felt to be too elaborate for the requirements of this college. The efficiency of the type of truss indicated was also questioned, and, although one of a similar type with a span of 180 feet 5 inches was used in the Pennsylvania "Palestra", it was felt that a truss of the arch type would be superior.

PLATE NO. I

Scheme No. 1, a scheme designed for a sloping site, with public entrance on the end at an upper level.

DOWN TO EXITS AT FIELDHOUSE FLOOR LEVEL.

PASSAGE TO BALCONY

TOIL.

TOIL.

TICK. OFF.

VES.

LOBBY.

2nd. FLOOR.

RUNNING TRACK UNDER.

CROSS SECTION

PLAN

LONG. SECTION

SCHEME NO. 1

ENTRANCE ON END AT AN UPPER LEVEL. PUBLIC CIRCULATION BY PASSAGE UNDER BALCONY. FACILITIES IN WING ON END.

Scheme No. 2 (Plate No. II) was another arrangement studied. This scheme would fit two locations--sites 1-b and 2. In this scheme, advantage was not taken of the slope to the south of the plot of ground north of the stadium, which would be graded level by cutting and filling. The public enter directly on to the field house floor through a public lobby. The crowd would be distributed on this floor to various sections of the balcony, reached by a flight of stairs in each bay. Those using temporary seats would immediately go to those seats, grouped around the basket-ball court in the center. Toilets, lockers, showers, and other necessary facilities are provided in the two-story wing on the side. In case need should arise, an identical unit could be constructed on the opposite side, at a later date. Here again, full length balconies are shown in the sketch. Originally, only as many bays as needed might be constructed

This scheme is quite similar to the final design submitted (See Plate No. VII, page 26) with respect to plan. It was discarded, however, because of the amount of grading required if the site north of the stadium were selected, and because the other site (that now occupied by the tennis courts) was felt to be inferior to the one chosen in the final scheme. The sketch of the elevation, of course, is

PLATE NO. II

Scheme No. 2, a scheme designed for a level site with the public entrance on the side.

B.B. Court

50' × 90'

Exits

Exits

Varsity

Men's

Off.

T.

Lobby

Ves.

T.

Off.

Women's

Visitor's

PLAN

ELEVATION

CROSS SECTION

SCHEME No.-2

5000 Permanent Seats if full length balconies are used.

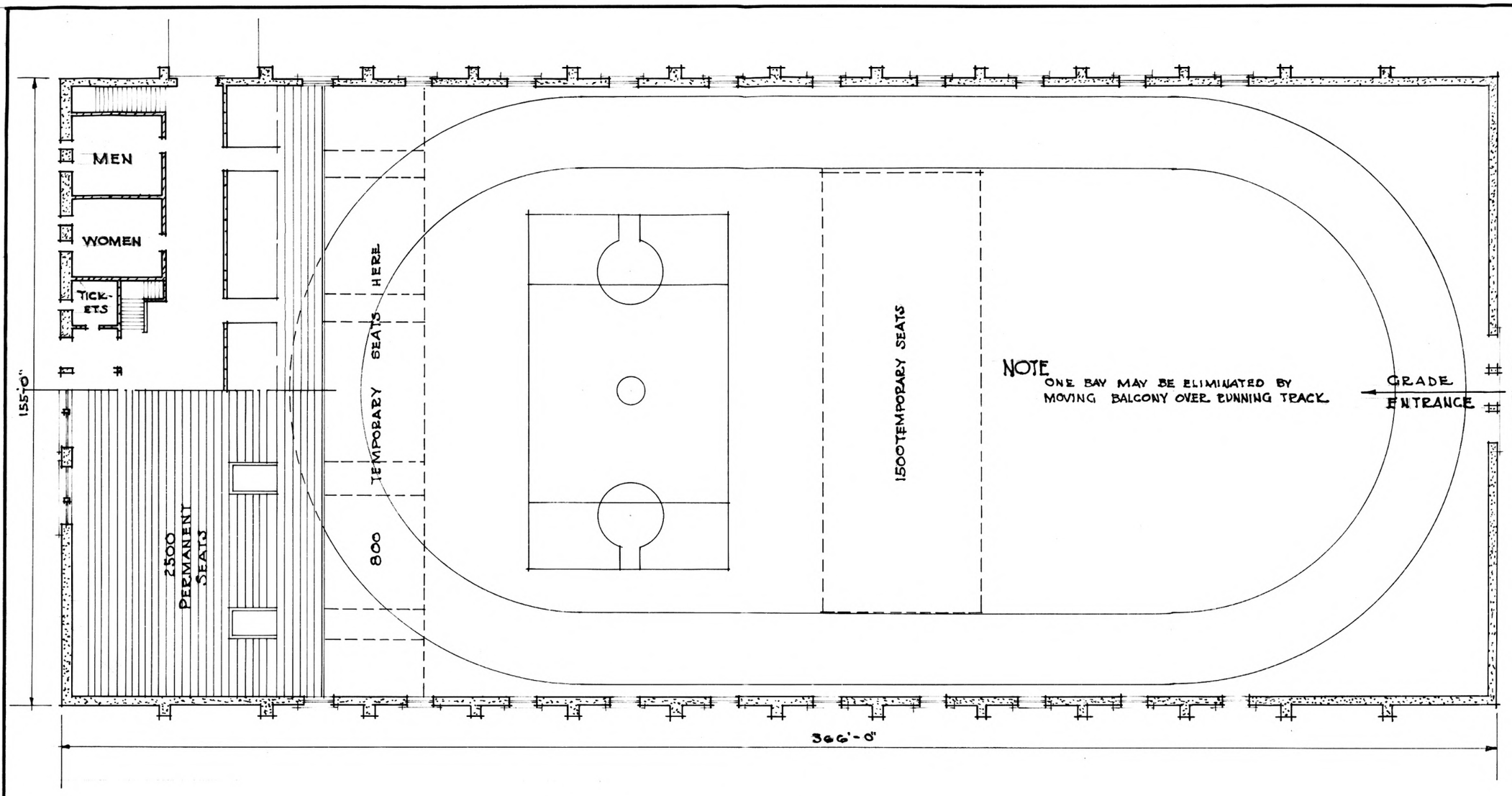
merely a suggestion, and would require further study, if developed.

It was not considered best to have all of the public brought in and distributed on the field house floor, but rather to separate the crowd in a lobby or a corridor designed especially for that purpose. However, the former plan was used in such field houses as those at the Universities of Minnesota, Illinois, and Michigan, and has proved satisfactory there. Further study was given this feature, and resulted in Schemes Nos. 3 and 4 (Plates Nos. III and IV).

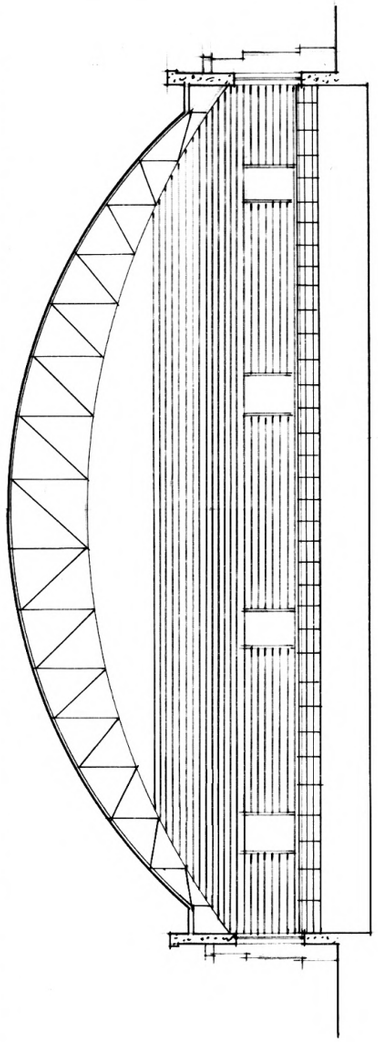
Here again the natural slope of site 1-a was taken advantage of. The balcony was placed in the end of the structure and is so arranged that the under side of the balcony, which would be of concrete, furnishes the ceiling for the rooms below, thus effecting a saving by eliminating the necessity of plastering. The public enters through a public lobby on the end and at a level above the field house floor. From this lobby the crowd is distributed along a wide corridor under the balcony, thence by means of ramps to the various sections of the balcony; and by means of stairs down to the level of the field house floor, where temporary seats are located.

