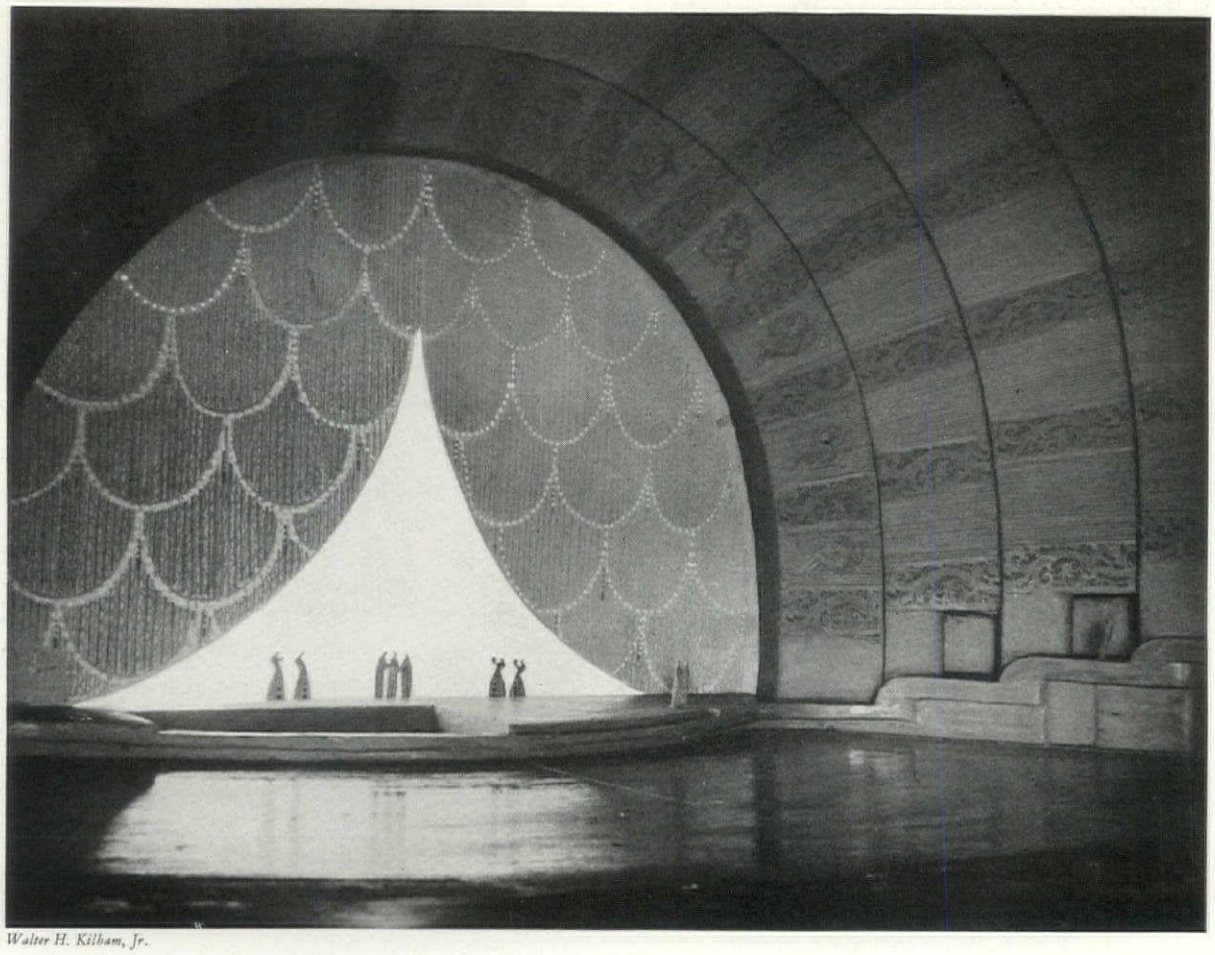
THE STORY OF ROCKEFELLER CENTER



Walter H. Kilham, Jr.

V. THE INTERNATIONAL MUSIC HALL

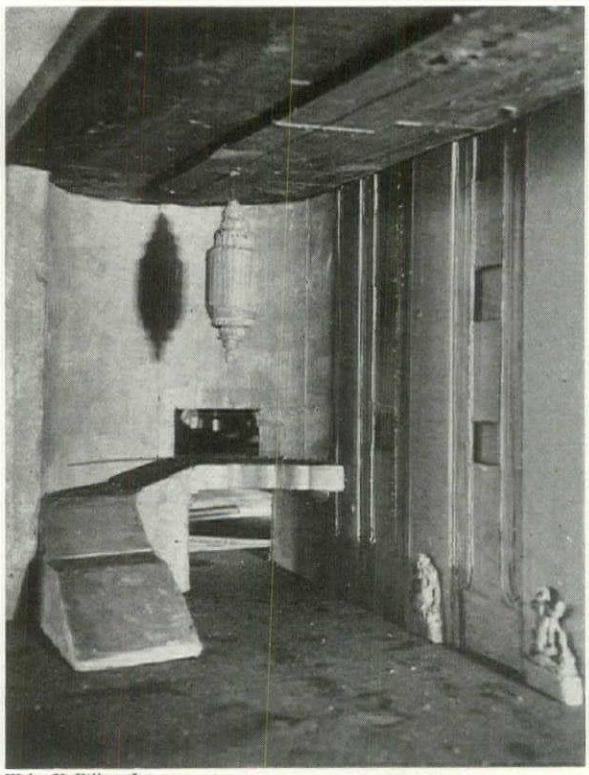
BY

HENRY HOFMEISTER

OF THE FIRM OF REINHARD & HOFMEISTER

NOVELTY and the spectacular in entertainment, inevitably associated with S. L. Rothafel, known better, in fact almost exclusively, as Roxy, had an important influence on the design and plan of the International Music Hall, now under construction in Rockefeller Center. Although Mr. Rothafel has not announced publicly the type of entertainment which he will offer in this largest of all theaters, it is understood that it will be a sort of glorified musical revue. The plan is flexible enough, however, to permit conversion into any type theater, motion picture or legitimate, concert hall or general auditorium. Sight and sound requirements for all types have been provided.

