...ONS OF THE
...ITISH FIRE PREVENTION COMMITTEE.—No. 132.
...e Executive.

THE

EFFECT OF FIRE.

A REPORT

ON

THE PARKER BUILDING FIRE,

NEW YORK, U.S.A.,

BY

W. C. ROBINSON.

With Illustrations.

LONDON, 1908.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(*Founded* 1897—*Incorporated* 1899).
1, WATERLOO PLACE, PALL MALL.

THE PARKER BUILDING
(AFTER THE FIRE)

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Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are:—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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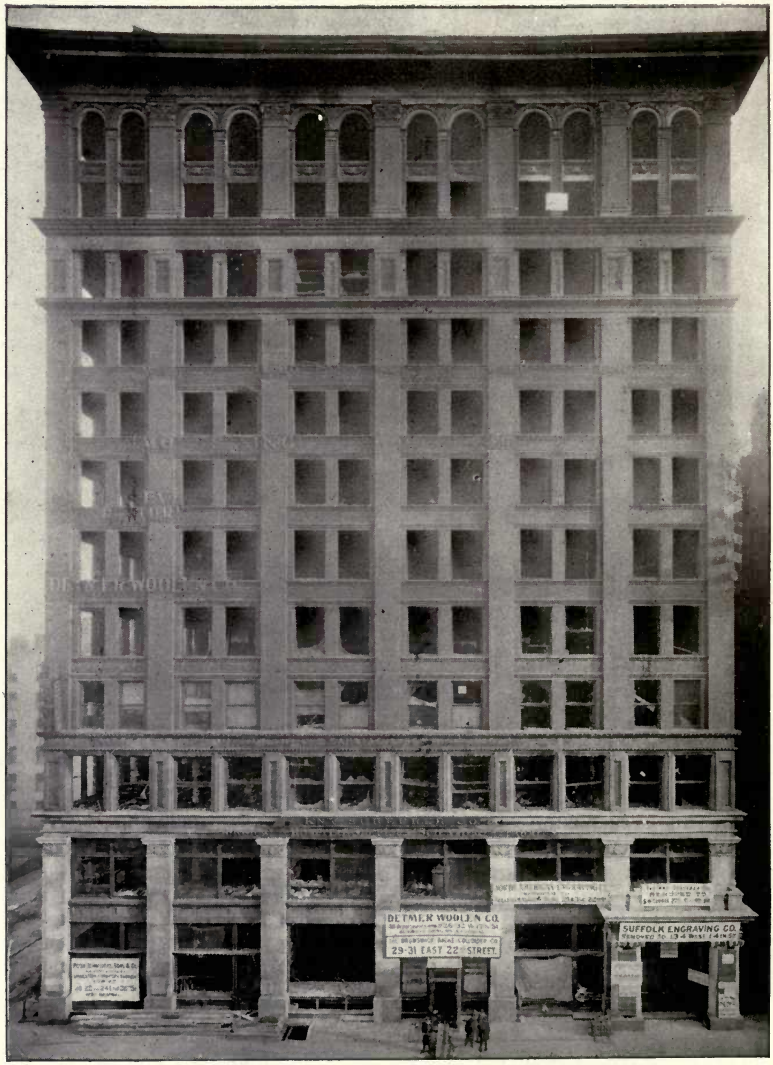


THE PARKER BUILDING, NEW YORK, U.S.A.
(*View after the Fire*).

NOTE.

By the courtesy of the New York Board of Fire Underwriters—and more particularly its "Building Code Revision" Committee of which Mr. C. F. Shalcross is chairman—the Executive of the British Fire Prevention Committee are enabled to publish for the use of the Membership a copy of a report by Mr. W. C. Robinson (Chief Engineer of the Underwriters' Laboratories, Chicago) on the effect of a fire which occurred on the Parker Building, New York, early this year.

Whilst expressing the Committee's thanks to our friends in the United States for the facilities afforded we cannot but congratulate them on the interesting and practical character of the Report they have obtained from Mr. W. C. Robinson.

It will be obvious to the members of the Committee, that the data concerning this fire, which have been so carefully and thoroughly collected and prepared, together with the facts deducted therefrom, makes the information of the utmost value to all those who are carefully studying the action of fire upon this class of building.

The fire is of particular interest at the moment to those resident in London, having regard to the fact that Parliament has granted the London County Council additional powers for sanctioning the erection of buildings of greater cubic contents, without stipulating the precise nature of the materials that are to be used and what additional precautions are to be taken against fire.

The fire is also of special interest to residents in the metropolis owing to the fact that we have, unfortunately, buildings within the London area, which, if not of so great a height and cubic contents, yet have some of the same features of construction.

The negative deductions from the Parker Building fire, and the positive ones from recent tests conducted by this Committee on modern forms of construction, will be of great value to the members.

The publication of this report on the Parker Building fire will serve a useful purpose, both to the London building owner and to those advising and controlling them.

EDWIN O. SACHS.

London, S.W.
October 29th, 1908

THE GENERAL ARRANGEMENTS FOR TESTS.

MEMORANDUM.

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily*; no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,
EDWIN O. SACHS, *Chairman.*

January, 1905.

The Parker Building Fire.

NEW YORK, March 26, 1908.

C. F. Shallcross, Esq., Chairman,
Building Code Revision Committee,
New York Board of Fire Underwriters.

Dear Sir:—

In accordance with your instructions I have made a detailed inspection of the Parker Building, S. E. corner of Nineteenth Street and Fourth Ave., this city, and have earnestly endeavored to ascertain the cause of the spread of fire through this building, and the reason for the collapse of various portions of the structure during the progress of the fire starting on the evening of January tenth. The results of this investigation are given in the following report.

So far as I am aware this is the first case on record where a so-called fire-proof building and its contents have been so extensively damaged by a fire starting within the building. Such an occurrence in the largest city in the country, and in a district receiving the full protection of a supposedly well equipped and efficient fire department, was generally unexpected. That the destruction of such a building is not only possible, but quite probable, makes it imperative that requirements for the introduction of necessary safeguards be provided and vigorously enforced.

The Parker Building is understood to be fairly representative of fire-proof buildings occupied for mercantile and light manufacturing purposes in New York City, and is said to have been of even better construction than many later buildings. Its practical destruction, while surprising to the general public, furnishes no reason for the discredit of fire-proof building construction and teaches no lessons to the fire protection engineer which have not been more or less thoroughly understood. The results of this fire do, however, serve to emphasize the necessity for better design, for the more effective use of the materials employed in fire proofing and also the necessity for efficient inside fire protection in high buildings used for the storage of large quantities of combustible materials.

A standard equipment of automatic sprinklers with ample water supply is generally recognized, at the present time, as the most efficient means for protection of this nature yet developed.

The large amount of combustible material in the Parker Building, its excessive area, inadequately protected stair and elevator shafts and lack of facilities for the prompt discovery of fire, furnished conditions which permitted this fire to gain very great headway before the arrival of the fire department. The loss on this building with its contents under such circumstances, directs attention to the probability that under similar conditions of construction, area and occupancy fires may assume proportions beyond the control of a well-equipped fire department, especially as unavoidable delays due to condition of the streets, absence of nearest engines at other fires, etc., are possible at any time.

I have not undertaken to make any special investigation of alleged deficiencies in fire-fighting facilities at this fire, as this did not come within the scope of my commission.

The report which follows contains much of the data obtained during my investigation, which was not completed until March twentieth, when all of the structural parts of the collapsed portion were available for examination. Such conclusions as seem warranted by this investigation and the results of previous fires in fire-proof buildings have beeen appended.

Most able assistance has been rendered throughout the investigation by Mr. Alfred Ludwig, C. E., Inspector Underwriters Bureau of The Middle and Southern States, who has given particular attention to the structural features of the building and kept in close touch with the conditions until the collapsed portions were removed from the débris. The drawings were executed by the draughting department of the above bureau.

DESCRIPTION OF THE FIRE.

Start and Progress of the Fire: The fire started in the eastern portion of the fifth story in the vicinity of the rear stairway. No reliable information regarding its origin was obtainable. It was discovered between five and ten minutes before eight in the evening by Mr. C. J. Spalding, of the Detmer Woolen Company, who, with another employee, was at work in the sixth story. These people first noticed an unusual number of mice running about the premises and shortly afterward heard glass cracking and saw a bright glow through the glass in the east stairway partition. Mr. Spalding placed the books in the safe, saw his companion out and afterward went back into the sixth story several times, meeting the firemen in the south hallway the last time he left. The fire broke through the glass in the east stairway partition soon after it was discovered and ignited a stock of empty packing boxes and some supplies of stationery located near the stairs. The packing boxes were well afire a few minutes after eight o'clock, and at about six to eight minutes after, the sixth story was so full of smoke that it was impossible to enter the rear portion.

The night watchman, who passed through the halls and did not enter the lofts, is reported to have been in the engine room about 7.25 and to have discovered the fire in the east stairway about the same time it was discovered by Mr. Spalding.

The watchman first turned in the alarm from special building signal box No. 3—892, located in the south hallway on the first story, which, in common with similar boxes in other buildings, was directly connected with Fire Department Headquarters by private circuit. He afterward turned in the alarm from street box No. 361 at the corner of Fourth Ave. and Eighteenth Street.

The first alarm was received by the Fire Department from special box No. 3—892 at 8.01 p. m., followed by street box No. 361 at 8.02 A second alarm was received from street box No. 362 at 8.12 and other alarms were sent in from the same box at intervals until 9.51 p. m., when the fifth alarm was given. Twenty-five engine companies and five truck companies were engaged at the fire.

The fire department responded promptly. The first company coupled up to the Siamese stand pipe connection on the Fourth Ave. side of the building and took off the first lead of hose in the south hallway on the sixth story. Both fifth and sixth stories were found to be on fire and filled with smoke, the fire being located in the rear or eastern portions.

The firemen were soon forced to retreat from the sixth to the fifth story and afterward withdrew from the south hallway on account of lack of water and the dense smoke. No effective inside streams were applied during the early stages of the fire, which was also en-

tirely beyond the control of the outside streams finally brought into service.

The south stairway was inaccessible above the sixth story on account of smoke and the east stairway above the fourth story on account of fire. The building was not provided with outside fire escapes.

Probably about eight or ten minutes elapsed from the time of first discovery until the alarm was turned in, and it is reasonable to believe that the fire had gained considerable headway on the fifth story before it was discovered. It spread rapidly to the upper stories through the rear stair well and gained great headway in the eastern portions of the fifth and sixth stories, the fifth burning slightly more rapidly than the sixth. At about 8.40 the fire burst out on the Fourth Ave. side on the fifth story, followed almost immediately by fire on the sixth.

Soon after 9 o'clock the fire had extended quite generally over the seventh and eighth stories, the twelfth taking fire a little later, and it was next noted on the ninth, eleventh and tenth in the order named. All stories above the fourth burned fiercely, but the fire was apparently hottest on the sixth, eleventh and twelfth, particularly in the north and east portions.

Although the wind was not high, the fire extended well out into Nineteenth Street. The records of the Weather Bureau show the wind to have been west and southwest, the velocity being six miles at eight o'clock and gradually falling to one mile per hour at seven o'clock on the following morning. The temperature was 28 to 29 degrees.

Shortly before ten o'clock all floors of a section of the building approximately 40 x 24 feet next to the rear court suddenly collapsed, killing three men, seriously injuring fourteen and slightly injuring many others. The collapse was said to be without warning, no falling of floor arches or portions of the building being previously heard or observed.

The collapse of a section of the twelfth floor, roof and roof house, approximately 60 x 30 feet and located about the center of the north side, occurred later, knocking out many of the arches in the floors of the lower stories. Most of the heavier material falling in this collapse was retained by the steel framing of the eleventh floor. Heavy safes and machinery on several floors broke through the arches at intervals during the later progress of the fire.