PLATE NO. III

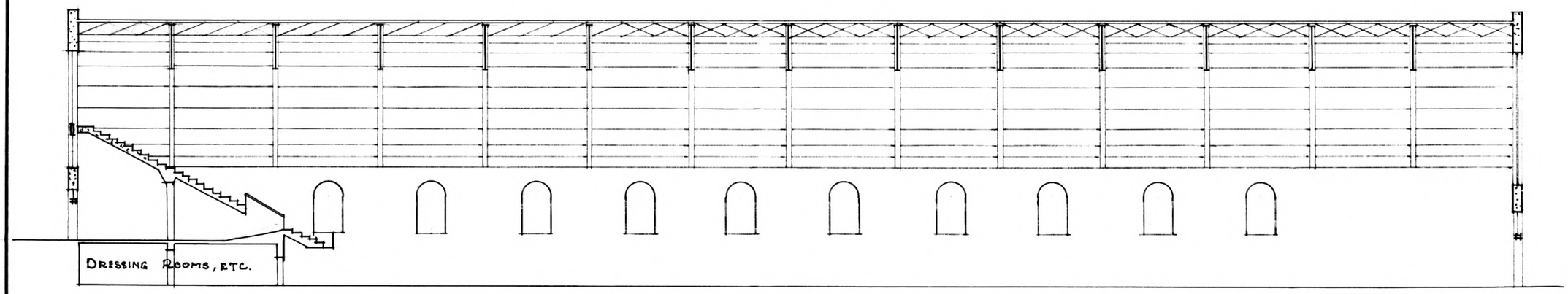
Scheme No. 3, a scheme designed for a sloping site with the public entrance and the balcony on one end.