The Music Hall will have a seating capacity of approximately 6,250, a few hundred more than the present Roxy Theater in New York. With 3,500 seats on the orchestra floor, the remainder will be distributed almost evenly throughout three mezzanines. Present plans call for a uniform price of admission to the entire auditorium, set tentatively at two dollars. The advantage of sitting in the orchestra will be offset by permission to smoke in the upper reaches, and perhaps some day, patrons will be permitted to sip drinks in the top mezzanine. The shape and size of the building lot was determined, of course, in relation to the general plan of Rockefeller Center itself. The Music Hall



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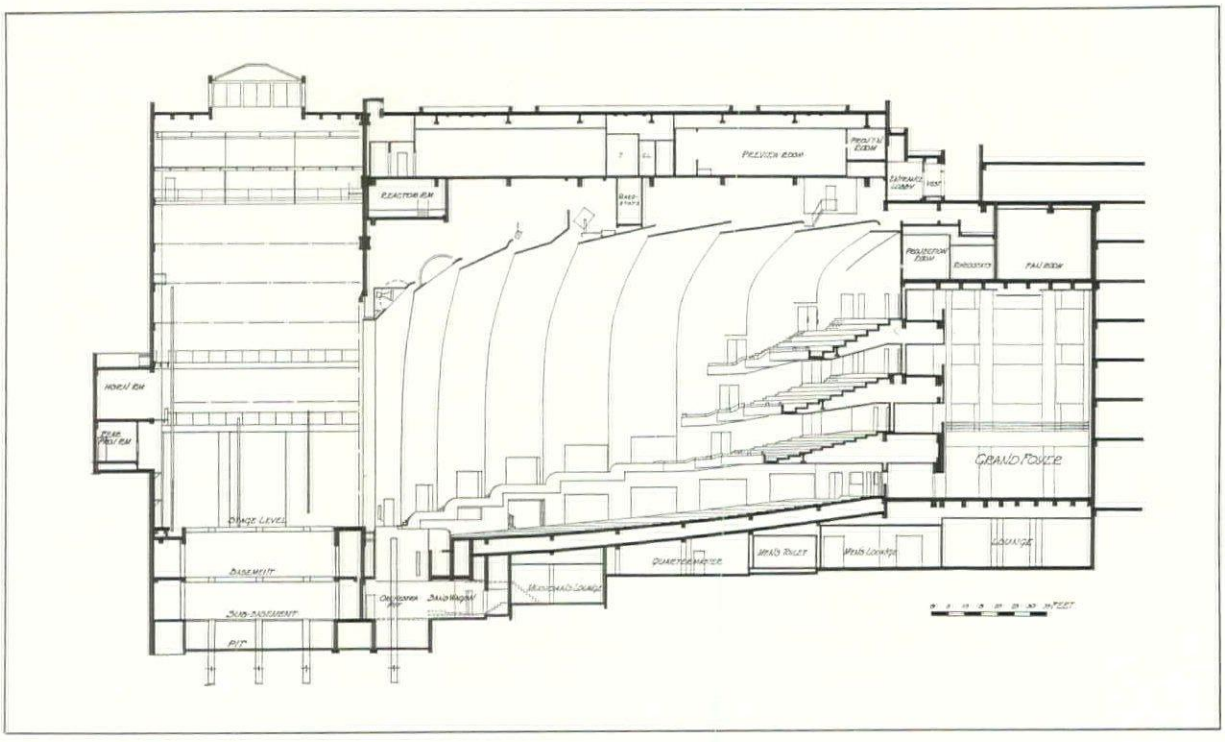
Rough model of the foyer, showing the staircase above which will hang Winters' mural. Velour will cover the right wall, mirrors the other

is located in the northwest corner of the three block site, from 50th to 51st Streets, with its main entrance located at the corner of 50th Street and Sixth Avenue. It is built in connection with the R-K-O office building, occupying the extreme northwest corner. The rear wall of the theater building supports the upper stories of the office building.

Design Development. After a succession of seating arrangements had been studied, the present plan was decided upon as solving successfully the manifold problems involved. Despite the unalterable provision that its seating capacity had to exceed 6,000, Mr. Rothafel was equally insistent that the theater retain an intimacy not usually thought possible in houses of such size. Had it been possible to obtain the necessary number of seats, it is likely that a stadium type plan would have been adopted, with only one floor sloping rather sharply to the stage and with ramps coming up through the floor for circulation. The chief advantage of such a plan would have been that the performers would have had a single unified audience to please. Theatrical people have paraphrased the old proverb to read, "A house divided against the performer cannot stand."

The obvious alternatives suggested themselves — one, a rather deep balcony, with perhaps a shorter balcony above, and second, three shallow

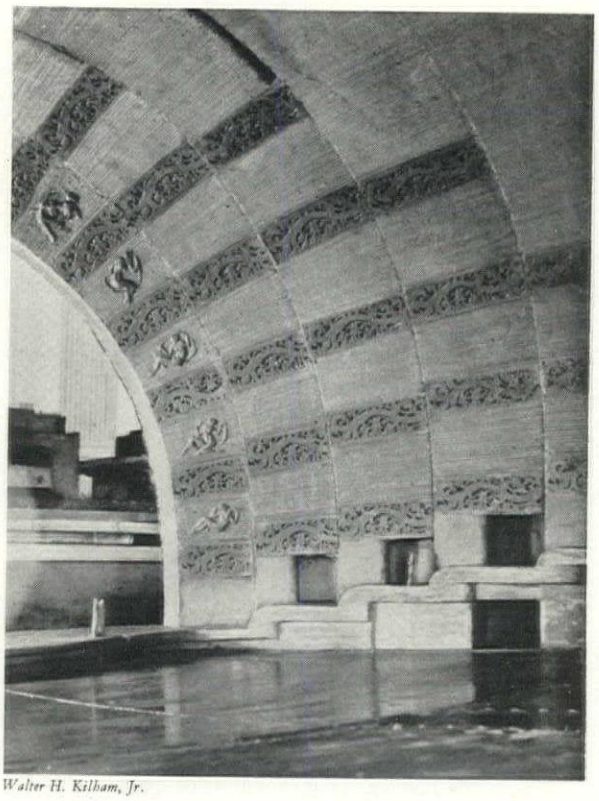


Longitudinal section. The variance in the angles of the ceiling segments were tested and revised to provide proper acoustics. The office building at the right rises 25 stories above the theater

mezzanines. From experience with scores of theaters in all parts of the country, the R-K-O interests were convinced that the deep balcony reacts unfavorably upon that part of the orchestra audience seated under the projection in the rear two thirds of the theater. Not only is their vision limited to the lower part of the proscenium opening, but they are consciously or unconsciously irritated by the feeling of "something hanging over them." Better vision from the balconies, it was believed, could be obtained by having short balconies. Even those seated far back will be able to see the audience in the orchestra as well as the presentation upon the stage. A maximum distance of 180 ft. from the stage to the most remote seat will insure adequate visibility, and an extensive public address system eliminates the possibility of inaudibility.