The fire was carried into the basement and lower stories by the first collapse, the damage by fire and to the structure below the fifth story being due to this collapse. The large, open well holes and openings through the floors formed by the failure of the various sections mentioned, caused the fire to burn with increased intensity. During the more advanced stages the fire communicated from story to story through the exterior windows, being drawn in after the glass was broken by the flames issuing from lower windows. This was most noticeable in the angle of the exterior court in the rear, but occurred to some extent on the Fourth Ave. side. The fire was not under control until seven o'clock on the following morning, about eleven hours after it started, and it continued to burn in the various stories for several days.

Subsequent examination shows that only the two upper stories, the large roof house, the north side of the ninth and west end of the seventh stories were fire swept, practically everything combustible being consumed in these localities. Large quantities of partially

burned stock, sections of wood flooring, furniture, etc., next to the rear court windows and to some extent along the west wall show the effect of the streams applied from the outside. The streams from the building across Fourth Ave. washed the cinder fill up into piles in several stories. These streams struck the floor twenty-five to thirty feet back from the windows.

Temperatures Developed: Careful examination of the metals and materials in the various stories shows that the maximum temperatures reached in this fire were seldom lower and often higher than those developed in the average fire-proof building in the Baltimore and San Francisco conflagrations.

Glass, brass electric fixtures, and lighter brass parts on typewriters and machinery, fused freely at many points in most all stories above the fifth. (Temperatures estimated at 1400 to 1800 degrees Fahr.) Copper wire was not so generally fused, but incipient fusion (slightly in excess of 1900 degrees Fahr.) was noted in several places in the seventh, eighth and ninth stories and a fairly large stranded copper cable was melted by heat from the fire at several points in the rear of the eleventh story.

The highest temperature noted in any story (estimated at slightly in excess of 2000 degrees Fahr.) was in the N. W. corner of the eighth, where the cast iron frame of a typewriter was fused. This was the only case where any signs of fusion were observed in cast iron, although presses and machines were examined wherever accessible. Brass castings having heavier sections were rarely fused, although steam valves had reached the brittle point in a number of places and brass fixture arms were broken into short sections by their own weight and were melted in several stories. The temperatures were more uniformly higher in the eleventh than in any other story in the building. The south stairs and elevators were subjected to comparatively little heat, but the condition of the steel in the east stair and elevator shafts shows the effect of temperatures quite as high, if not higher, than in any other part of the building.

The temperatures rarely exceeded 1900 degrees, but were probably in excess of 1800 degrees for considerable periods in several stories. The amount of quenching by means of outside streams had a material influence on both the severity and duration of the fire in stories below the tenth, but the opportunity for the application of water from nearby buildings was comparatively favorable.

The observations made indicate that in buildings of large area containing considerable quantities of combustible material, the fire proofing should be capable of withstanding temperatures as high as 2000 degrees Fahr. for several hours.

BUILDING.

General: Twelve stories and basement with one story and basement extension in southeast corner. One large and two smaller roof houses on twelve-story portion. Ground area 17,750 square feet. Inside area above first story 15,148 square feet. Area of roof houses, 4,566, 962 and 120 square feet, respectively. Building fronts 121 feet on Fourth Ave., 150 feet on Nineteenth Street, and is about 175 feet in height from the curb to the highest point of the roof houses. First story 16½ and upper stories mostly 12½ feet in height. Tar and gravel covering on fire-proof roof, except at cornice where covering is laid on wood. Building erected by John H. Parker & Company in 1900. Plans and specifications by Wm. H. Birkmire, Architect.

Contrary to the general impression, this building was originally designed as a mercantile building and not an office building.

Walls: Building is founded on sand and gravel, the basement walls and columns resting on concrete. Walls of brick 28 inches thick in basement, 24 inches at 1st story, 20 inches at 2nd to 4th story, inclusive, 16 inches at 5th to 8th story inclusive, and 12 inches above this point. Walls above 2nd floor supported on spandrel beams at each floor. North and west sides of pier construction, enclosure walls between piers being 12 inches thick, except east wall at the four upper stories which is 8 inches. Parapets 36 to 48 inches above roof on south and east sides. Walls of roof houses made of 3 and 4 inch hollow tile between angle framing.

The walls on street fronts are faced with limestone ashlar at the two lower stories, with granite bases at 1st floor level, terra cotta at 3rd story, red pressed brick and terra cotta sills and lintels above. Terra cotta mullions at 10th and terra cotta panels at two upper stories. Heavy terra cotta courses at 4th, 10th and 11th stories. Large projecting sheet iron cornice at roof.

Damage: The walls are generally in good condition. The damage is apparently greatest at about the middle of the north wall at the 11th and 12th stories, where the brick backing was thrown off or badly damaged by the collapse of the steel framing. The wall is also somewhat bulged and may have to be removed at this point. The eight inch enclosure wall at east end of the 12th story has settled and is loose at the top.

The hollow brick backing (used to a limited extent) was very badly chipped and broken in the S. W. corner at several points, notably in the 6th story. Two brick mullions in the court are missing at the third story (next to main collapse).

The exterior of the walls received very little injury below the 5th story. Above this they are badly smoked and the terra cotta trimming and pressed brick are noticeably chipped and broken at many windows on both street fronts. The cornice is badly damaged on the north side and to a lesser extent on the west side.

Columns: Interior columns round, and wall columns square. All made of cast iron, except star-shaped steel columns in large roof house and 5 inch I columns in smaller roof house.

Diameters and Thickness of Columns.

Bsmt., 1st & 2nd,	15 x 2 inches;	Eighth	10 x 1½ inches;
Third story	14 x 1½ " ;	Ninth	9 x 1 " ;
Fourth & Fifth	13 x 1½ " ;	Tenth	8 x 1 " ;
Sixth story	12 x 1⅜ " ;	Eleventh	8 x 1 " ;
Seventh "	12 x 1¼ " ;	Twelfth	8 x ⅞ " .

Standard brackets, lugs and connections between columns were used throughout. Above the second floor all wall loads are transmitted directly to wall columns. Analysis of the column loads shows that the columns as designed were of sufficient strength to safely carry a uniform live load of 120 pounds to the square foot on all floors, the factor of safety being approximately five. (Building posted for 120 pounds per square foot.)

No evidence was found that these loads were exceeded, except possibly on columns Nos. 33, 34, which in addition to an extremely heavy roof load (cinder fill in excess of 30 inches in thickness) also carried a water tank estimated to weigh twenty-five tons, and two heavy safes.

Damage: The cast iron columns were apparently uninjured except in and surrounding the collapsed areas and at one or two other points. The sixth story section of column 45 failed about four feet six inches below the seventh floor and the eleventh story sections of columns 33 and 34 failed about four feet below the twelfth floor level.

These failures were caused by heat, the columns being deflected and bulged at the points of fracture. (See Plates XX, XXI, XXIX, etc.)

The failure of column 45 caused the collapse of a section approximately forty by twenty-four feet of all floors from roof to basement, located near the rear court. The ninth, tenth and twelfth story sections of this column were broken into two or more pieces in falling. (See floor plans and section.)

The failure of columns 33 and 34 caused the collapse of a section of the twelfth floor, roof and roof house approximately sixty feet long by thirty feet wide, and an adjoining section of the roof and twelfth floor, approximately fifteen by twenty feet. The falling material mostly lodged in the framing of the eleventh floor, large quantities of the tile arch blocks going through to lower stories and causing the failure of numerous arches by impact. (See floor plans and section.)

The ninth story section of column 25 was deflected by heat about one inch, but did not fail. Slight deflection was also noted in the eleventh story section of column 27. Examination shows that the sixth story section of column 45 was defective both in thickness and material. About twenty-five or thirty per cent. of the lugs on the columns next to the main collapsed portion, namely, Nos. 38, 44, 46 and 51, were more or less broken, the fracture being through one bolt hole in some and both bolt holes in others. The bolts were either sheared or the threads stripped.

Column Covering: Interior columns protected by circular porous terra cotta blocks, the shell being 1 inch with ribs of the same thickness and depth at the back. One inch air space between shell and column. (See Plate XVII.) Electric conduits were placed against columns, the tile blocks being cut away to accommodate this piping. The outer ends of the brackets were unprotected. Column covering finished with 1 to 1½ inches of plaster in two coats. Hollow plaster caps at ceilings.

Wall columns were protected by 4 inches of brick work in lower stories and 2 inches in upper stories, a few columns in east and south walls being protected by expanded metal and plaster on the inside. Steel columns in roof houses unprotected.

Damage: While the column covering was generally in position, careful investigation shows that it failed to protect the columns at several points, notably in the sixth and eleventh stories, the failures in these stories resulting in the collapse of the large areas heretofore described. The failure in the 11th story may have been caused by a weakened condition of the covering resulting from a previous fire in this story. In many cases remote from the collapsed portions the column covering was badly split and damaged at the top, notably in the 6th, 9th, 11th and 12th stories, and to a lesser extent at other points. The weakened condition was apparently due to the distortion of the metal conduits, the lack of proper bonding on account of these pipes, and to the expansion of the tile itself. About 25 per cent. of the total column protection, although mostly in position, was badly damaged by fire. About 20 per cent. was damaged to a lesser degree. Due consideration has been given to the fact that considerable column protection was knocked off by falling material after the fire. In many instances the ultimate fire resisting point had apparently been reached.

The wall column covering was practically uninjured, except at a few points at the collapsed portions.

Floor Framing: Consists of 15″ I 60 lbs. and 15″ I 42 lbs. girders generally spanning about 15 feet, center to center of columns, run-

ning east and west, and 12″ I 40 lbs. and 12″ I 31½ lbs. floor beams spanning about 20 feet, the 12″ I 31½ lbs. beams being placed at columns and 12″ I 40 lbs beams. in the center of the panels. Three-quarter inch tie rods were generally used, spacing not exceeding 8 feet. The girders were connected to the columns in the usual manner, the bottom flanges bearing on brackets and the webs being connected to lugs by two ¾ inch bolts. The beams were connected to the girders by two 3½″ x 3½″ x 5/16″ angles riveted to the webs of the beams by three ¾ inch rivets and bolted to the girders by six ¾ inch bolts. (See Plates II to XIV.)

Analysis of the strength of the steel framing shows that the safe live load capacity of the girders was 102 lbs. and of the floor beams 120-135 lbs. per square foot (load uniformly distributed). The connections of beams to girders were very weak, being over 40 per cent. lighter than the standard connection angles at present in use (2Ls. 6″ x 4″ x 7/16″.) Although the strength of the girders and connections fall below the requirements of good practice for buildings of mercantile or light manufacturing occupancy, there is no evidence to show that these defects caused the collapse of any of sections noted.

Damage: No deflection of girders or floor beams was apparent except in localities where the arches failed or the floors collapsed. In such localities both girders and floor beams were often deflected, bent, or twisted by heat, and in some cases by the impact of falling bodies. The steel work in the collapsed portions was very badly bent and distorted. In many instances the Bessemer steel beams were broken, the fractures showing the usual characteristics of this class of steel.

The connection angles in the collapsed portions were straightened out or badly twisted and torn in many instances. No sheared rivets were found, the beams being torn from the girders either by stripping the threads or shearing the bolts.

In and around the collapsed sections, the steel framing failed generally at the connections, either by shearing the bolts or stripping the threads, or by breaking the lugs of the columns. A number of bolts were also loosened in adjoining panels on account of the shock and strain due to the collapse.

At some points remote from the collapsed sections, broken cast iron lugs and damaged bolts were found in line with the girders. This damage may have been caused by expansion in the girders or by strain due to the collapse, or, in the case of broken lugs, by the use of drift pins at the time the building was erected. At right angles to the girders, the bolts, rivets and lugs of columns were in good condition. This damage was observed after the arches were removed.