COMPOSITE FLOOR PLAN



CROSS SECTION

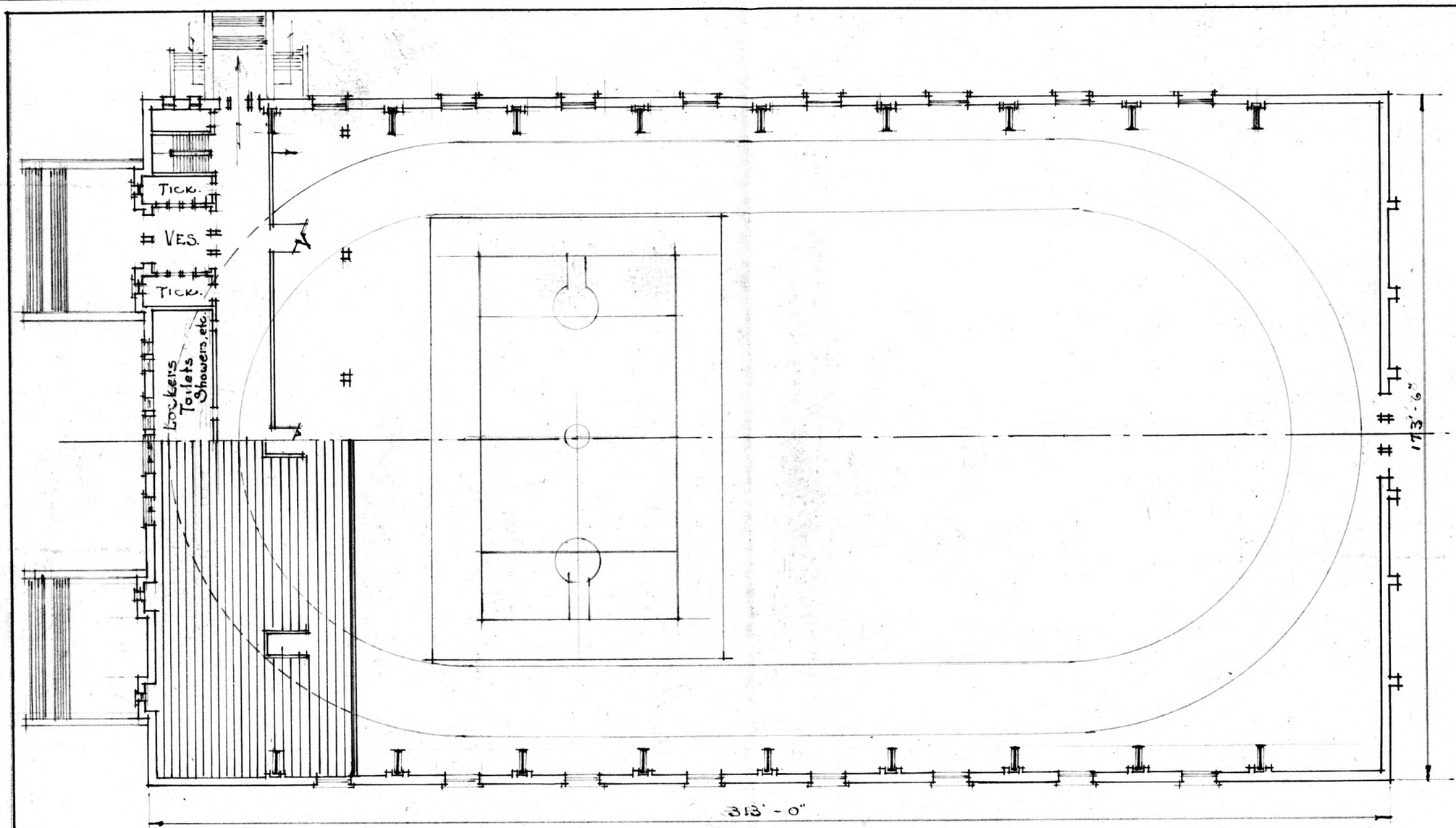


LONGITUDINAL SECTION

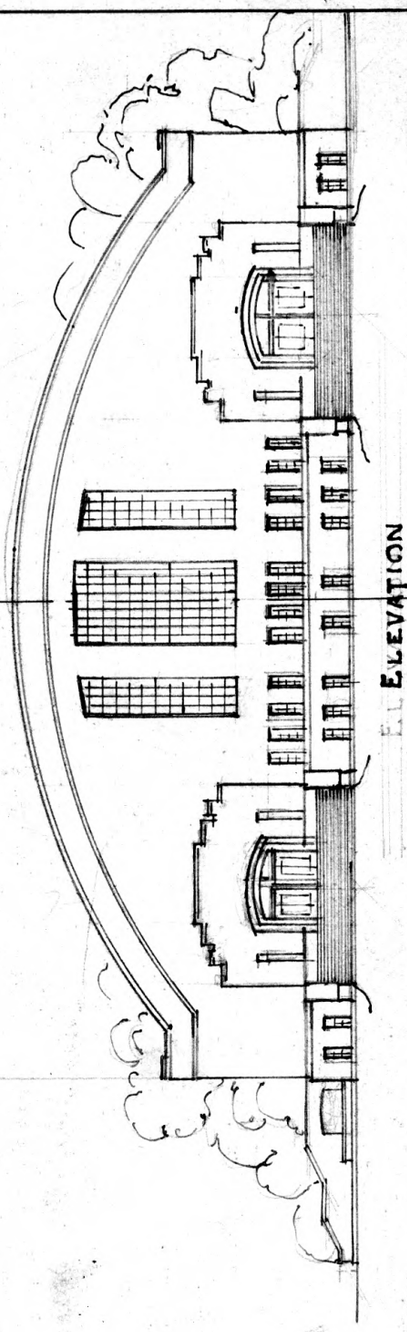
SCHEME NO. 3.
SEATS BANKED ON ONE END
2500 PERMANENT SEATS
2500 TEMPORARY SEATS

PLATE NO. IV

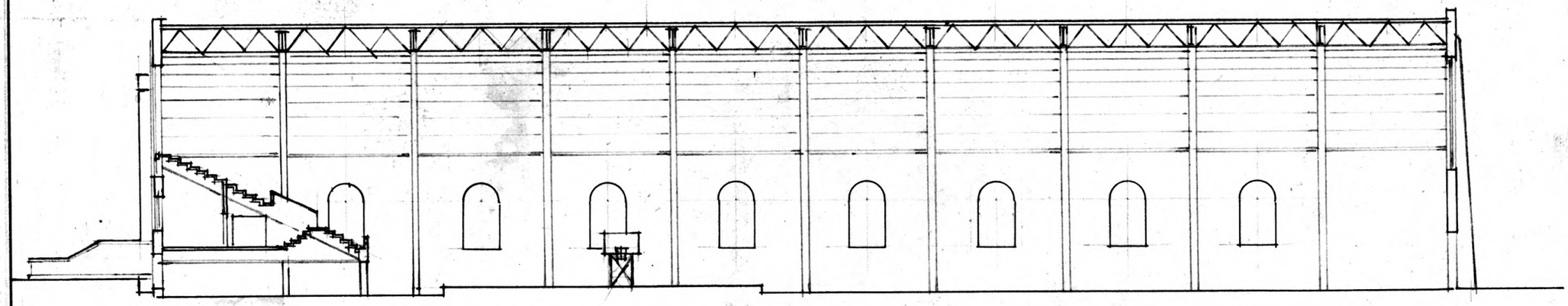
Scheme No. 4, a compact scheme with all elements provided in a building that just encloses the running track.



PLAN



ELEVATION



LONGITUDINAL SECTION

SCHEME No.-4

TWO PUBLIC ENTRANCES ON END AT AN UPPER LEVEL. RUNNING TRACK UNDER BALCONY.

It will be noticed that the two schemes--Scheme No. 3 (Plate No. III) and Scheme No. 4 (Plate No. IV)--are quite similar in parti. Scheme No. 4, however, is much more compact than Scheme No. 3, and has been included simply to show that a building of minimum size (just inclosing the 220-yard running track) could be made to function if it were economically necessary. Scheme No. 3, however, is much more desirable. The running track does not extend under the balcony as it does in Scheme No. 4; the space available for toilets, showers, and lockers is more than double that furnished in Scheme No. 4, where only an absolute minimum is provided; and the awkward row of columns across the field house, which support the balcony, is eliminated. Scheme No. 4 is quite similar to the new Brewer Field House at the University of Missouri, where, it is admitted by Mr. Brewer (according to Professor M. F. Ahearn), a decided improvement would have been made had a plan similar to No. 3 been used instead of the more compact scheme.

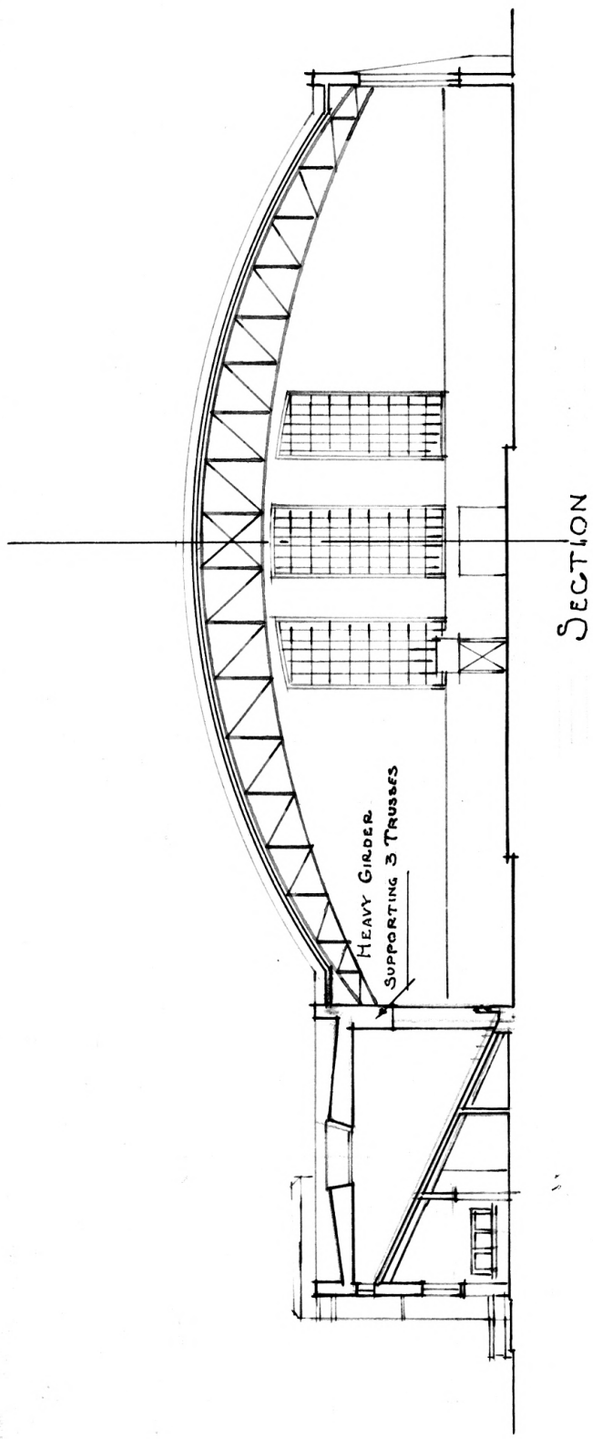
Another scheme developed for site 2 is that illustrated by Plate No. V. Here the public is still distributed before it reaches the field house floor; in fact, only that portion using the temporary seats ever reaches it at all. The public entrance is from Anderson Avenue into a public lobby. The

crowd would be distributed along a corridor from which ramps lead to various sections of the stadium type balcony. Those using temporary seats would find two ample entrances to the field house floor at each end of the corridor, where, incidentally, would be provided effective control for this portion of the crowd. The balance of the space below the balcony would be taken up by the toilets and dressing room facilities, which would only be provided in a minimum amount However, a basement could be provided under the balcony wing if more such space were needed. The scheme has some disadvantages, however, in the framing, because it does not permit the use of an arch, and because, in order to dispense with an objectionable row of columns across the front of the balcony, it is necessary to carry one end of each of several trusses on a girder. While this is not impossible, of course, it was not considered the best practice, and would probably prove expensive.