Innovation. Further intimacy between performers and audience will be obtained by a rather unique innovation. Runways will extend around the side walls from the stage to the first mezzanine. Upon these, the chorus, dancers and other performers will disport themselves. Not only will greater intimacy result, but opportunity for more spectacular presentations will be afforded, and the side aisle seats will become more desirable.

Circulation on the orchestra floor will be provided by six aisles, 6 ft. 3 in. wide at the rear,



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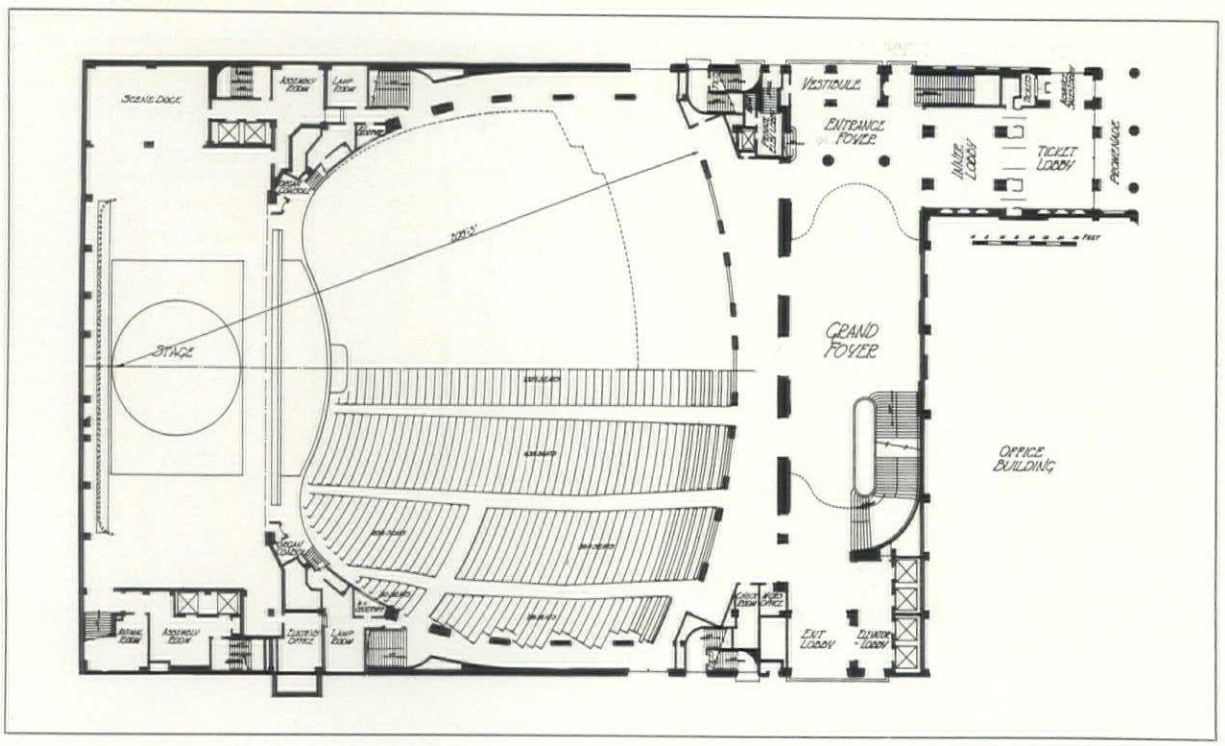
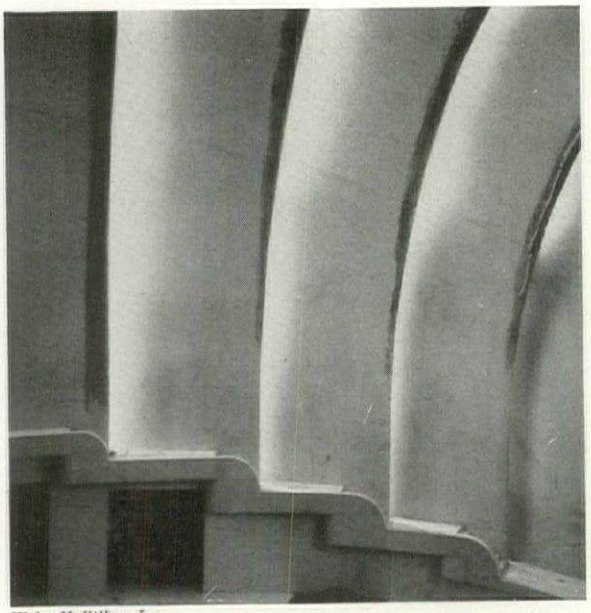
Study for the walls and ceiling of the auditorium, and the fan-like arrangement of the grilles which will conceal amplifiers and organ pipes



Ground floor plan. The orchestra has a seating capacity of about 3,500, with a maximum row seating of 14. Note the advance sales booth out of the main line of traffic at one side of ticket lobby