As far as could be ascertained by careful inquiry regarding the condition of ceilings and plastering, no cracking or other evidence of overloading or excessive vibration was apparent prior to the fire.

Beam Protection: Lower flange of girders unprotected, except by ¾ to about 1 inch of plaster. Lower flange of floor beams protected by 1¼ to 1½ inches of solid tile (lips to skew backs) and ½ to ¾ inch of plaster. (See Plate XVII.)

Damage: While no deflection in girders or floor beams was noticeable in localities where the floor arches remained in position, cracked and broken lugs and partially sheared bolts were found at some points in line with the girders. This damage may have been caused by expansion of the girders, due to the insufficient fire protec-

tion on the lower flanges. The plaster on girder flanges dropped off in all cases where subjected to heat. The tile flange protection on floor beams remained in position except in spots in the localities subject to heat of greatest intensity. This was noticeable in the N. W. corner of the 8th story, near the main collapse on several stories, and also at different points in the rear of the building.

Floor Arches: Flat, side construction, 8 inch semi-porous hollow tile arches were used throughout, the soffit being 1½ inches below the lower flanges of the floor beams. Over the arches was a loose cinder fill (some sand and some cement) 8½ inches in thickness (except roof) and practically flush with the top of the 3 inch wood sleepers upon which 1⅛ inch matched pine top flooring was laid The arch spans were generally 5 feet in north and south bays excepting one arch in front of passenger elevators, which was 7 feet. The spans were 4 feet 6 inches and 6 feet in the main portions of the floors. (See Plate Nos. II to XIV and XVII.)

The light weight 4 cell arch blocks were used with 2 cell blocks next to the keys in the wider arches. The key blocks were generally 3 and 4 cell, broken tile and mortar being used in some cases. Skew backs having lips 1¼ to 1½ inches in thickness were employed. The shells were ⅝ to ¾ inch in thickness and the webs ⅝ inch except for skew backs, in which the shells and webs were ¾ inch thick. The tie rods extended through the center of the arch blocks. The mortar joints between blocks were ½ to ¾ inch in thickness. The workmanship was apparently above the average. (See Plate XVII.)

The architect's application for a building permit provides for a live load capacity of 150 pounds per square foot. It is understood that the allowable live load was afterwards reduced to 120 pounds.

Investigation of the strength of the various arches used develops the fact that they were extremely weak for the spans employed. The allowable load carrying capacities of the arches on the 7 and 6 foot spans were 5 and 35 pounds per square foot, respectively, over and above the dead loads; in other words, any live loads averaging in excess of these, on the floor, would introduce stresses in excess of those allowable by good practice. This is also true to a lesser extent in the case of the 4½ and 5 foot spans.

The effective depth of the arches was approximately 6½ inches, as the soffit was 1½ inches below the bottom flanges of the beams. These shallow arches were not only too weak for the spans, but their live load capacity was considerably reduced by the unusual amount of cinder fill. At the large roof house the dead load alone exceeded the allowable safe live load, the cinder fill at this point being in excess of 30 inches. While subject to some extent to vibration caused by cylinder printing presses, any stresses from this source are not believed to have been important, as the presses were not large or in any considerable number.

Damage: Approximately 22½ per cent. of the total number of floor arches dropped out, sagged or were noticeably cracked during and immediately following the fire, many falling some time after the fire was extinguished. Next to the failure of the columns and resulting collapse of adjoining floor panels, the failure of the arches was the most noticeable feature of the structural damage resulting from this fire. From the information obtainable it is not believed that any of the arches failed previous to the collapse of the columns or for about two hours after the fire started. The arches were not strong enough to withstand the impact of any considerable amount of falling material, and the failure of by far the greater number was

from this cause. Heavy safes and presses broke through and fell several stories in a number of instances, although these heavy weights were sometimes retained at the original floor level by the steel framing. On several stories some of the arches were undoubtedly weakened by heat to a point where they would not sustain the dead load. The 7 foot arch in front of the elevators fell out on ten floors, starting at the tenth. (Vacant story above.) A number of other arches in several of the upper floors also fell, although subject to no live load.

The wood sleepers and top flooring were not broken through in numerous cases where the arches apparently fell subsequent to the fire, although the impact of the falling material was sufficient to cause the successive failure of the arches in several floors directly underneath.

It was very noticeable that by far the greater number of arch failures occurred on the 6 foot spans, the failure being almost without exception by shear next to the skew backs. The inability of this type of arch to withstand shearing stresses was very apparent.

Comparatively little of the soffit dropped off of the arches which remained in position, but the damage by fire, water and frost will undoubtedly necessitate their removal on all floors. The soffit generally came off in small patches, this damage being most noticeable in the rear of the 5th story, in N. E. corner and on each side of the collapsed portion in 6th, in S. W. corner and north side of 7th, in the N. W. section of 8th, north side of 9th and on the 11th story.

Floor Openings: Elevators: Two freight elevators in one shaft on east wall, enclosed by three inch hollow terra cotta partition blocks, supported at each floor and provided with unprotected angle iron framing at door openings. Paneled elevator doors about two inches thick, generally protected on shaft side by tin plate poorly joined and nailed to edges, mounted with butt hinges fastened to doors by 1¼ inch wood screws. Doors fastened together at center by ordinary spring catches and bolts screwed to woodwork.

Three passenger elevators in one shaft near east end of south wall, enclosure similar to freight elevators except open grill work used at doors to hallway in each story.

Stairways: Narrow stairway (39 to 41 inches wide) next to each elevator. Steel stringers, cast iron risers and slate treads and landings unsupported by metal backing. Open to all stories and roof, enclosed by three inch hollow terra cotta hallway partitions supported by wood bucks and provided with paneled wood doors and large wood framed side lights at each story. Doors and side lights glazed with ⅛ inch ordinary glass.

Two open stairways from basement to first story, one iron and one iron and stone. One circular open iron stairway from 12th story to large roof house.

Courts: One large exterior court above one story extension.

Skylights: One over each stair and each elevator shaft. Large skylights at west end of large roof house and over smaller roof house. Skylights provided with ¼ inch ribbed glass in metal framing. Two small skylights in main roof and two in one story extension, metal frames for latter skylights fastened together by solder, kind of glass unknown. Two openings from 12th story to large roof house equipped with heavy glass.

Pipe Shafts: One in N. E. corner next to stack, one on south wall west of court, enclosed by three inch hollow terra cotta blocks. Seven or eight large to medium pipes independently through floors, provided with thimbles and floor plates.

Damage: The inadequately protected stair and elevator shafts were probably the most important factor contributing to the spread of fire and the destruction of this building. The thin glass in the hall partitions quickly dropped out and allowed the fire to communicate to the upper stories through the stair shafts, particularly in the east shaft. The doors on freight elevator shaft were soon destroyed by fire on the unprotected side.

Above the fourth story the partitions enclosing the east elevator either fell or were badly cracked and bulged. The south elevator was not severely exposed, but the enclosing partitions were cracked and damaged at several stories. The angle iron framing at openings to elevators was badly warped and bent, particularly in the east shaft, where the fire was hottest.

The east stairway was very badly damaged above the fifth story. The stairs collapsed at the sixth and seventh stories, the steel stringers hanging down in a twisted mass. Stringers and metal parts badly warped at most other stories above the fifth. Except where the stairs collapsed, the slate treads, although very badly damaged, generally remained in position. Slate landings fell out at some stories.

The south stairway received little damage, as it apparently served to supply air to the fire. The trend of the fire was generally away from this opening. The slate treads were considerably cracked and broken at some stories, notably the seventh, but the wood hand rails were only partly burned at several points.

The skylights in the roof houses, roof and over east stairway and elevators were destroyed and showed the effects of severe heat. The skylight over the south stairway and elevators was hardly cracked. Two small skylights on main roof and two in roof of one story extension collapsed.

Partitions: The partitions enclosing the stair and elevator halls and the corridors were built of three inch hollow terra cotta blocks. Wood bucks were used at door openings and wood framing and casings at large side lights next to door openings. Doors provided with thin glass panels and side lights glazed with thin glass. Four inch hollow terra cotta blocks were used for a few corridor and room partitions, notably in upper stories. Some terra cotta partitions reported to have been built on wood top flooring. Electric conduits mounted in hall partitions in some cases. Plaster board nailed to wood studding and resting on wood top flooring used in some stories. Thin matched board and light wood and thin glass partitions frequently used throughout the building. Rooms mostly very large.

Damage: Hall and corridor partitions presented no obstruction to the progress of the fire on account of the wood doors and large thin glass side lights. Partitions collapsed when wood supports were destroyed. In some cases sections of room partitions, not provided with openings, remained in position but were generally loose, bulged or badly damaged. Plaster board, wood and glass partitions generally totally destroyed.

Finish: The walls, terra cotta partitions, ceilings and columns were finished with plaster directly applied. Trim was of wood. Iron grill at south elevators.

Damage: Plaster finish and wood trim throughout the building generally destroyed by fire. Ruined by water where not burned. Grill at south elevators in fair condition at most stories. Heating, plumbing and electrical work practically destroyed above the basement. Boiler and engine room received little damage by fire.

Safes and Machinery: A large number of portable safes were located on the premises of the various tenants throughout the building. Safes weighed from two to seven or eight tons and were supported on 3 x 6 and 4 x 8 wood stringers, resting directly on wood top flooring. Five medium-sized cylinder presses and about sixteen job presses were located on the eleventh floor. Several job presses on eighth and twelfth floors. Fairly heavy cutter located on eleventh floor in area which collapsed. Lighter machinery on several upper floors.

Damage: Many safes broke through the floor arches when the wood floors and wood stringers on which they rested burned away. This did not happen until several hours after the fire started. A large safe fell from the ninth to the fifth floor shortly after twelve o'clock. In some cases the safes tilted over and broke a hole through the arch without falling. In other cases they were retained by the steel framing, the arches being successively knocked out of several floors directly underneath. In still others the safes fell several stories before lodging in the floor framing. By far the larger number of safes did not fall through. The contents were preserved in most all cases.

Three cylinder presses, a number of job presses and lighter machinery fell through several floors, but may have been carried down by the collapse of the two upper stories previously noted. One cylinder press broke through the eleventh floor in the rear, but did not fall through. Shafting fell from the ceiling to the floor in several stories.

Occupancy: Miscellaneous. Mostly printing and engraving in eleventh, twelfth, roof houses and parts of eighth story. Tenth story vacant. Large stock of books and editorial and business offices in ninth story. Manufacturing plaster art casts and gold pens in part of eighth story. Large stocks of furniture, woolens and tailor's trimmings, books, and rugs in the seventh, sixth, fifth and fourth stories, respectively. Embroidery manufacturing and stock of woolens in third story. Large stock of hospital supplies in second story. Stocks of bar fixtures, billiard tables, furniture, refrigerators and upholsterer's goods and fabrics in basement and first story. (See Plate XVI.)

Exposures: North, 60 feet street to three and six story brick buildings, numerous unprotected openings at all stories. East, row of three to five story brick buildings adjoining and ten to fifty feet across court to eight story fire-proof hotel. Iron shutters at one story extension and at openings above roof of adjoining buildings. Numerous unprotected openings across court. South, ten feet across alley and fifty feet across court to eight story fire-proof hotel. Openings on alley protected by iron shutters, except one at eighth and one at twelfth stories. Numerous unprotected openings across court. West, one hundred feet street to thirteen story sprinklered fire-proof Lithographing Establishment. Numerous unprotected openings at all stories. (See Plate I.)

Remarks: The iron shutters were considerably warped where subjected to heat. They were of inferior construction, badly rusted through in many places, provided with a flat bar framing and fastened at one point near center to a cross bar screwed to wooden window framing. The shutters were not designed to withstand interior exposure and were free to open when the wood window frames were destroyed.