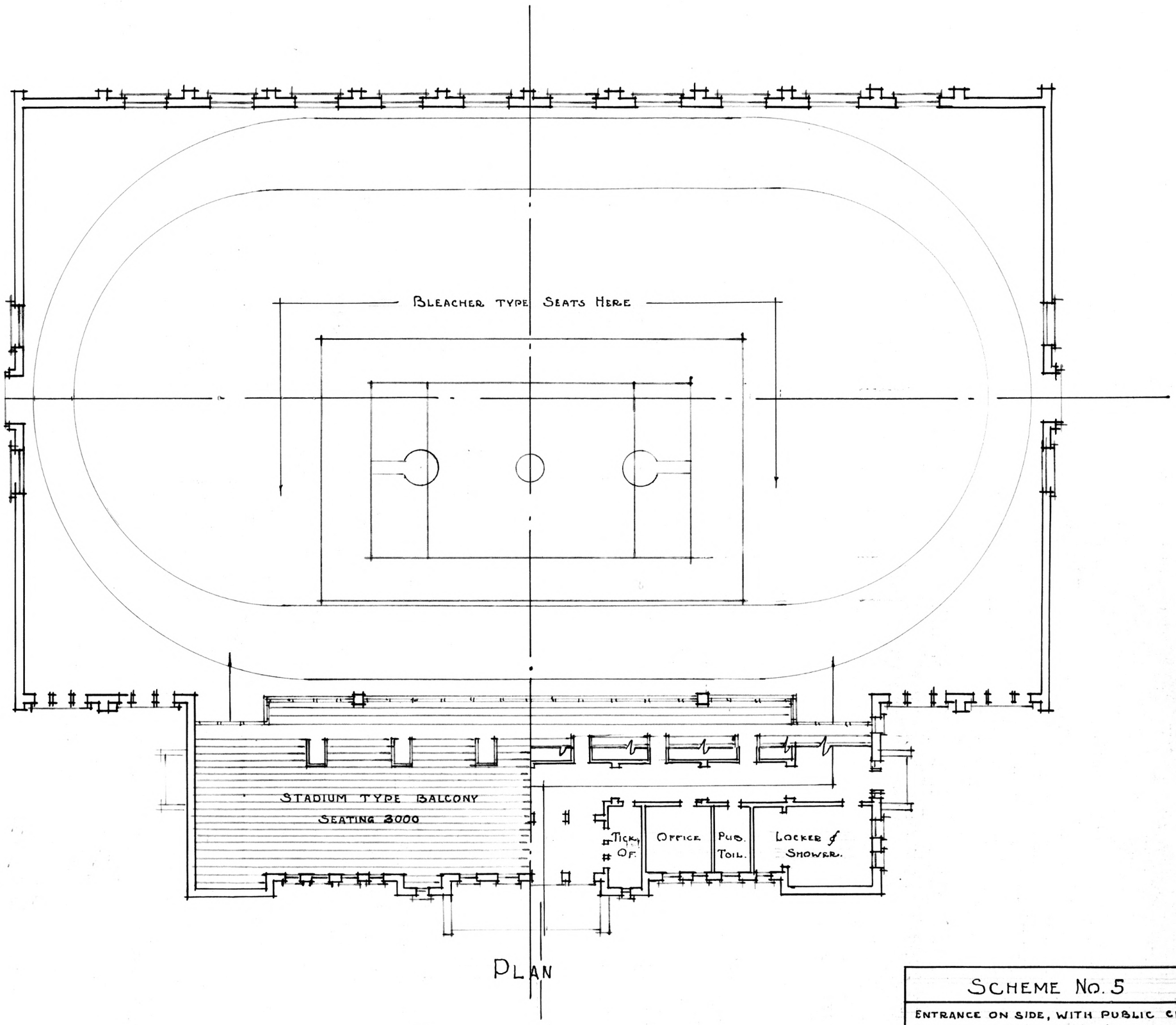
The author wishes to call attention to a possible expansion of this scheme, wherein the balcony wing might be balanced at some future date by another wing on the opposite side, which would serve as a boys' gymnasium, and which would of course contain additional dressing rooms, augumenting those initially provided. This expansion is also

PLATE NO. V

Scheme No. 5, a scheme designed for a level site with the public entrance and the facilities on the side under the stadium type balcony.