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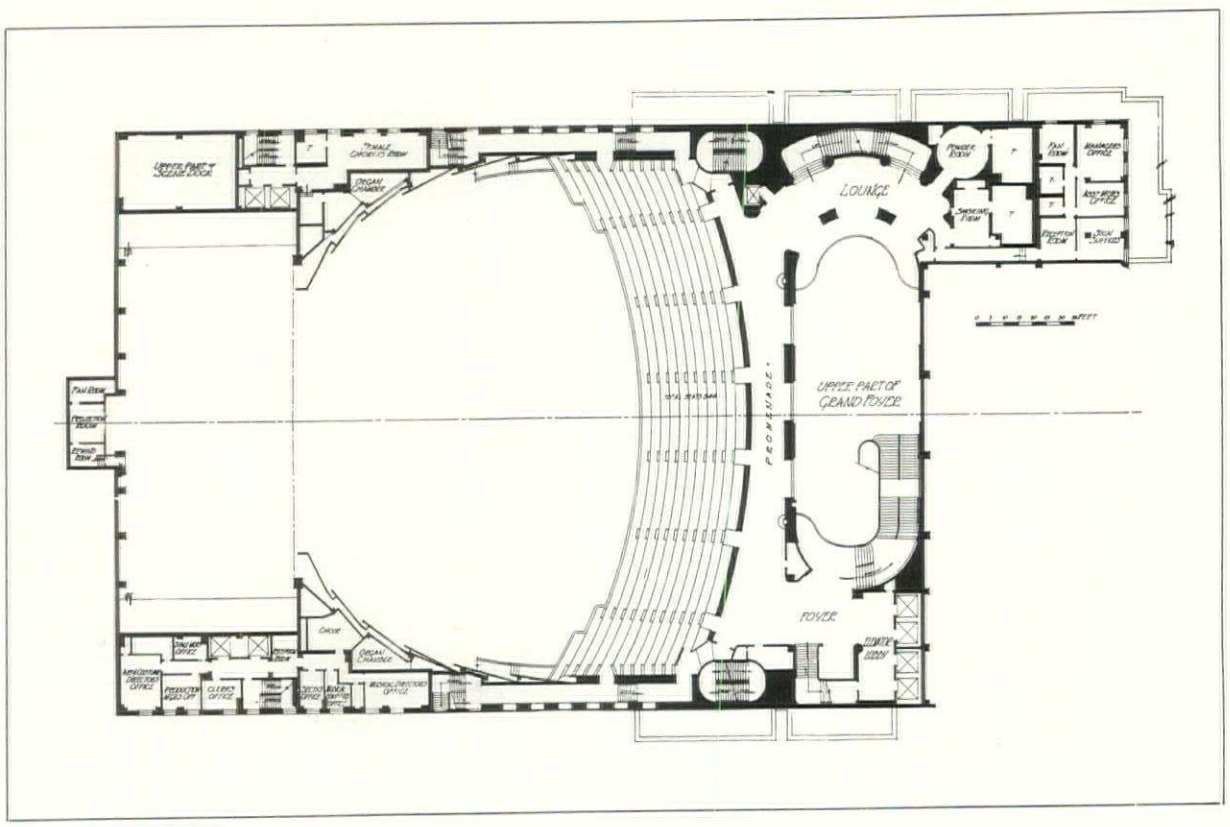
Portion of the large model used to study the actual conditions which will prevail in the theater. The dark edges of the curved segments indicate that they have been undergoing corrections. The concealed lighting system is also being studied to eliminate all possibility of error in theory

5 ft. 10 in. wide in the center, and 3 ft. 4 in. in front. A cross over occurs one third of the distance back from the stage. In accordance with fire regulations, the maximum number of seats from aisle to aisle is 14, but only 13 in one section and 10 in the other. More than the customary space between rows of seats has been provided. The usual 2 ft. 4 in. has been increased to 2 ft. 10 in., giving maximum leg room and comfort. In the mezzanines, the shallowness eliminates any traffic problem, and the seating is simply divided by four aisles.

Design. The design of the main auditorium indicates an acceptance of the current trend toward oval shaped roofs for theaters. Acoustic experts are almost unanimous in declaring this type to be as nearly perfect as possible for sound transmission. The roof is formed of a series of flat circular arches, stepped back from each other in such a way as to create breaks about 2 ft. deep. These occur about every 30 ft. The arches themselves are of acoustical plaster, with hard plaster ridges every 6 ft.

At first, it was intended to curve the arches themselves, but acoustic engineers advised against the practice because it would set up concentrated



First mezzanine plan. This is slightly larger but similar to the two upper mezzanines. Each of the three floors has adequate lounge and toilet facilities. Each is served by elevators

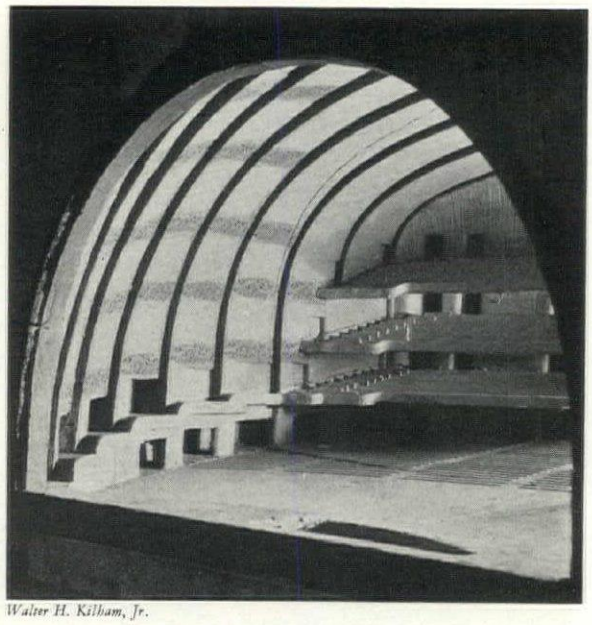
sound spots. The angles for the arches have been determined on the basis of acoustics as well as upon the principles of design. It was found, for instance, that the angle for the arches nearest the stage had to be changed in order not to set up pockets of sound in the openings.

In a fan shaped arrangement, plaster grilles will be located in the ceiling. These are to be used to conceal amplifying equipment and organ pipes. The breaks in the ceiling will conceal all the lighting for the theater, as well as for the stage presentations. They will be controlled from a light organ located directly in front of the orchestra pit. As in the Earl Carroll Theater, the light conductor will be able to see the effect of his work, and to correct deficiencies immediately. Also concealed in the ceiling breaks will be the air conditioning equipment.

The Stage. More interesting probably than any other features of the theater are the stage and orchestra pit arrangements. From one proscenium column to the other, the stage measures 110 ft., and from the center of the stage front to the rear wall, 60 ft. In its center is a revolving section approximately 50 ft. in diameter. Not only does this central portion revolve, but it is divided into three segments which may be raised and lowered independently or together. The mechanism for their operation is so timed as to permit synchronized elevation and descension, with the rear section moving more rapidly than the central one, and the central section more rapidly than the first.

Transportation of the "band wagon," which is the movable platform upon which the orchestra performs, is decidedly novel. Directly off the dressing room for musicians, which is located below the auditorium floor, the band wagon is loaded. It may then be rolled horizontally to an opening just in front of the stage, and there raised to its regular position in the pit. Or it may be rolled underneath an opening in the stage, and raised to the stage level. From the stage it may either be rolled off to the side or lowered again into the basement.

Back Stage. The speed with which scenes are changed in the musical presentations today and the unusually large number of performers who must be accommodated in the region beyond the footlights combined to make the back stage planning of the International Music Hall unusually complicated. On each side of the stage, two elevators will serve to transport actors and actresses to and from the stage in the quickest time possible. The circular iron staircase has been definitely supplanted. Because of the large number of chorus girls, their dressing rooms, rest rooms, and other facilities are concentrated as near the stage as possible. On the other side of the stage, dressing rooms for male performers are grouped.