The passage of fire from exterior windows of lower stories through windows of upper stories, in this case, points to the neces-

sity of greater care in the protection of exterior openings, particularly in angle walls and courts and in buildings in which large volumes of gas and flame may be generated.

Owing to favorable weather conditions and surroundings the burning of this building did not seriously expose neighboring property.

Fire Appliances: A four inch stand pipe was located in south hallway, equipped with 150 feet 2½ inch linen hose supplied through 2 inch connections, and controlled by 2 inch globe valves. (Play pipes removed and sizes not ascertained.) Stand pipe supplied by a four inch connection from a gravity tank holding approximately 1,600 gallons, located directly on roof, by a four inch Siamese steamer connection from each street and a two inch connection from the house and boiler feed pumps. Four inch roof hydrant with two connections. Check valves against each supply. (Check against tank apparently of globe pattern.) Roof hydrant subject to frost. No stand pipe in east stairway.

Basement equipped with a perforated pipe system supplied through a three inch Siamese steamer connection, reduced to two inches on inside of building.

A liberal supply of fire pails was said to have been distributed throughout the building and also several hand chemical extinguishers in basement, first and eleventh stories.

A special building signal box was located in the south hallway on the first story. Night watchman in halls.

Remarks: The supply of water from the gravity tank was inadequate and a single stand pipe insufficient for a building of this area. The reason for the failure to obtain an adequate stream from the first steamer through the stand pipe was not ascertained. The perforated pipe system in the basement was not used, but was badly broken where the floors fell through from above. The night watch service was wholly inadequate.

Reason for Spread of Fire: From the foregoing it will be seen that the fire gained great headway owing to the lack of proper equipment for prompt discovery or control and that the unprotected stair and elevator shafts acted as flues and were the principal cause of the rapid spread of fire through the building. The unrestricted spread through these vertical openings and through the large floor areas soon permitted the fire to assume proportions beyond all control.

Cause of Collapse: The collapse of the various portions of the building was primarily due to the inadequacy of the fire proofing on the columns. The extensive structural damage and loss of life can be attributed to the fact that the columns were of cast iron.

CONCLUSIONS.

To summarize the more important features brought out by this investigation I submit the following:

1.—IN BUILDINGS OF MERCANTILE, MANUFACTURING OR STORAGE OCCUPANCY, IT IS ABSOLUTELY ESSENTIAL THAT ALL VERTICAL OPENINGS BE THOROUGHLY ENCLOSED IN SUBSTANTIAL FIRE PROOF SHAFTS HAVING STANDARD FIRE DOORS AT ALL OPENINGS OR SO ARRANGED THAT THE SHAFT IS WITHOUT OPENINGS DIRECTLY INTO THE VARIOUS STORIES. UNPROTECTED VERTICAL OPENINGS THROUGH BUILDINGS ARE THE GREATEST FACTOR IN THE LOSS OF LIFE AND PROPERTY BY FIRE AND THE PROPER SAFEGUARDING OF THIS HAZARD DEMANDS THE MOST CAREFUL ATTENTION OF ALL CONCERNED.

The unprotected vertical openings through the floors furnished the condition which was the main cause of the rapid spread of fire and the almost total destruction of the Parker building and its contents.

High buildings filled with combustible materials and having unprotected vertical openings present fire conditions which are very apt to be beyond the control of fire departments, no matter how efficient or well equipped. Promptness of discovery, nature of the contents, proximity of the fire to the vertical openings, area of the enclosure in which the fire occurs and distance above the street, all influence the chances of control of fire in such buildings.

That the danger of the rapid spread of fire through unprotected vertical shafts also exists to a very considerable degree in fireproof office buildings, is evidenced by the great rapidity with which several such buildings were destroyed in the San Francisco conflagration. The buildings to which reference is made were not subject to general conflagration conditions.

2.—THE HEIGHT OF FIRE PROOF BUILDINGS OF MERCANTILE, MANUFACTURING OR STORAGE OCCUPANCY SHOULD BE LIMITED TO CORRESPOND TO THE DEGREE OF PROTECTION THE BUILDING EQUIPMENT AND THE FIRE DEPARTMENT IS ABLE TO FURNISH. IN OTHER WORDS, IF ADEQUATE FIRE PROTECTION IN ANY BUILDING IS NOT AVAILABLE ABOVE A CERTAIN HEIGHT, THE BUILDING SHOULD BE LIMITED TO SUCH HEIGHT.

The more important conditions influencing the height to which buildings can be safely erected relate to questions of design, materials used in construction, building equipment, nature of the contents, exposures, degree of efficiency of the fire department and nature of the equipment with which the department is provided. These conditions all bear close relation to each other.

In the upper stories of high buildings filled with combustible contents the greatest difficulties are to be found. Restricting the height of such buildings seems to be the only safe practice unless adequate internal fire protection be provided.

The fire in the Parker Building furnishes an excellent example bearing on this question, as will be apparent from a study of the building, the way in which it burned and the efforts to extinguish the fire.

3.—BUILDINGS OF LARGE UNBROKEN FLOOR AREAS FILLED WITH COMBUSTIBLE CONTENTS DEVELOP THE SEVEREST FIRES AND CONSTITUTE ONE OF THE MOST DANGEROUS SOURCES OF GENERAL CONFLAGRATION. FLOOR AREAS IN BUILDINGS OF THIS CHARACTER SHOULD BE SUB-DIVIDED BY SUBSTANTIAL BRICK FIRE WALLS SUFFICIENT TO FORM A POSITIVE BARRIER TO THE SPREAD OF FIRE.

The severity of the Parker Building fire was due to its excessive area and the large quantities of combustible contents in all stories. Fortunately the building was so located and the weather conditions such that surrounding property was not seriously exposed.

4.—FIRE PROOF BUILDINGS, NO MATTER HOW WELL DESIGNED AND CONSTRUCTED, DO NOT PREVENT THE DESTRUCTION BY FIRE OF CONTENTS IN ANY STORY; AND IT IS ESSENTIAL THAT HIGH BUILDINGS OF MERCANTILE, MANUFACTURING OR STORAGE OCCUPANCY BE THOROUGHLY PROTECTED BY A STANDARD EQUIPMENT OF AUTOMATIC SPRINKLERS.

The lack of proper equipment for the prompt extinction of fire, or, for that matter, for its discovery, was most apparent in the Parker Building.

The unavoidable lapse of time between the discovery of fire and the application of water by the fire department, renders it necessary that high buildings used for the storage of large quantities of combustible materials be provided with some automatic means of extinguishing fire in its incipiency. Many years of experience have shown that the Automatic Sprinkler is the best known means of accomplishing this result.

5.—EXTERIOR OPENINGS IN BUILDINGS SHOULD BE THOROUGHLY PROTECTED AGAINST EXPOSING FIRES. UNIVERSAL EFFICIENT FIRE PROTECTION OF EXTERIOR OPENINGS WILL PRACTICALLY ELIMINATE THE DANGER OF CONFLAGRATION IN CITIES.

Neglect to provide proper protection against exposures is almost universal and little, if any, resistance to the horizontal travel of fire is provided, even in congested districts of cities. The contents of fireproof buildings having numerous unprotected windows are but little safer from exposing fires than the contents of buildings of ordinary construction; and fire-proof buildings with unprotected openings do not serve as a positive barrier in retarding the spread of a conflagration.

Fires in buildings containing large quantities of combustible contents generate large volumes of gas and flame which must find exit through the windows. The necessity for effective window protection to prevent such fires from re-entering at other stories was again demonstrated at the Parker building. Wired glass windows in standard metal frames are particularly well adapted for protection against exposure of this character, but should not, alone, be depended upon at points where the exposure from the exterior is severe.

Exterior openings in buildings can be effectively protected against exposing fires by standard fire doors and shutters, steel rolling shutters, wired or prism glass in standard metal frames, open sprinklers, or combinations of these devices. However, the fire retardant qualities of these various devices are not equal and their selection for use should depend on the severity of the exposure.

6.—HIGH BUILDINGS OF MERCANTILE, MANUFACTURING OR STORAGE OCCUPANCY SHOULD BE PROVIDED WITH LARGE, PROPERLY ENCLOSED STAIRWAYS IN SUFFICIENT NUMBER TO AFFORD SAFE EXIT AT TIME OF FIRE. SUCH BUILDINGS SHOULD ALSO BE PROVIDED WITH OUTSIDE FIRE ESCAPE AND STAND PIPE EQUIPMENTS.

The stairways in the Parker building were wholly inadequate both in number and size. The east stairway was inaccessible on account of fire almost from the start; and the firemen were driven from the south stairway by smoke a few minutes after they arrived. The conditions in this building were such that the loss of many lives might easily have been the result if the fire had occurred during working hours. As it was, the use of the life line was required to save several men who were caught on the roof.

Outside fire escapes and outside stand pipe equipments are often necessary even where stairways are properly enclosed, on account of smoke.

7.—BUILDINGS OF MERCANTILE, MANUFACTURING OR STORAGE OCCUPANCY SHOULD BE PROVIDED WITH ADEQUATE SYSTEMS OF INSIDE STAND PIPES EQUIPPED WITH LINEN

HOSE AND NOZZLES SUITABLE FOR FIRE DEPARTMENT USE, AND, IN ADDITION, A SMALLER LINEN HOSE AND NOZZLE SUITABLE AND SAFE FOR THE USE OF OCCUPANTS. THESE EQUIPMENTS SHOULD BE ACCESSIBLE AND IN SUFFICIENT NUMBER TO EFFECTIVELY COVER ALL PORTIONS OF THE BUILDING. THEY SHOULD EXTEND THROUGH ALL STORIES AND SHOULD BE SUPPLIED FROM A RELIABLE SOURCE OF WATER UNDER ADEQUATE PRESSURE, IN ADDITION TO SIAMESE STEAMER CONNECTIONS ON THE OUTSIDE AT STREET LEVEL.

The life of even the best grades of cotton rubber-lined hose is very limited when placed inside buildings. Standard linen hose will last indefinitely if kept dry, and the small amount of leakage or sweating when water is first turned into it is a matter of no consequence. The present practice of replacing hose attached to stand pipes with fire department hose, consumes time and is entirely unnecessary where standard grades of linen hose are provided. Where pressures are effective the use of 2½ inch hose by occupants of buildings is extremely dangerous.

8.—THE USE OF PERFORATED PIPE SYSTEMS SHOULD BE PROHIBITED, AS SUCH SYSTEMS ARE UNRELIABLE, INEFFICIENT AND LIABLE TO RESULT IN WATER DAMAGES WHOLLY DISPROPORTIONATE TO THE EXTENT OF FIRE. WHERE IT IS DESIRABLE TO PROTECT ONLY A PART OF A BUILDING, A SYSTEM OF AUTOMATIC SPRINKLERS WITH ADEQUATE WATER SUPPLY SHOULD BE EMPLOYED AND THE PORTIONS PROTECTED PLAINLY MARKED AT THE SIAMESE STEAMER CONNECTIONS ON THE OUTSIDE OF THE BUILDING.

Partial equipments of this character should be confined to buildings which do not require complete protection. Automatic sprinklers possess the advantage of not only delivering water automatically, but also of delivering it in considerable quantity and at the seat, or in the immmediate vicinity of the fire. Constant water supply is necessary to insure prompt action and to prevent the operation of a large number of sprinklers before the arrival of the fire department.

9.—CAST IRON COLUMNS SHOULD NOT BE USED IN HIGH BUILDINGS, AS THEIR FAILURE IS USUALLY COMPLETE, AND RESULTS IN SUDDEN TOTAL COLLAPSE OF THE SECTIONS SUPPORTED. GIRDERS AND BEAMS CANNOT BE RIGIDLY ATTACHED TO SUCH COLUMNS AND DEFECTS IN THE MATERIAL CANNOT BE EASILY DETECTED.