SECTION



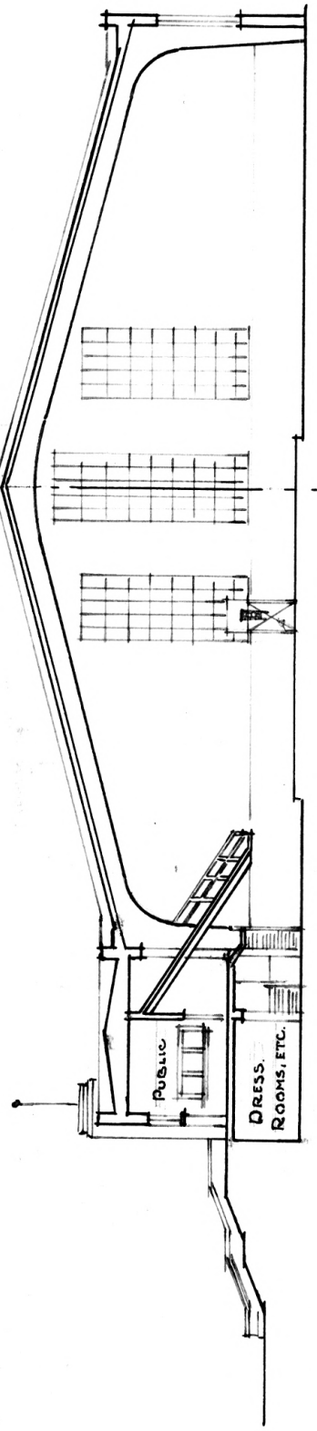
PLAN

SCHEME NO. 5

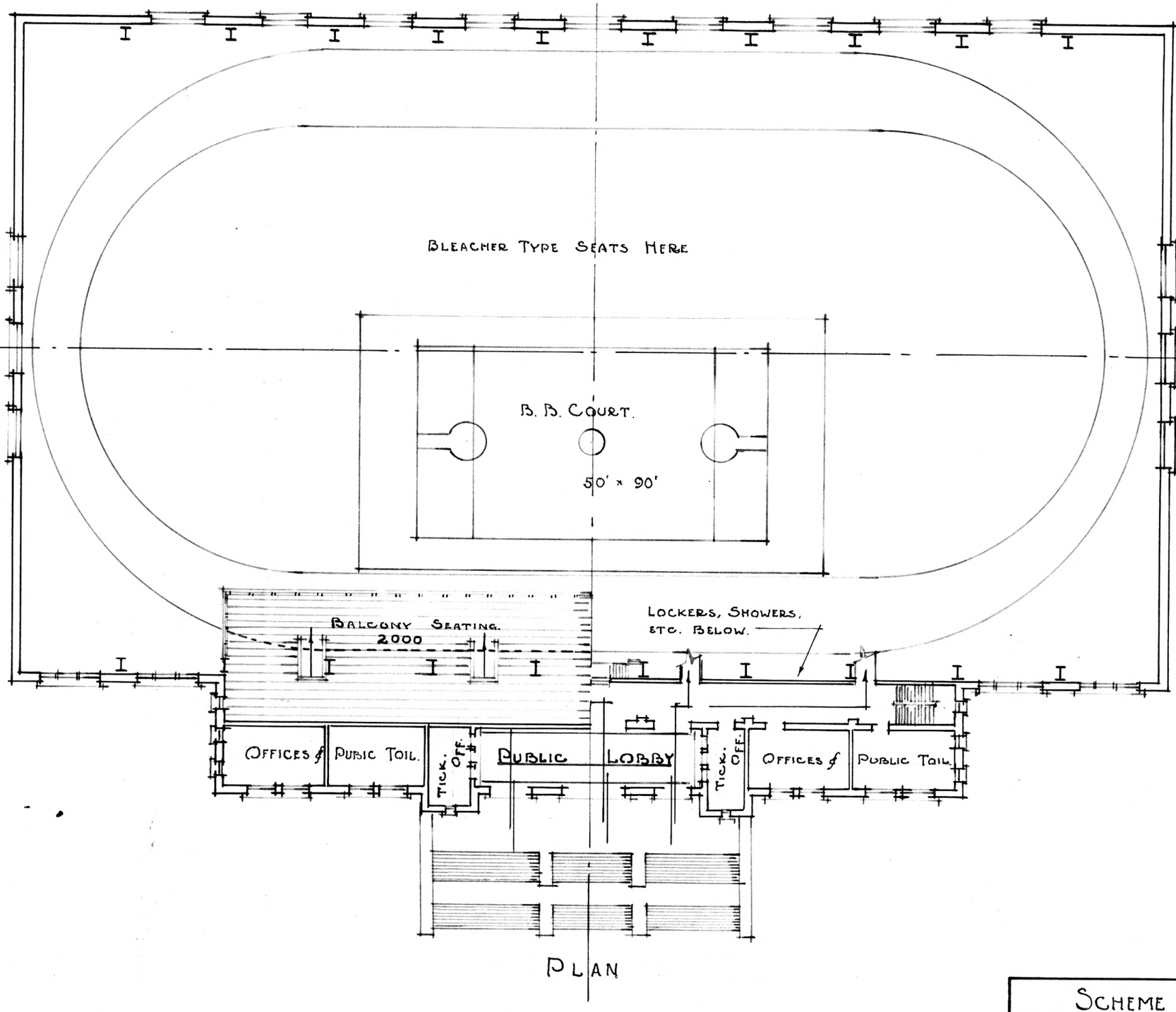
ENTRANCE ON SIDE, WITH PUBLIC CIRCULATION, LOCKER FACILITIES, ETC. PROVIDED IN SPACE UNDER BALCONY.

PLATE NO. VI

Scheme No. 6, a scheme designed for a sloping site with the public entrance on the side at an upper level.



SECTION



PLAN

SCHEME NO. 6.

ENTRANCE ON SIDE AT AN UPPER LEVEL. 2000 PERMANENT SEATS IN ONE BALCONY.

applicable to Scheme No. 2.

Scheme No. 6 (Plate No. VI) is, perhaps, the least desirable of all the partis submitted. It illustrates another attempt to take advantage of the natural slope to the south of the plot of ground just north of the stadium. Entrance would be from the north into the public lobby, thence into a corridor from which stairs would lead up to the balcony and down to the field house floor level. The parti is objectionable in that the arches coming down in the center of the balcony would obstruct the view of spectators to some extent; and a great amount of grading would be required. The type of arch indicated is like that used in the field house recently constructed at the University of Chicago, designed by Holabird and Root, Architects, which is referred to later in this thesis.

Scheme No. 7 (Plate No. VII) was undertaken in an attempt to determine if a field house could be practically employed as the completing unit to the stadium. This idea was first suggested by Mr. Frank Root when he stated that, in his opinion, the site just south of the stadium was the ideal location for a Field House for Kansas State.

The scheme was at first thought to be impracticable because, with the present location of the running track, the site is not large enough to accommodate a building of

the size required. However, by moving the running track north a distance of 40 feet, and by attaching the field house to the stadium, the design illustrated in Plate No. VII is possible. As shown by the sketch, the same method of public distribution as that used by the Universities of Illinois, Minnesota, and Michigan in their field houses is here employed. The main public entrance to the field house is from Anderson Avenue. Entrance is directly into a small lobby which is served by two ticket offices placed in the flanking towers of the entrance motif. The crowd is quickly shunted into the field house proper, where it is distributed on the field house floor as in Scheme No. 2. Two balconies are hung on the trusses on either side, as shown; and by utilizing the central five bays, seats for approximately 2,300 people are obtained. Temporary seats would be grouped around the basket-ball court in the center of the field house. Public toilets are provided in the two towers as indicated on the sketch, and the dressing rooms, lockers, and other such facilities which are already included in the original design for the stadium would serve the field house also, thus effecting a material saving.

The memorial feature planned in the original designs of the stadium is still retained and, as indicated by the sketch, would serve as the connecting units between the

PLATE NO. VII

Scheme No. 7, a scheme designed as the completing unit to the Stadium.

MEMORIAL ENTRANCE TO STADIUM HERE

PUBLIC TOILET

PRESENT PYLON

MEMORIAL ENTRANCE TO STADIUM

PUBLIC TOILET

Court

50' x 90'

NOTE:

Lockers, Showers, Toilets, etc.; to be provided under the present stadium.

TICK. OFF.

LOBBY

TICK. OFF.

FIELD HOUSE

SCHEME No. 7

HOOKED ONTO STADIUM WITH 2300 PERMANENT SEATS IN BALCONIES.

field house and that part of the stadium already constructed thus providing a memorial entrance to each wing of the stadium.

In selecting one of these schemes for full development, the author has attempted to take what he believed to be the best practical solution reached as a result of this study. In doing so, Scheme No. 7 has been selected. It was felt that the location for this scheme is perhaps the best of the three available, for it is one of the most accessible places on the campus to the general public, and is equally accessible to the athletic units now in use. It is the only site of the three that is at present unoccupied and which would not require some feature now in use to be transferred to a new location. A maximum amount of parking space is available, and a large percentage of it would not be on the campus.

This scheme is economical in that it will require less excavation and grading than any other design studied, and will not require a separate set of dressing room facilities, as would any design other than this one.

Another reason for choosing the development of this particular design was to present to those interested another possibility in the solution to the problem of completing the stadium.

DEVELOPMENT OF SUBMITTED DESIGN

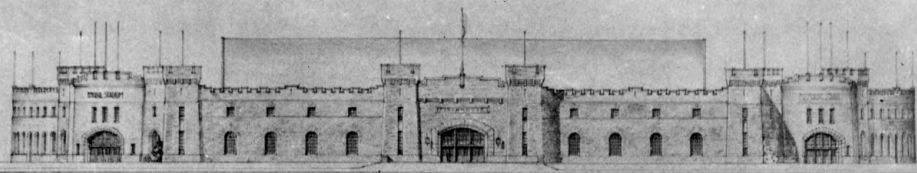
Layout and Design

In refining the selected design, variations of length and breadth of the inclosing rectangle of the 220-yard track were tried. It was found that the more elongated this rectangle became, the smaller was the area of the required building. There are, however, practical limiting factors, such as the sharpness of the turns and providing sufficient room in the center for a basket-ball floor with bleacher type seats on each side. After investigation and study it was found that a track with circular ends of a radius of 57 feet 3 inches, with a 150-foot straight-away between, was entirely satisfactory. The straight-aways were made 21 feet wide and the curves narrowed to 14 feet at the minimum point. Thus the dimensions of the inclosing rectangle of the track are 156 feet 6 inches by 292 feet 6 inches. Allowing 5 feet clearance at each end and 9 feet on each side, the inside dimensions of the building become 302 feet 6 inches by 174 feet 6 inches, wall to wall.