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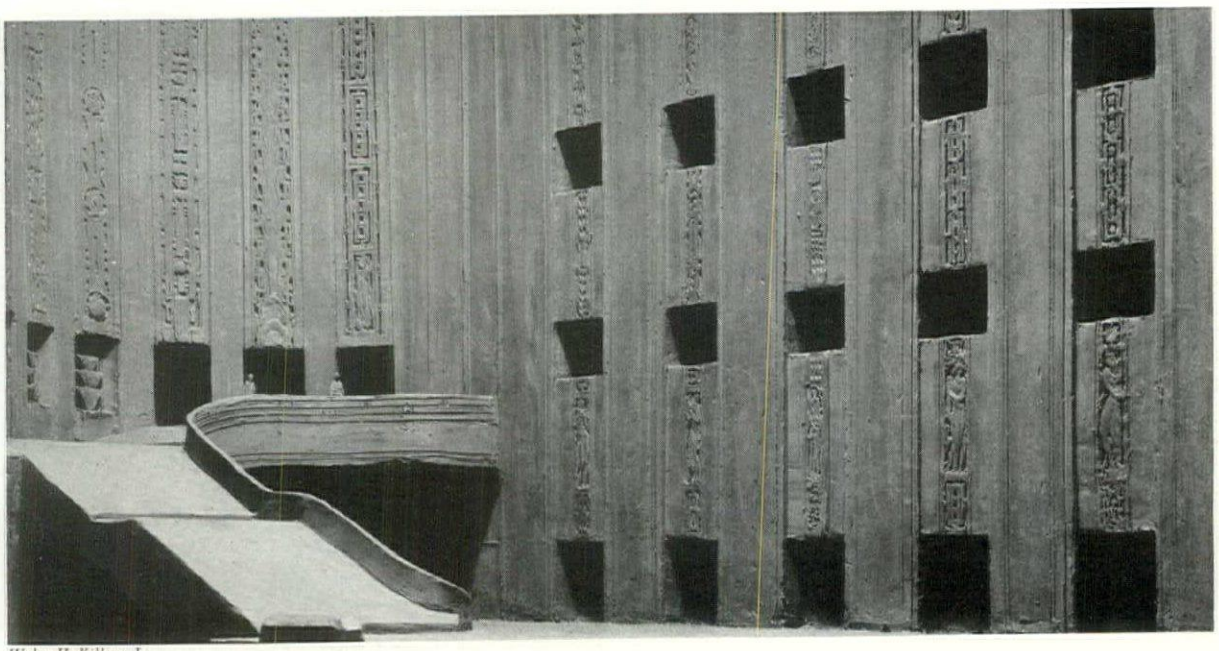
View of model looking from the stage into the auditorium, showing particularly the side runways

Distributed throughout the remainder of the back stage area are offices for the various executives of the theater, locker rooms, clubs rooms for ushers, stage hands, and other members of the theater staff. The architects were aided considerably in laying out the various rooms required, and in determining sizes of rooms by officials from the construction department of the Radio-Keith-Orpheum Corporation, who have, through experience with scores of theaters in all sections of the country, been able to contribute definite knowledge of actual conditions when the "show is on." Every effort has been made, furthermore, to provide accommodations for performers and other employes that are equal in comfort and convenience to a first class hotel. This is an outgrowth of the Roxy policy that "happy performers make successful shows."

Lobbies and Foyer. The relation between the theater building and the adjoining office building was so flexible that it would have been possible to locate the main entrance of the theater anywhere on Sixth Avenue from 50th to 51st Streets. The 50th Street corner was chosen in preference to an inside space to provide a longer approach to the theater from the street, with visibility from Broadway. A further argument in favor of such a location was the fact that the corner site provided a greater number of entrances and exits to the ticket lobby.

Six ticket sales booths, grouped in pairs, are located 22 ft. from the entrance doors. Although there would have been some spontaneous-sale



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An early model for the grand foyer. It has since been revised to include the mural over the staircase, and the wall openings at the right have been reduced to obtain a surface of greater simplicity

advantage in having a booth directly on the street, it was felt that greater comfort, especially during stormy seasons, would result to patrons if the booths were placed under adequate shelter. The four aisles into which the booths divide the space are continued up to the ticket deposit boxes. The space between them is 16 ft., too small for congregating, and yet large enough to eliminate congestion. The architects were guided by the success of a similar arrangement in the Roxy Theater.

One feature of the ticket lobby plan that is intended to relieve congestion is the provision, off to one side, of advance sales windows. They are located out of the path of the general line of traffic, yet prominently identified so that confusion will not result.

In the main foyer, located just beyond the ticket lobby, ample space has been provided for a large portion of the audience in the orchestra. It runs the entire width of the theater and is approximately 40 ft. deep. A broad staircase sweeps up the far end, leading to the mezzanine lounges which encircle the main one on three sides. Through the main foyer, mezzanine patrons may pass to a bank of four elevators beyond the staircase. On each of the mezzanine floors, as well as on the ground floor, there are powder, toilet, and smoking rooms, larger in size than is generally considered adequate.

Probably the main object of decorative interest in the theater is the huge mural painting for the main foyer by Ezra Winters. It is 60 ft. long, and 30 ft. wide, and is so located as to follow the sweeping curve of the grand staircase.

The basement lounge, which is about twice the size of the main foyer, will serve as the chief *entr'acte* place of congregation. Refreshments will be served to theater patrons here as guests of the management. From this lounge, an arcade running under 50th Street leads into the Forum, which is located between 49th and 50th Streets near Sixth Avenue. The Forum will serve as an entry and exit, not only for the International Music Hall, but for all the buildings in the Center as well. It will also serve as a social center, its chief attraction being a restaurant, with music for dancing and entertainment. Ticket offices for all theaters will be located there, and in that way, it is hoped, will relieve the strain on the main box offices.

Studio Floor. Above the theater proper, in the space between the roof trusses, Mr. Rothafel will have a series of studios for his private use. On this floor also will be two pre-view rooms, a rehearsal room, and a broadcasting studio.

The Model. All the details of the decorative scheme are being worked out on a plaster model that is large enough for a man to walk about in. The difficulty of obtaining the proper proportions in the curved ceiling of the auditorium made it necessary to adopt this method. As shown in an accompanying photograph, the curves can be revised very readily, with the result that when it is completed contractors will be able to work directly from the model.