Although most of the columns in the Parker Building were intact, the failures noted were responsible for the loss of three lives and serious injury to many firemen, the destruction of large portions of the building and the loss of considerable property in lower stories which would not otherwise have been destroyed.

In contradistinction, the failure of steel columns is gradual and does not often result in the total collapse of the sections supported. This was fully demonstrated in the San Francisco conflagration, where the serious deflection of hundreds of steel columns did not result in the total collapse of floors except in one or two instances.

10.—IT IS ESSENTIAL THAT ALL STRUCTURAL MEMBERS OF FIRE PROOF BUILDINGS BE PROTECTED BY A SUFFICIENT MASS OF FIRE PROOFING TO THOROUGHLY INSULATE THEM AGAINST THE HEAT WHICH WOULD BE DEVELOPED BY THE RAPID BURNING OF ALL MATERIALS PERMITTED IN ANY STORY OF SUCH BUILDINGS. IT IS ALSO ESSENTIAL THAT ALL FIRE PROOFING BE FIRMLY ANCHORED, OR OTHERWISE SECURELY HELD IN POSITION, WHERE IT IS OF SUCH A NATURE

OR SO DESIGNED THAT IT WILL BECOME LOOSE AS A RESULT OF HEAT. ON ACCOUNT OF THEIR GREAT IMPORTANCE STRUCTURALLY, COLUMNS SHOULD BE INSULATED BY AT LEAST FOUR INCHES OF FIRE PROOFING; AND NO PIPES OR CONDUITS SHOULD BE PLACED IN OR BACK OF THE FIRE PROOFING MATERIAL. ON ACCOUNT OF THE HEAVY MASS OF FIRE PROOFING WITH WHICH GIRDERS AND FLOOR BEAMS ARE IN CONTACT, A LESSER AMOUNT OF PROTECTION CAN BE SAFELY EMPLOYED AT THE SOFFITS. GENERALLY THIS SHOULD NOT BE LESS THAN TWO INCHES FOR GIRDERS AND ONE AND ONE-HALF INCHES FOR FLOOR BEAMS.

Buildings of large area and buildings in which large quantities of combustible materials are stored, require heavier and more efficient fire proofing than buildings of moderate area and those containing limited quantities of fuel. The tendency has been toward lightness and cheapness, and fire proofing is often reduced to a point where unsatisfactory results can be expected.

While largely in position after the fire, the column protection had reached its ultimate fire resisting point in many places in the Parker Building. It failed to protect the columns in several instances, and these failures resulted in the collapse of large sections of the building. The unprotected columns in the roof houses failed in every case.

Although no deflection was noted in the girders which could be attributed to the lack of soffit protection, the number of failures in other fires has demonstrated the necessity for the thorough protection of these members. The soffit protection on the floor beams cracked and fell off in many cases, but, so far as could be ascertained, it served to prevent serious damage to these members.

The serious damage to the angle iron framing at the elevator enclosures clearly indicates the necessity for the thorough insulation of structural steel in partitions or enclosing walls. The disastrous effect of placing metal pipes and conduits inside column protection was again demonstrated.

11.—ALL FLOOR ARCHES SHOULD BE PROVIDED WITH A LARGE FACTOR OF SAFETY SO AS TO SAFELY CARRY THE IMPOSED LOADS, NOT ONLY UNDER ORDINARY CONDITIONS, BUT WHEN SEVERELY EXPOSED BY FIRE.

The arches in the Parker Building were weak, particularly the wider spans. Many collapsed as a result of the impact of material falling from the upper floors, thus carrying down the arches in several floors below. In many places the arches were knocked through by heavy safes and machinery, which settled or fell when wood floors and supports were burned. Quite a number which had no heavy loads above them collapsed as a result of fire. The majority of the arches which failed were on the six feet spans, although the failures were by no means confined to these.

12.—ARCHES OF ALL FORMS IN COMMON USE ARE SERIOUSLY DAMAGED WHEN DIRECTLY EXPOSED TO HIGH TEMPERATURES OF LONG DURATION. IN BUILDINGS CONTAINING LARGE QUANTITIES OF COMBUSTIBLE MATERIAL, THEY SHOULD BE SO DESIGNED OR PROTECTED AGAINST FIRE THAT SERIOUS STRUCTURAL DAMAGE WILL BE PREVENTED.

Damage by fire to the soffit of hollow terra cotta arches is due to the unequal expansion between the shells and webs of the arch blocks, the shells receiving very much more heat than the webs.

This is an inherent weakness and cannot be remedied by any practical increase in the thickness of the members. Additional lower cells in the blocks would in all probability prevent serious structural damage and permit of economical repair.

Substantial suspended metal lath and plaster ceilings, although resisting fire streams poorly after exposure to fire, afford sufficient additional protection to properly designed floor arches.

13.—NO WOOD OR OTHER COMBUSTIBLE MATERIAL SHOULD BE EMPLOYED IN THE CONSTRUCTION OF FIRE PROOF PARTITIONS AND ALL METAL SUPPORTS OR REINFORCEMENTS SHOULD BE THOROUGHLY INSULATED FROM HEAT. FIRE-PROOF DOORS AND WIRED GLASS IN STANDARD METAL FRAMES SHOULD BE USED AT NECESSARY OPENINGS IN CORRIDOR AND ROOM PARTITIONS. PROVISION FOR EXPANSION IN THE MATERIAL USED AND IN METAL SUPPORTS ENTERING INTO THE CONSTRUCTION OF FIRE PROOF PARTITIONS IS ESSENTIAL, PARTICULARLY WHERE HOLLOW TERRA COTTA BLOCKS ARE EMPLOYED. ALL FIRE PROOF PARTITIONS SHOULD REST ON SOLID INCOMBUSTIBLE MATERIAL.

The unreliability of stair and elevator enclosures made of hollow terra cotta blocks and of partitions containing wood supports and large openings with wood doors and ordinary glass was again demonstrated by the Parker Building fire.

14.—IN BUILDINGS OF FIRE PROOF CONSTRUCTION ALL FLOOR SURFACES, DOORS, WINDOW FRAMES, SASH AND OTHER TRIM AND FINISH SHOULD BE OF INCOMBUSTIBLE MATERIAL.

All interior finish, both combustible and otherwise, is susceptible to destruction by fire. It should not, however, be made of materials which will act as fuel or convey fire. Wood top flooring and wood trim not only materially add to the severity of fire, but serve as a means of its communication.

15.—THE SUPPORT OF HEAVY SAFES AND MACHINERY ON WOOD FLOORS AND WOOD SKIDS IN FIRE PROOF BUILDINGS IS A MENACE TO BOTH LIFE AND PROPERTY, AND SHOULD BE ABSOLUTELY PROHIBITED. HEAVY SHAFTING SHOULD BE ATTACHED TO CEILINGS IN SUCH A MANNER THAT IT WILL NOT FALL AS A RESULT OF FIRE.

Floors are seldom designed to withstand the impact resulting from the dropping or overturning of heavy safes, which are often supported six to twelve inches above the floor and commonly weigh from three to six tons. These loads should be safely distributed by means of steel framing resting on non-combustible material.

The destruction of the Parker Building serves to again direct attention to the almost universal neglect to provide essential safeguards in buildings of fire-proof construction, particularly those having mercantile, manufacturing or storage occupancy.

It also serves to again call attention to the fact that the temperatures developed by fire in a single fire-proof building may be practically as high as those developed in buildings of this character in a conflagration.

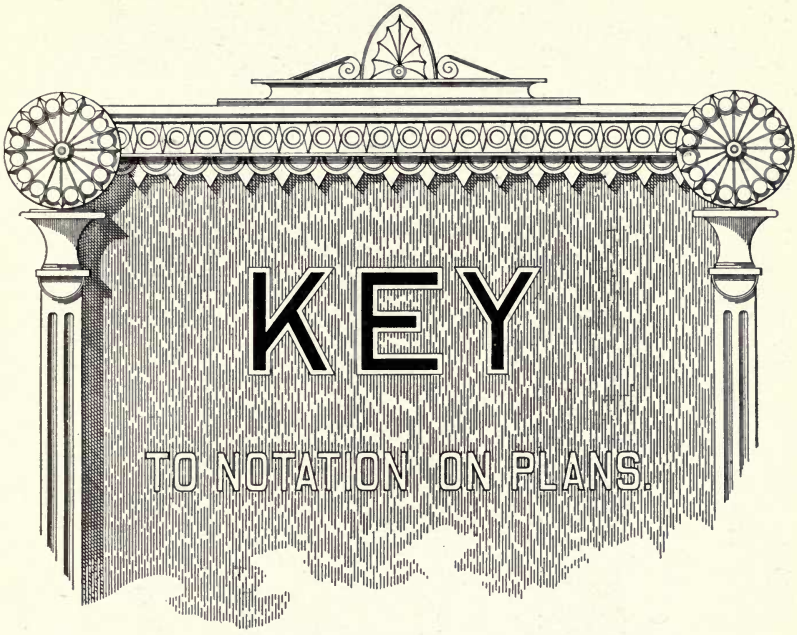
Respectfully submitted,

W. C. ROBINSON, Chief Engineer,
Underwriters' Laboratories, Inc.

APPENDIX

LOSS ON PARKER BUILDING

	Sound Value	Loss Value	Percentage
Carpenter Work, Hardware, Painting and Glazing	$88,249	$84,000	95.2
Cut Stone	21,298	1,125	5.3
Electric Wiring and Equipment	20,000	9,500	47.5
Electric Light Fixtures	1,500	1,500	100.
Elevators	22,500	14,500	64.4
Fire-proofing, Floor Arches and Partitions	44,502	40,182	90.3
Heating	15,151	9,000	59.4
Iron Work	131,000	34,500	26.3
Mason Work (including Painting Brick Work)	95,154	23,966	25.2
Marble Tile and Terrazzo	11,931	10,750	90.1
Plastering	27,713	27,713	100.
Plumbing	11,000	9,200	83.6
Roofing and Sheet Metal Work	7,650	7,000	91.5
Terra Cotta	13,800	3,960	28.7
General Contractor's Profit and Architect's Fee	51,295	27,839	54.3
		304,735	
Cost Removing Debris, including Iron Work, Floor Arches, Partitions, etc., and also including Shoring, Bracing, etc., to make the building safe previous to reconstruction		64,265	
Totals	$562,743	369,000	65.5



- Column Stripped Of Fire Proofing
- Column Fire Proofing Intact.
- Column Fire Proofing Damaged.
- Column Fire Proofing Cracked.
- Column F. Proofing Intact, Plaster Standing
- Column F. Proofing Intact. Plaster Damaged.
- Column F.P. Intact, Plaster Standing, Cap Damaged
- Column F.P. Intact, Plaster Standing, Cap Intact.

- ..... Arch Out Entirely.....
- ..... Arch In Place, But Sagged.
- ....Arch In Place, But Cracked..
- F. ..... Arch Dropped By Fire..
- S. ..... Arch Dropped By Safe..
- I. .....Arch Dropped By Impact.
- ———— Terra Cotta Partitions. Blocks 3" Thick, Plastered On Both Sides; Total Thickness 4½".

NOTES.

Where arches are not marked, cause of failure unknown or questionable.