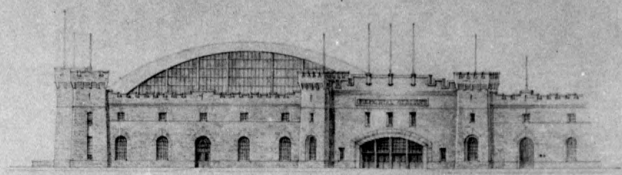
It was found that this layout fit in quite well with the stadium, allowing the curvature of that portion of the

PLATE NO. VIII

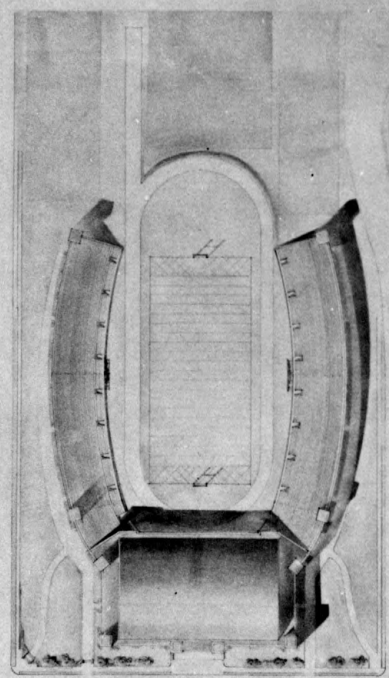
Plot plan and elevation of the submitted design.
(Scale: 1/16 inch - 1 foot)



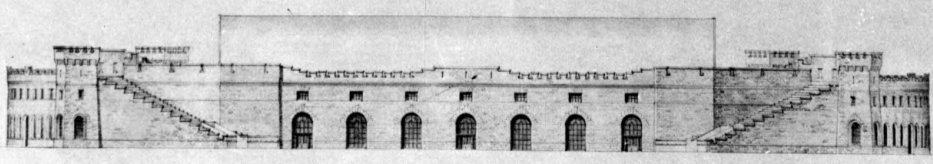
FRONT ELEVATION



SIDE ELEVATION



PLOT PLAN



STADIUM ELEVATION

"A FIELDHOUSE FOR KANSAS STATE"

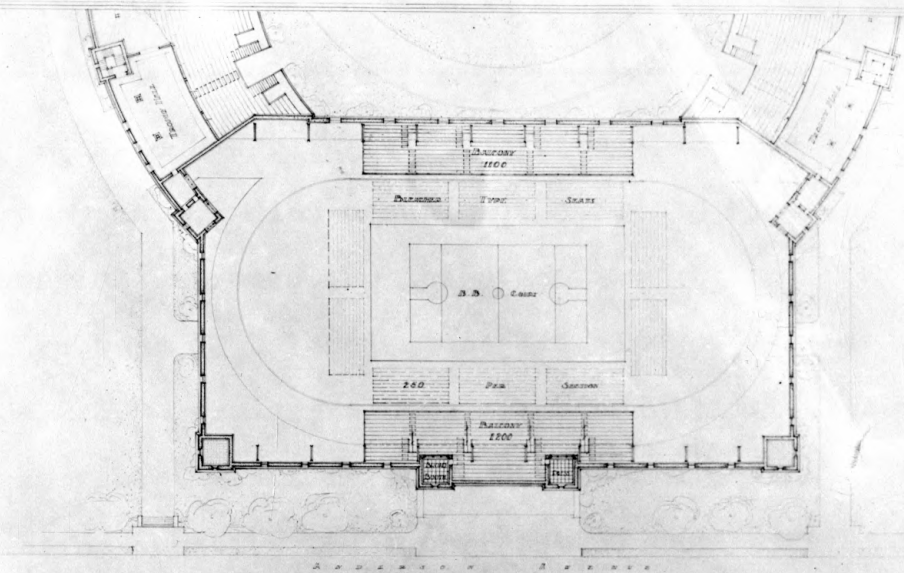
original design of the stadium, yet uncompleted, to be retained. As was stated previously, it was necessary to move the 440-yard track in the stadium north a distance of 40 feet which also necessitated moving the football field north 10 yards. When this is done and the layout above employed, it was found that the main part of the field house would be 45 feet from the curbing line on Anderson Avenue, which should be ample room.

In designing the facades, it was thought best to retain the same wall height and treatment as are already used in the stadium. This was done as shown in Plate No. VIII. The north wall is treated in much the same manner, except the arch openings are broadened and heightened to some extent. The main entrance is provided on Anderson Avenue, and has two ticket offices in the flanking towers. Exits are provided on each end of the building, and of course the two entrances to the stadium could also be used as exits. The inclosing walls, of stone, would prove more pleasing on the interior if faced with a light colored brick. The height of the roof at the parapet is 35 feet.

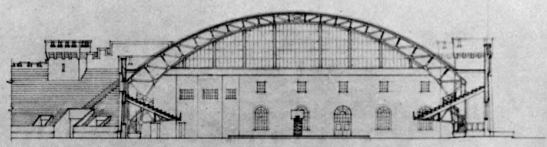
Two public toilets with anterooms are provided in the towers placed at the junction of each wing of the stadium to the field house, as shown by Plate No. IX. The second

PLATE NO. IX

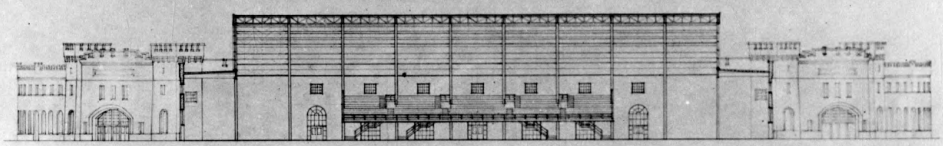
Plans and sections of the submitted design.
(Scale: 1/16 inch - 1 foot)



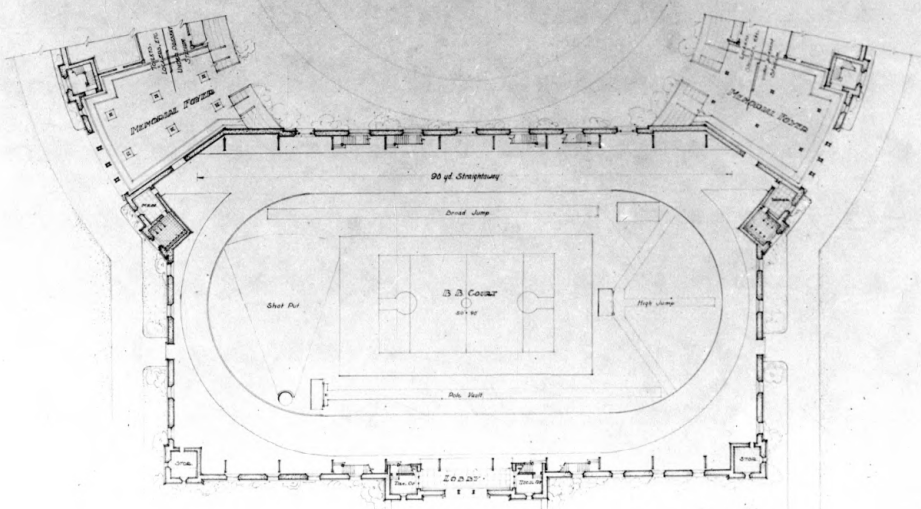
SEATING PLAN



CROSS SECTION



LONGITUDINAL SECTION



floor in these towers provides office space reached from the trophy hall, which occupies the second floor of each of the memorial entrances to the stadium.