THE STORY OF ROCKEFELLER CENTER

VI. THE STRUCTURAL FRAME OF THE INTERNATIONAL MUSIC HALL

H. G. BALCOM
STRUCTURAL ENGINEER

ALMOST any theater is an interesting problem to a structural engineer. Even the smallest has its complications. Far from being an exception, the International Music Hall in Rockefeller Center offered more than its share. In addition to its size, there were many unusual requirements, some of which were absolute innovations in theater design.

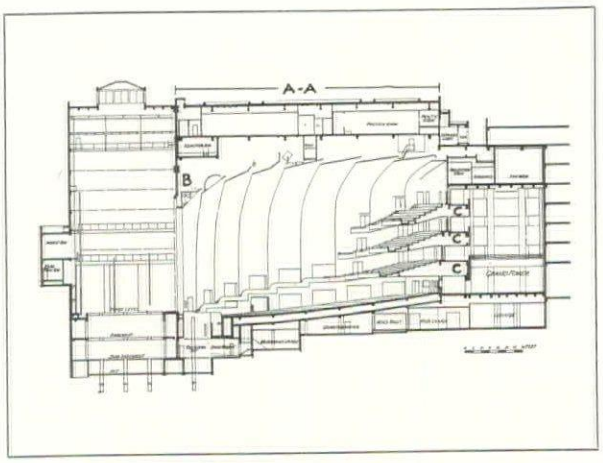
Generally speaking, the structure is composed of a 30-story office building and a theater having a seating capacity of slightly more than 6,000 persons. The main entrance, the grand foyer, the elevators serving the theater, the lounges, smoking rooms, powder rooms, etc., are all contained in the lower portion of the office building. The steel columns which support the east side of the office building also serve as supports for the rear of the theater. The office building, however, does not extend over any portion of the theater auditorium proper.

Wurts Bros.

Progress photograph of R-K-O office building, with steel erection almost completed, and of International Music Hall, with the orchestra framing finished

Foundations. Fortunately, the foundations offered no difficulties, because solid, hard rock was encountered a short distance below the natural surface. It was, therefore, possible to support the columns on short, concrete piers of slightly greater area than the grillages or bearing plates. With the exception of the two columns which support the proscenium truss and a large part of the roof and studio floor framing, and the columns at the rear of the auditorium which support the main trusses over the auditorium and also part of the office building adjacent, none of the column loads was unusually heavy. The proscenium columns, which were the heaviest, carried a load of slightly less than 7,000,000 pounds each; and the columns at the rear of the auditorium carried loads of between 5,000,000 and 6,000,000 pounds.

Auditorium. The main auditorium is approximately 175 ft. from the curtain line to the rear wall of the theater, and is about 200 ft. wide. The roof over it is supported on heavy trusses. Four of them extend the full length of 175 ft., and two others, one on each side, have a 140 ft. span. They weigh 260 and 215 tons each respectively, and have a depth of 29 ft. from center to center of chords. To erect the trusses, a special steel tower had to be built in the middle of the main auditorium. The tower will act as a temporary support for the middle portion of the trusses until they have



Longitudinal section, showing position of trusses. A-A indicates span of the 6 roof trusses; B is the proscenium truss; C the cantilevered mezzanine trusses

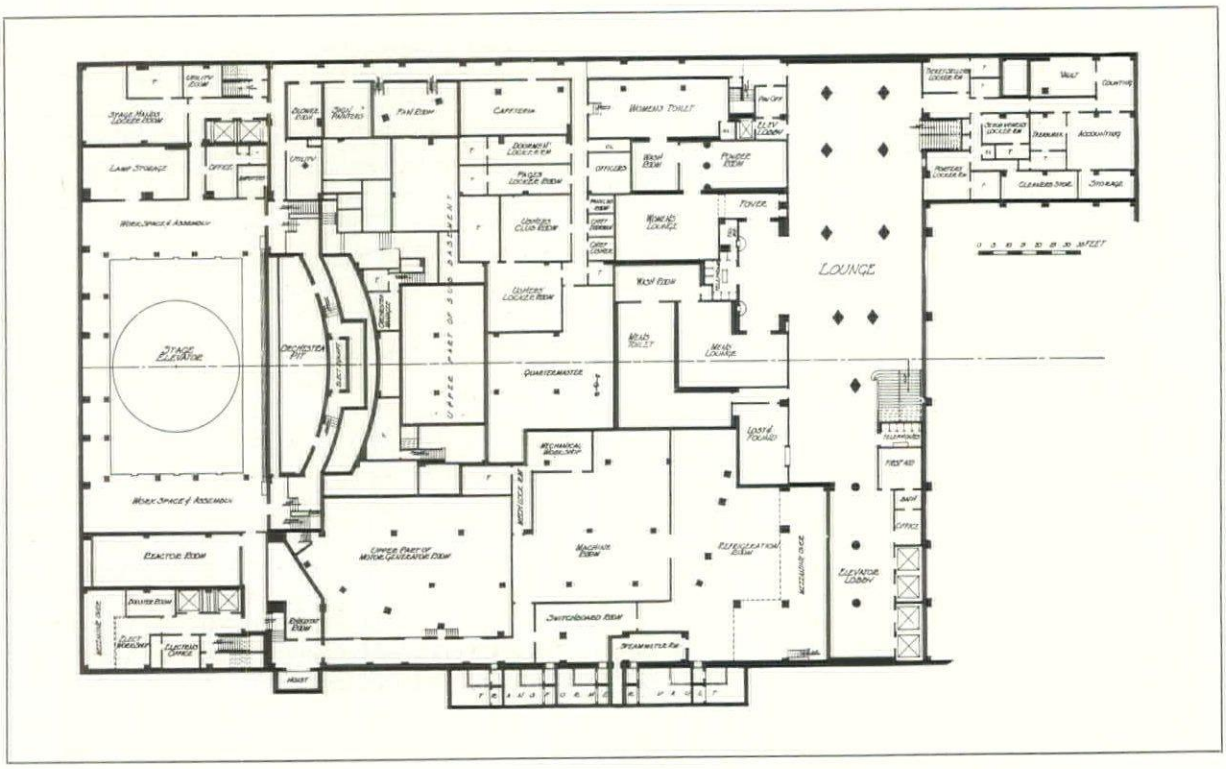
been fully assembled and riveted into place, after which it will be removed, and the steel used in another building in the Center.