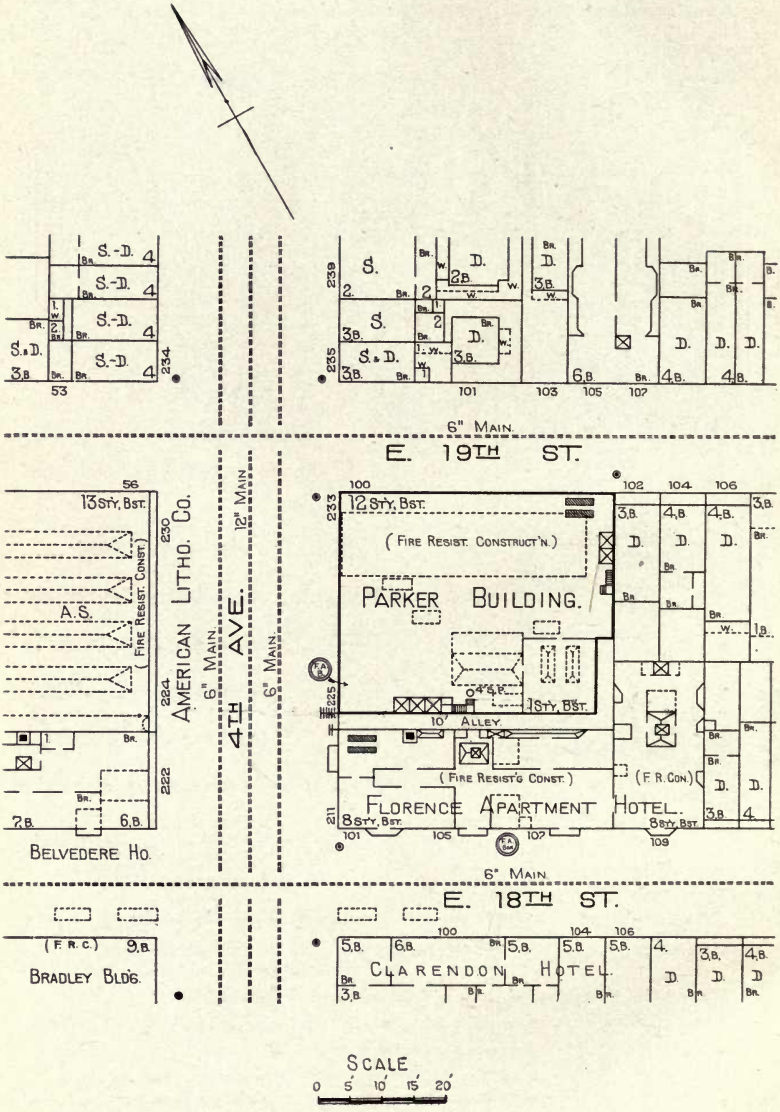
Around stairs and elevators, partitions are generally glazed in upper part.

Plates show condition of floor arches on February 1, 1908.

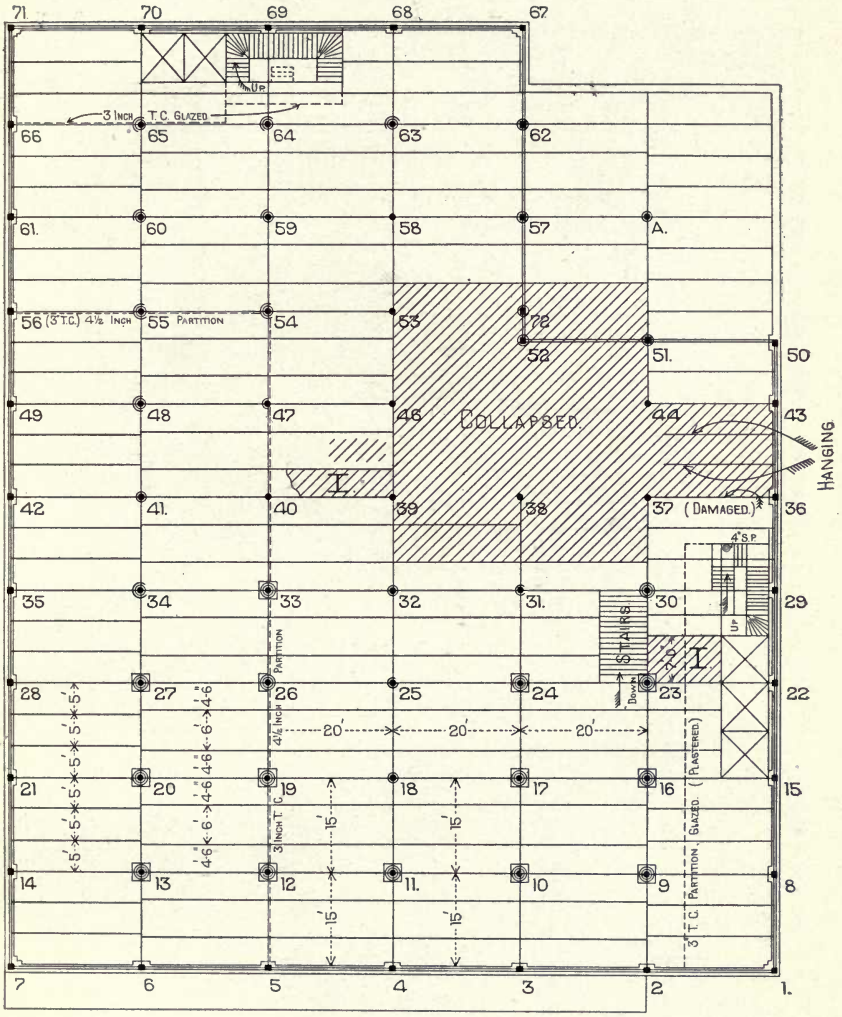
Since the above date many additional arches have developed weakness to such an extent that they had to be taken down. The cause of the failure of the latter was largely due to the weather, viz: Snow, rain, freezing and thawing.

ERRATA.

Plate XVII, Figs. 2 and 3. Tie rods should pass through centre of terra cotta blocks; shown too high on cuts.

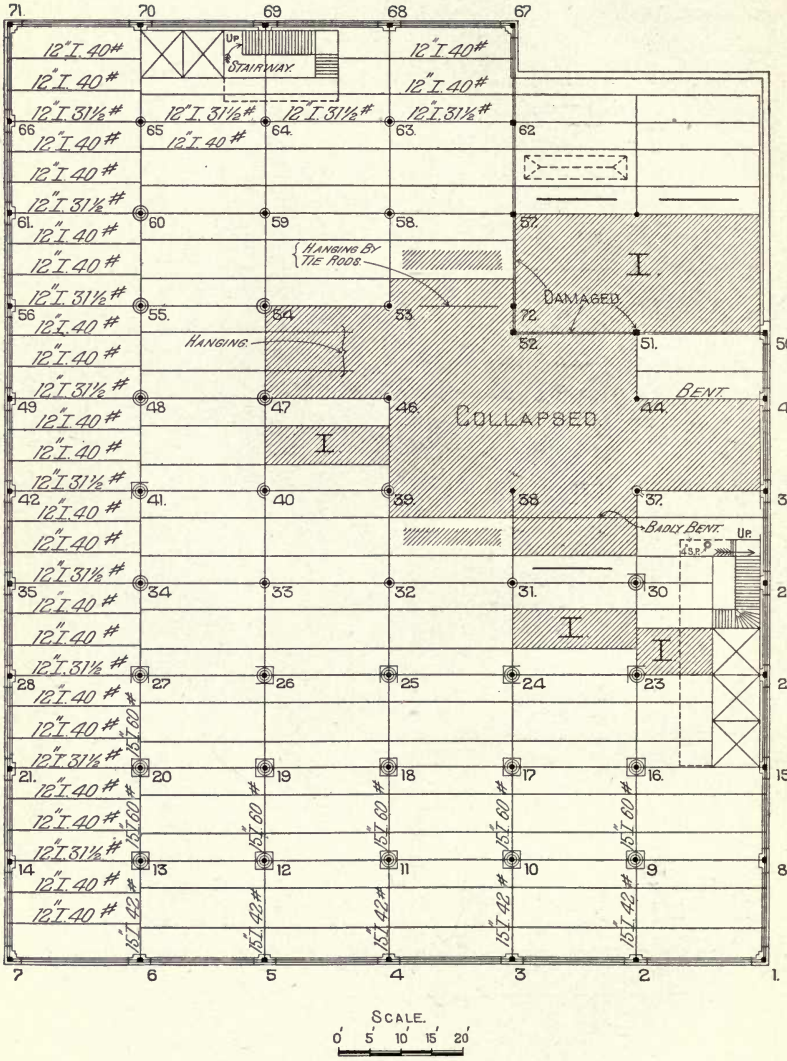


GENERAL PLAN AND LOCATION, EXPOSURE, ETC.

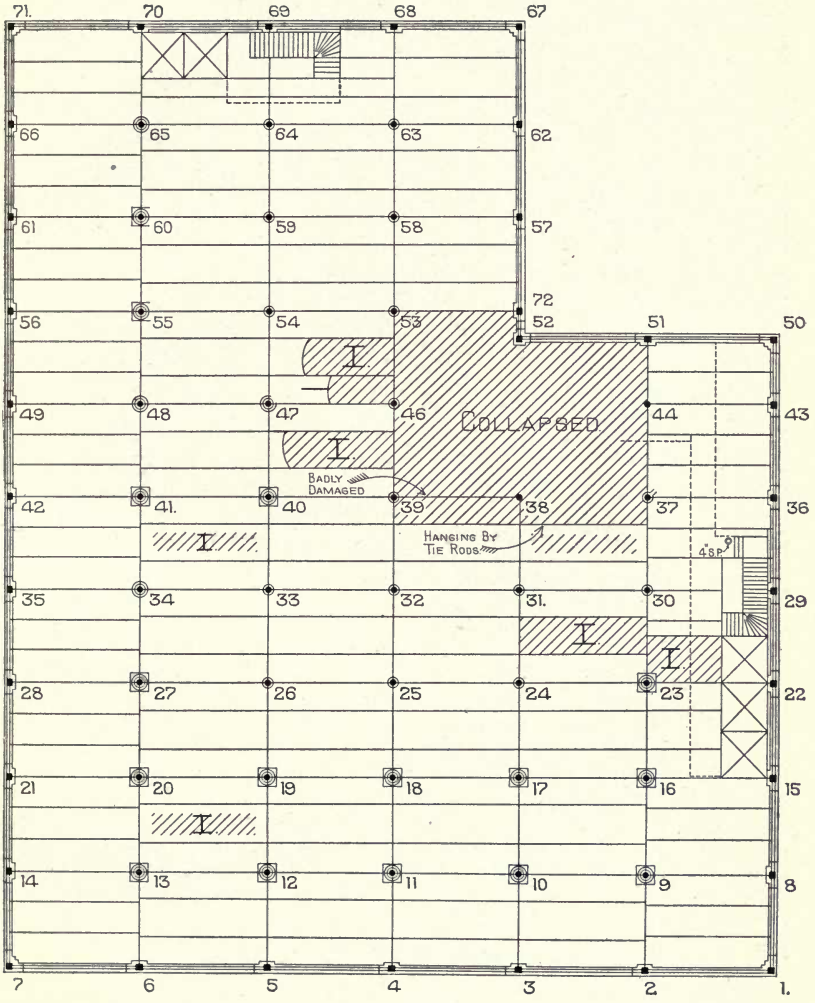


SCALE
0' 5' 10' 15' 20'