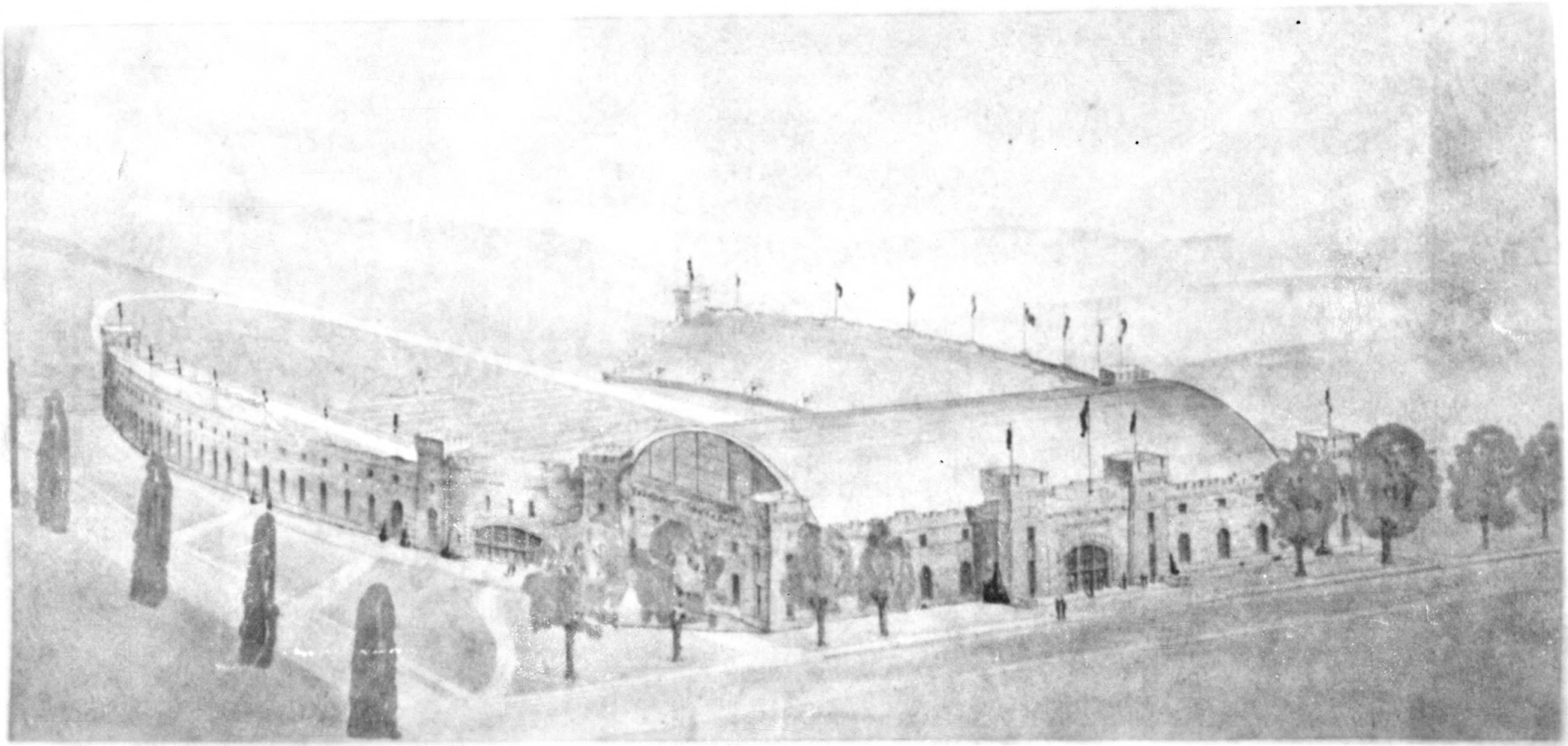
Five bays of balconies on each side of the field house provide 2,300 permanent seats, with an ultimate increase to 4,000 permanent seats if four more bays are added. The total seating capacity for a basket-ball game will be approximately 6,000 if a compact type of temporary seat arrangement is used. The upper part of the two entrance towers contains space for broadcasting and press, and is reached from the balcony. The main portion of the balcony contains 12 rows of seats, 2 feet 2 inches back to back, and each row rises 1 foot above the one in front. The seats of the balcony are wood and the facing concrete, while the framing is steel.

The main floor of the field house would be earth, with the exception of the lobby, ticket offices, and toilets, which would be of concrete. A removable basket-ball floor of 10-foot-square sections is provided in the center, and surrounding it are temporary seats. Storage space is provided in the two end towers.

A large memorial foyer is provided in the entrance to each wing of the stadium, and here could be placed bronze

PLATE NO. X

Aerial perspective showing the design as a whole.



tablets, etc., commemorating the World War Veterans. This foyer gives access to the football field, field house, and dressing rooms. These two connecting units also add approximately 2,000 to the seating capacity of the stadium.

Plate No. X shows an aerial view of the general scheme, as a whole, and should give the reader some idea of how the structure would actually appear.

Framing

A three-hinged arch-type truss was selected because it was felt that this type of truss would produce a more safe and satisfactory structure than would a truss of the Warren or bowstring types, either of which would have to be carried on columns or the walls. Some consideration was also given a two-hinged steel arch, similar to that used in the University of Chicago field house (see Plate No. VI, page 23), but there was not sufficient time for an arch of this type to be designed for this structure. The Chicago Field House, however, is quite similar to this structure in span and height of truss, and a comparison between their arch and the one designed for this structure should give a reasonably accurate idea of the comparative efficiency of the two types.

Plate No. XI shows a detailed drawing of the arch as designed. Ten such arches are required to support the roof and balconies, with a bay length of 27 feet 6 inches as used. Their span is 166 feet 6 inches center to center of pins and the rise is 64 feet from the center of the bottom pin to the center of the top pin. The radii of curvature of the chords is 125 feet 6 inches for the upper chord, 100 feet for center portion of the lower, and 80 feet 3 inches for the end portions of the lower chord. The back post of the truss is vertical to a height of 31 feet 8 inches above the lower pin. The truss is made up of 12 inch Carnegie I sections, varying from 12 inch I 28 lbs. to a 12 inch I 70 lbs. Connections are accomplished by means of two gusset plates riveted to each flange of the I section. Where Carnegie sections are not used for the web members, two angles, 3-1/2x3-1/2x3/8 tied together with stay-plates are used. Each arch is detailed so that the chords are composed of five or six panel lengths, depending upon the change in section necessary, the curvature to be produced by a cold "kink' at the panel points. The struts are placed on radial lines of the upper chord. The diameter of the bottom pins is 5-3/4 inches, and the top pins, 3-1/2 inches. Cast steel base shoes 30x36 inches are bolted to 6x8 feet concrete foot

ings 3 feet thick, which are designed for the vertical component of the thrust only, the horizontal component being taken by an 8x3/4 inch tie plate incased in concrete and placed 2 feet below the field house floor. The balconies are framed by placing a cantilever bracket on the lower chord of the trusses, between which, and out a distance of 14 feet from the center line of the back post, is framed a truss over which run heavy I beam cantilevers or outlookers, 5-1/2 feet on center, which in turn support the concrete facing to the balcony.

The balcony was designed for dead load plus a live load of 150 lbs. per square foot with 100 per cent impact added. The impact was reduced to 50 per cent when the balcony load was applied to the trusses. All combinations of balconies, both loaded and unloaded were tried in designing both the arch and the balcony. The roof was designed for a horizontal wind pressure of 30 lbs. per square foot against a vertical plane, and a snow load of 20 lbs. per square foot of horizontal projection of the roof area. The arches were designed to carry the roof and balcony loads plus a dead load of 35 lbs. per square foot of roof area, which included the dead load of the roof, purlins, and truss.