The depth of the trusses made it possible to include, over the auditorium, an additional floor which is supported on the trusses about 10 ft. above the lower chord. This floor is to be used for rehearsal and broadcasting studios.

Made up of segments arched across the auditorium, the hung ceiling is a rather radical departure from ordinary construction. The segments overlap each other, with a space of about 2 ft. between them, which form coves for concealment of lighting. Due to the extensive area of the ceiling, it was necessary to hang from the trusses a sub-frame of structural steel completely across the auditorium from which the ceiling could be hung and constructed.

The auditorium floor was of the usual dish-shaped type. It was framed by spacing columns about 20 ft. apart in east and west direction, and in varying spacings from 17 to 23 ft. in north and south direction. The north and south line of the columns was placed on arcs of the same radius as the seating of the auditorium. The beams were framed on the center line of columns in both directions; and a two-way concrete slab 8 in. thick was used to form the floor construction. Below the auditorium is the plenum chamber, approximately 4 ft. deep, which also has an 8 in. slab at the lower side similar to that of the auditorium floor.

Stage and Orchestra. The stage is 135 ft. wide and 60 ft. deep, with a proscenium opening 100 ft. wide and 60 ft. high. The truss over the opening has a span of 110 ft., is 36 ft. deep, and weighs about 260 tons. It supports the ends of two main



Plan of the first level below ground. The lounge is to be connected by an underground passage of the Forum. The diamond-shaped columns are to be sheathed in mirrors. The level below contains additional mechanical equipment

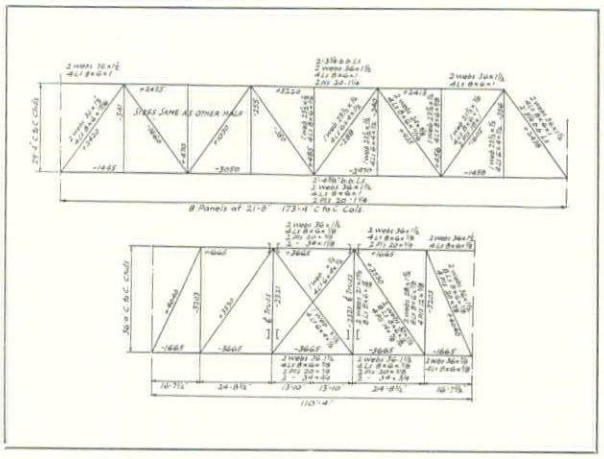
roof trusses, part of the stage roof, the gridiron over the stage, the 12 in. brick wall between the auditorium and the stage, and the double leaf steel and asbestos fire curtain.

Provision for the movement of the "band wagon," which may be transported to a position in the orchestra pit, or on to the stage itself complicated the stage framing considerably. In order to do this, it was necessary, of course, to provide an opening the full width of the orchestra pit (about 70 ft.) underneath the stage. The front part of the stage had to be supported on girders spanning across the clear width of the required opening for the band wagon. It was necessary, further, to install a rigid fire curtain below the stage to cut off this opening at all times except when the band wagon was being moved.

Since the orchestra pit and stage elevators are of the plunger type, the weight of the elevators did not have to be supported by the structural frame.

The roof of the stage is supported on plate girders spanning from the front to the rear of the stage. From the girders is hung the gridiron. The rear wall columns are made up of 30 in. rolled girder sections in order to get sufficient stiffness for the immense unsupported height of the wall.

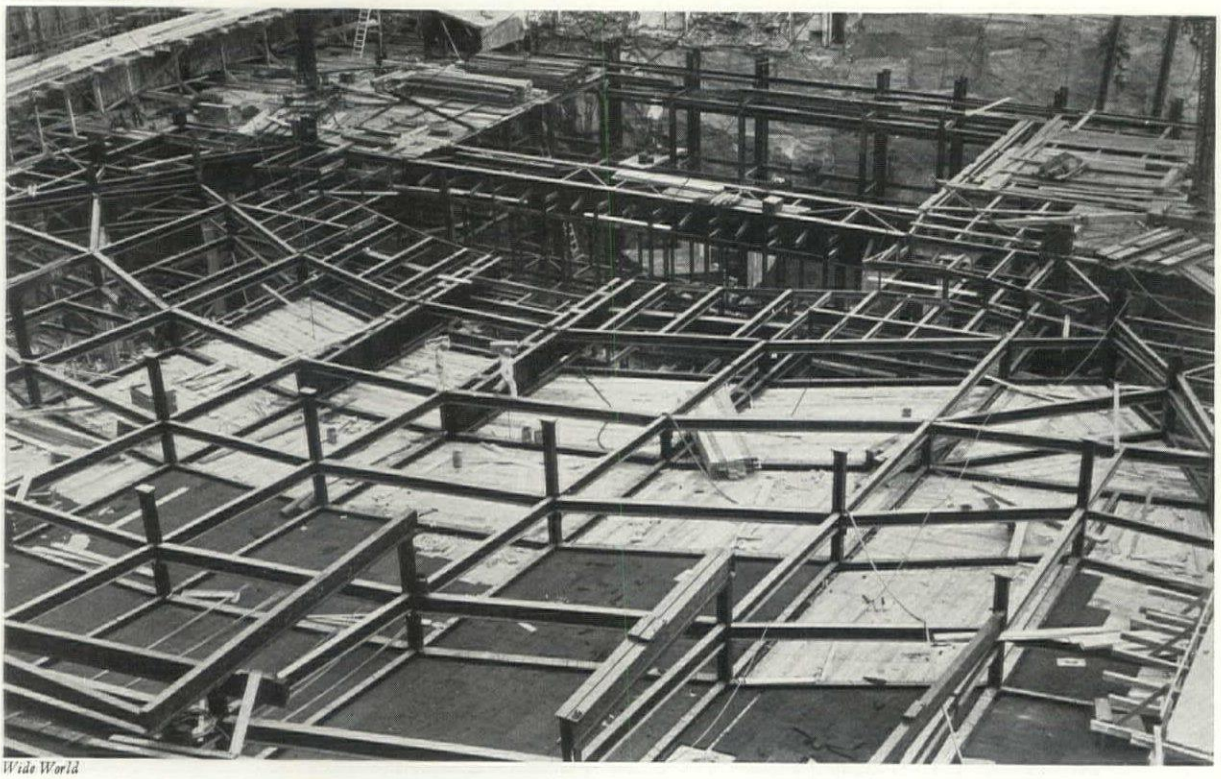
At both sides of the auditorium there are runways which extend from the stage level along the