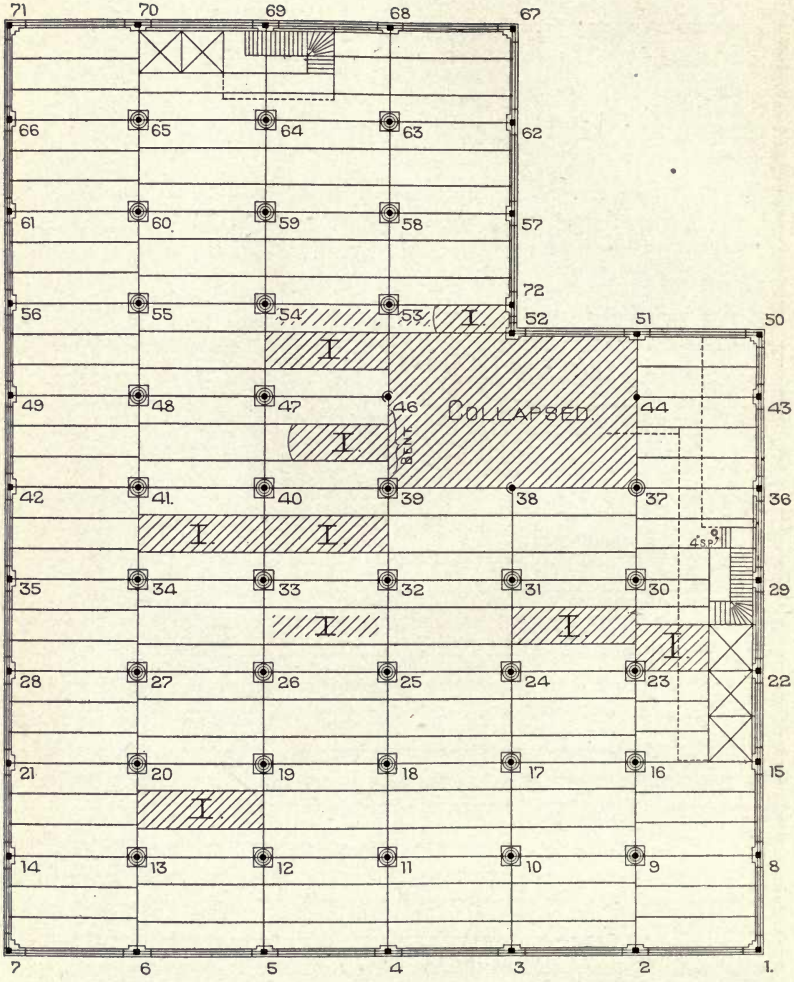
FIRST FLOOR PLAN.



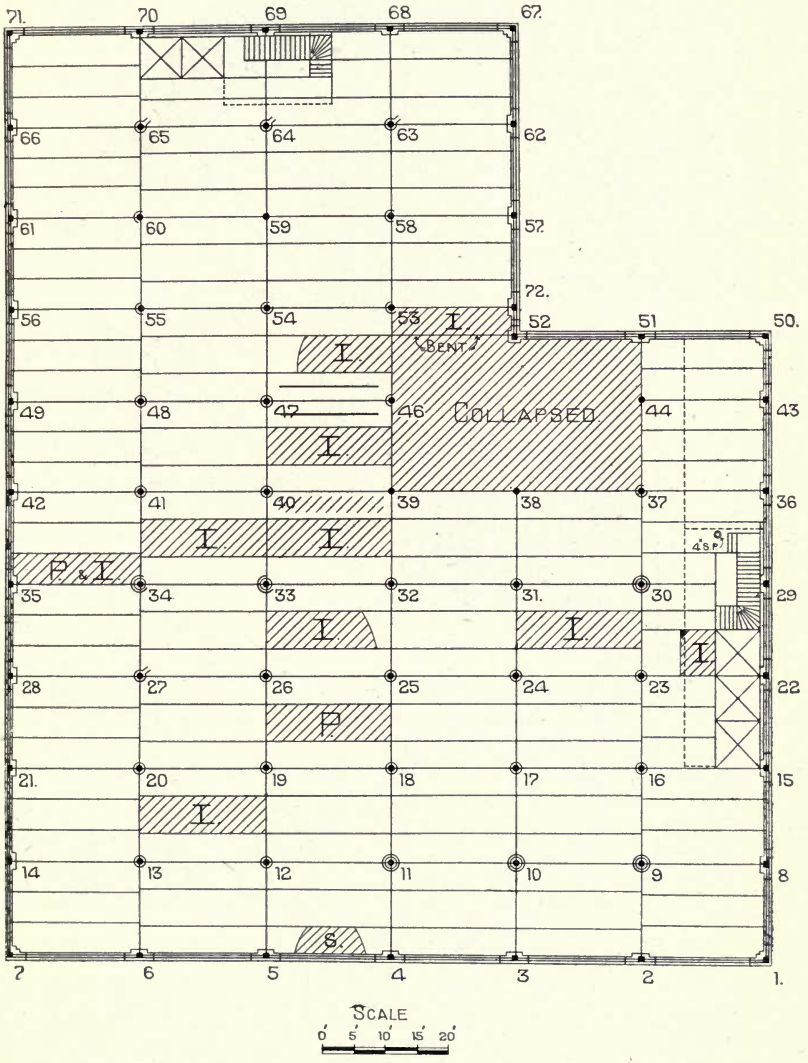
SECOND FLOOR PLAN.



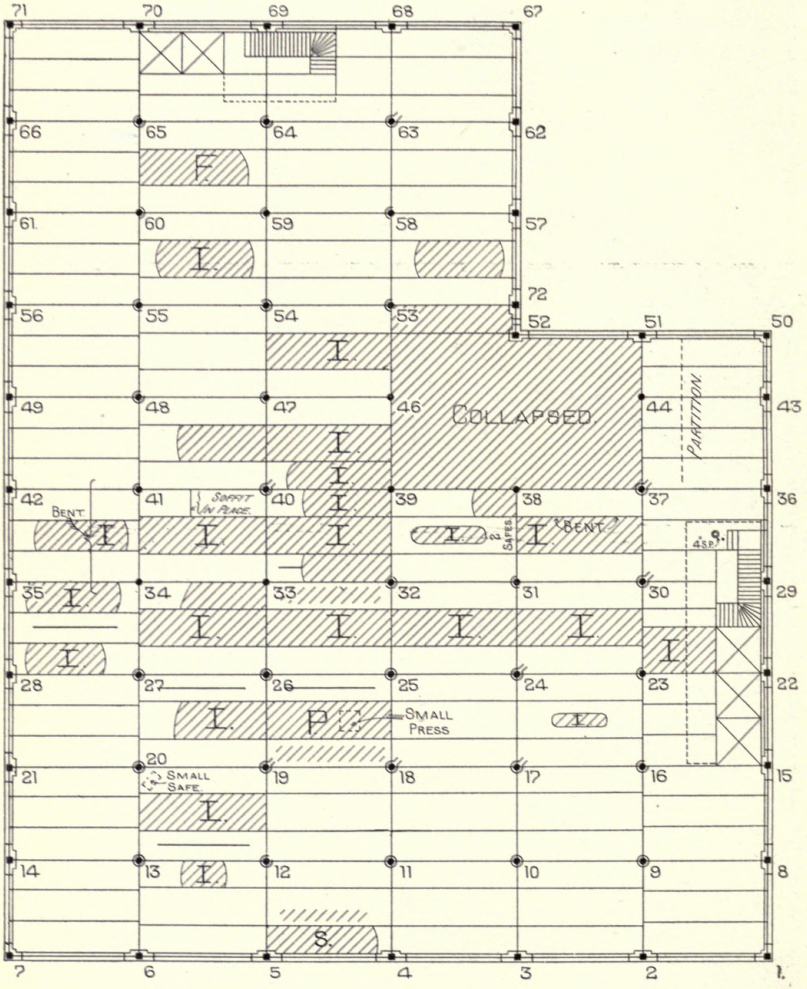
THIRD FLOOR PLAN.



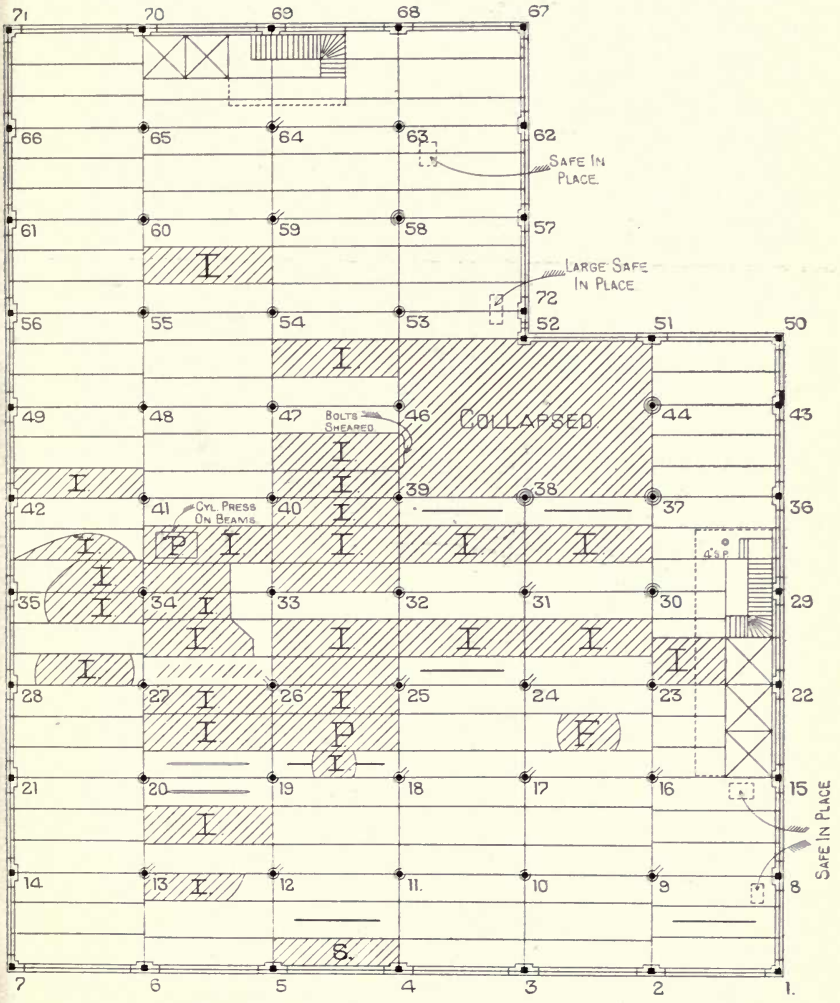
FOURTH FLOOR PLAN.



FIFTH FLOOR PLAN.

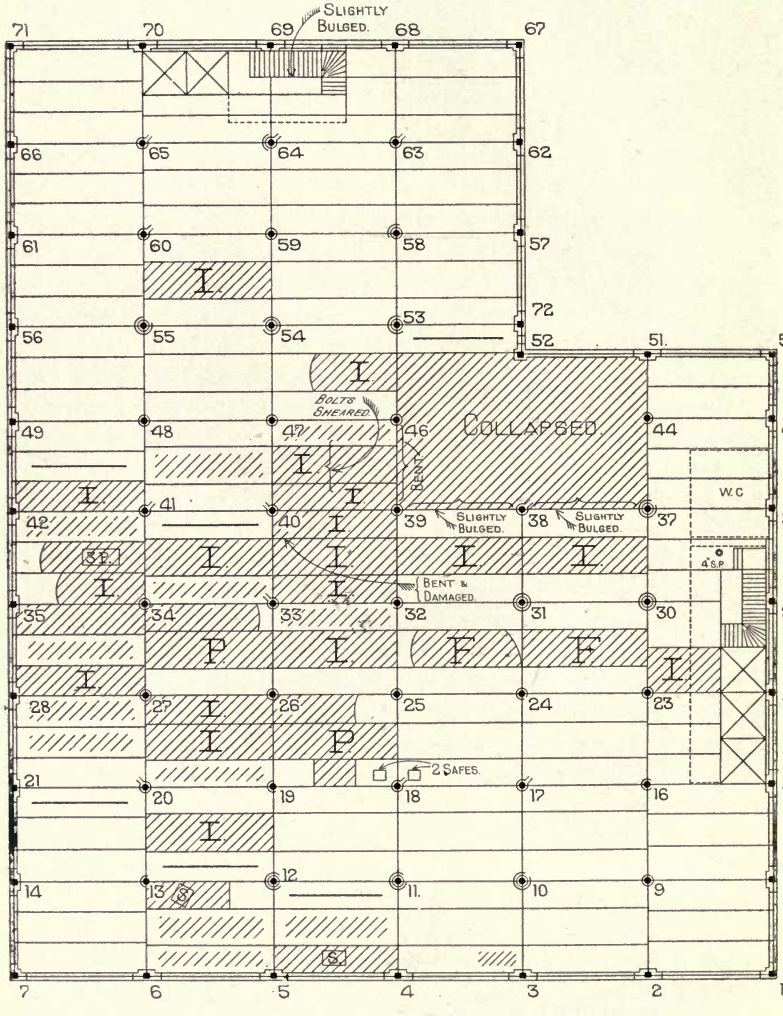


SIXTH FLOOR PLAN.