The framing of the roof follows the usual method of

connecting the main trusses by truss purlins, which also act as lateral bracing. The purlins in turn carry 3 inch tees 4 feet 7 inches on center, upon which are laid pre-cast gypsteel slabs 3 inches thick and 4-1/2 feet long. Over this is a built-up composition roof.

Since the barrel roof does not cover the entire plan, the deck roof over the end bays is framed by hanging a row of beams from the last truss by means of 12 inch I section hangers placed at alternate panel points of the lower chord. The deck roof is then framed with steel joists to the end walls, the spaces between the hangers being glassed in with steel sach bolted through the webs of the hangers. The end of the last truss is sealed off with a plate of some light-weight metal such as aluminum or copper.

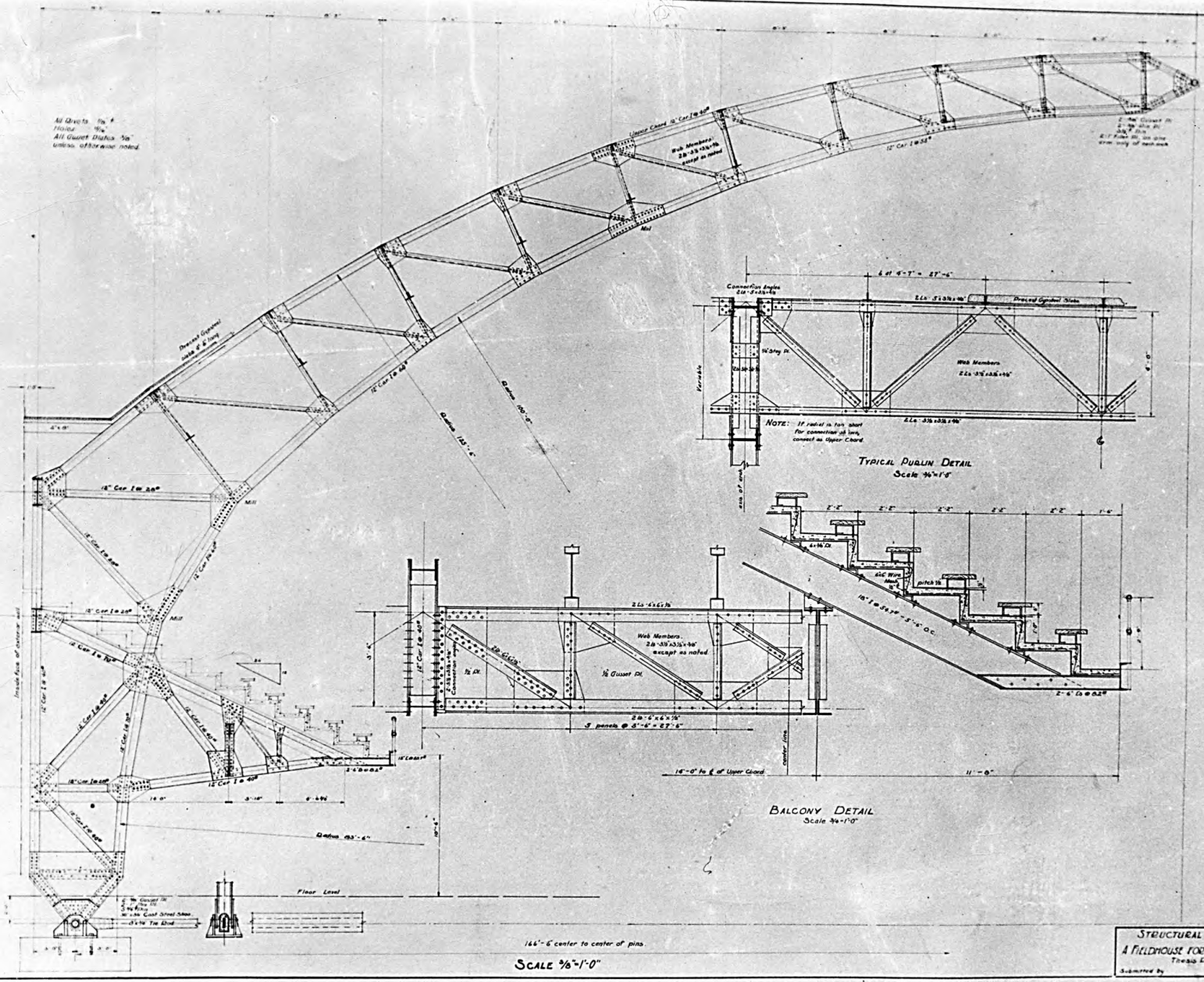
Each truss as designed weighs approximately 26 tons, and the total steel tonnage in the building is 550 tons. The two-hinged steel arch used in the University of Chicago field house weighs approximately 32 tons and the bowstring truss used at the University of Pennsylvania "Palestra" weighs approximately 46 tons; but, of course, spans 180 feet 5 inches.

The trusses are set clear of the inclosing stone walls a distance of 1 foot, measured from the center line of the back post to the inside face of the wall.

An estimate of the cost of this structure was made by a local contractor, and was given at $130,000, not including the two memorial connecting units between the field house and the stadium.

PLATE NO. XI

General drawing of truss and balcony framing.


All Gusets 5/16"
Flanges 1/2"
All Gusset Plates 5/16"
unless otherwise noted.
Web Members
2 ∠s - 3½ x 3½ x 5/16
except as noted
Mill
Radius 100'-0"
Radius 153'-6"
Radius 193'-6"
Floor Level
166'-6" center to center of pins
SCALE 3/8"=1'-0"
Connection Angles
2 ∠s - 3" x 3½ x 5/16
Web Members
2 ∠s - 3½ x 3½ x 5/16
NOTE: If rod is in two sheet for connection at both, connect as Upper Chord.
TYPICAL PURLIN DETAIL
Scale 3/4"=1'-0"
2 ∠s - 6" x 6" x 7/16
Web Members
2 ∠s - 3½ x 3½ x 5/16
except as noted
3 panels @ 8'-6" = 27'-6"
14'-0" to ℄ of Upper Chord
11'-0"
BALCONY DETAIL
Scale 3/4"=1'-0"
STRUCTURAL SHEET
A FIELDHOUSE FOR KANSAS STATE
Thesis Drab
Submitted by

CONCLUSION

As a result of this study, it appears quite obvious to the author that the design suggested is not only the best and most economical way in which to provide a field house for this college, but also presents a more practical solution for the completion of the stadium than has been presented heretofore. It will be readily admitted that the additional seats provided, if the stadium be completed as originally designed, are not desirable seats for witnessing a football game. Therefore, it seems to the author that a much more practical idea is to complete the stadium with some necessary units such as are herein presented, that will function perfectly as the completing unit, and which in itself is more advantageously placed and more economically provided by being so used.

Never, in the knowledge of the author, has the capacity of the stadium now available been completely used, nor has it ever been close to being used, for more than a single game each season. On the other hand, practically every basket-ball game played necessitates that the crowd be "packed" into the space now available. Why not, then, at one stroke, and at practically the same cost as that of

completion of the stadium as originally designed, provide a new building for indoor athletic events, which is admittedly necessary, and also complete the stadium--incidentally in doing so increasing its seating capacity from approximately 18,000 to 20,000. This capacity will amply serve the needs of this college for some time to come, and when more seats are necessary for just a single game, let them be of the bleacher type and placed just north of the football field out on the grass. Then, when the time does come when a stadium of greater seating capacity than 20,000 is necessary, these additional seats can be provided by double-decking the present stadium at a much lower cost per seat and in a more desirable location than by completing the "horse-shoe".

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