Diagrams of two trusses. The upper one is an auditorium roof truss, and weighs approximately 215 tons. The lower one, the proscenium truss, weighs 260 tons

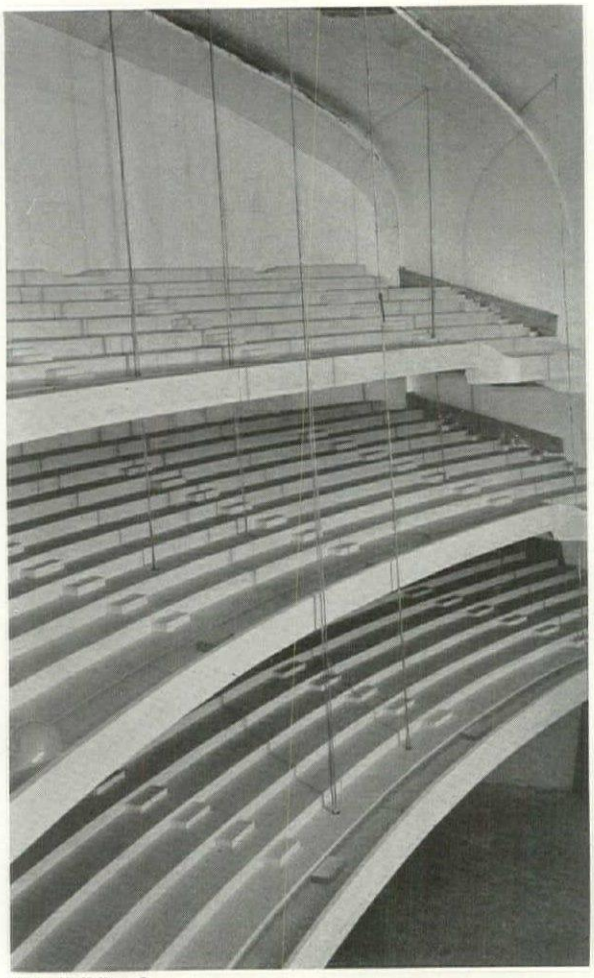
auditorium walls to the first mezzanine level. The runways are arranged in a series of platforms connected with short flights of steps. The framing for them was supported on cantilever brackets, riveted to the face of the columns, and involving considerable bent and special work.

Foyer and Mezzanines. Extending across the rear end of the auditorium, the grand foyer is 40



Wide World

Section of the framing for the dish-shaped auditorium floor and plenum chamber. The size is suggested by the workmen in the center. The stage opening for the elevators necessitated the heavy girder supporting the stage



Walter H. Kilham, Jr.

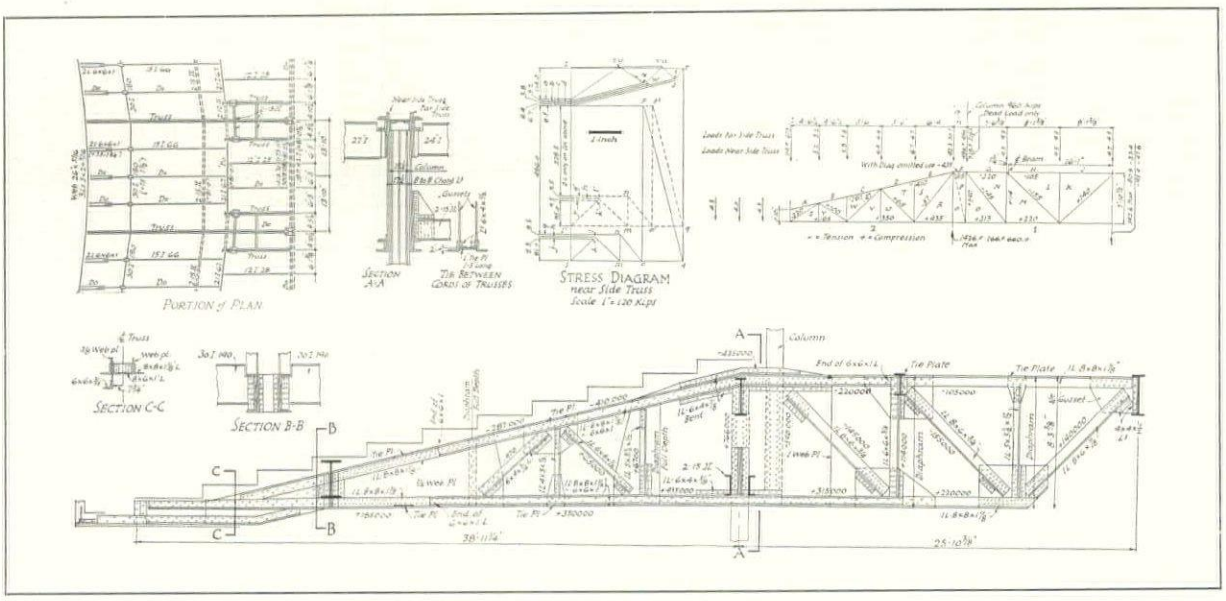
Mezzanine portions of the large model. The supporting rods will not, of course, be present in the building

ft. wide, and 80 ft. high in the central portion. Over the ceiling of the foyer are trusses two stories deep, which carry 25 stories of office building above.

The three mezzanines extend across the entire width of the auditorium. They are carried on cantilever trusses which are supported on columns at the rear of the auditorium seating space. The overhang of the cantilever truss in the lowest mezzanine varies from 38 to 45 ft., and is only slightly less for the upper mezzanines. The mezzanines were made as shallow in vertical depth as it was reasonably possible to make them from a structural standpoint. This was done to keep the sight lines as low as possible.

This type of construction was made possible by the fact that the columns receiving the upward thrust from the end of the anchor arm of the cantilever trusses were very heavily loaded by the office building which they also supported. No special anchorage, therefore, was necessary. There are six trusses in all, supplemented by the type of framing shown in an accompanying illustration.

Conclusion. The structural design was rather unique as a whole because the important structural members, the trusses, had to be very heavy to support great weights and to span long distances. A further reason for their weight was that the entire roof is to be landscaped with gardens and fountains, thus adding greatly to the dead load. Earth 30 inches deep in some places, in which trees 30 feet high will be planted, had to be figured in the loads. All these elements combined to make it an unusual problem.



Details of the framing for the mezzanines, showing the assembly of a cantilever truss, stress diagram, and a section of the floor framing. The heavy load on the supporting column permitted the long unsupported overhang