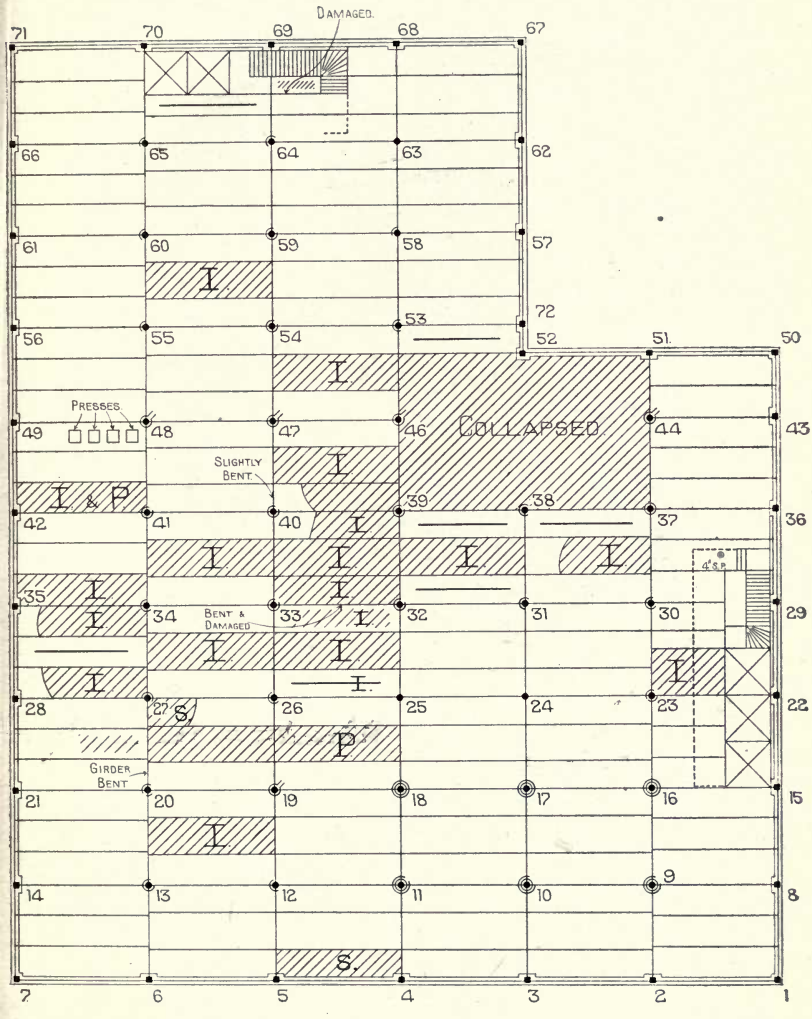


SCALE
0 5' 10' 15' 20'

SEVENTH FLOOR PLAN.

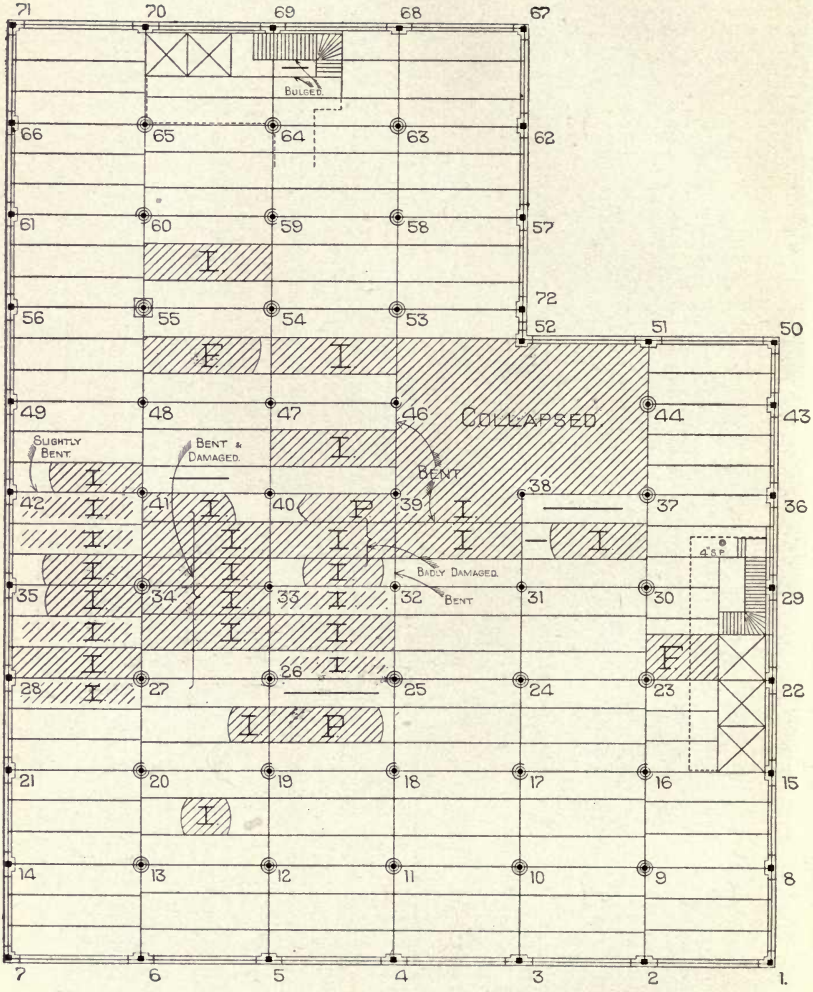


EIGHTH FLOOR PLAN.

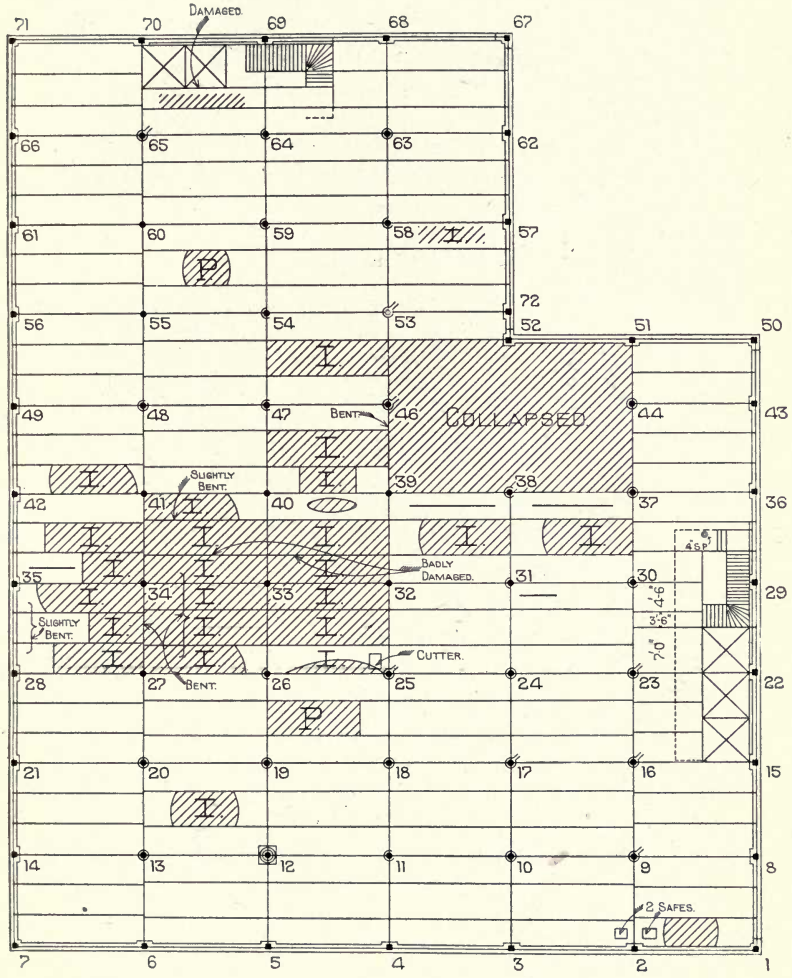


SCALE
0 5' 10' 15' 20'

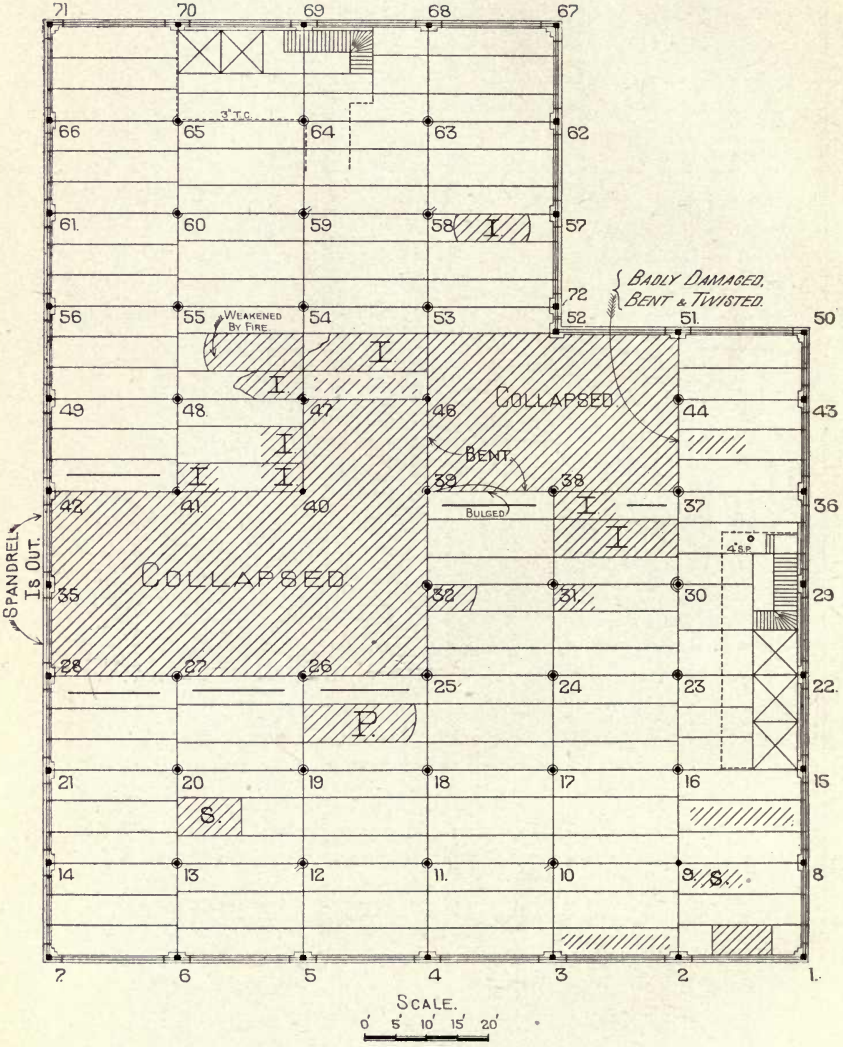
NINTH FLOOR PLAN.



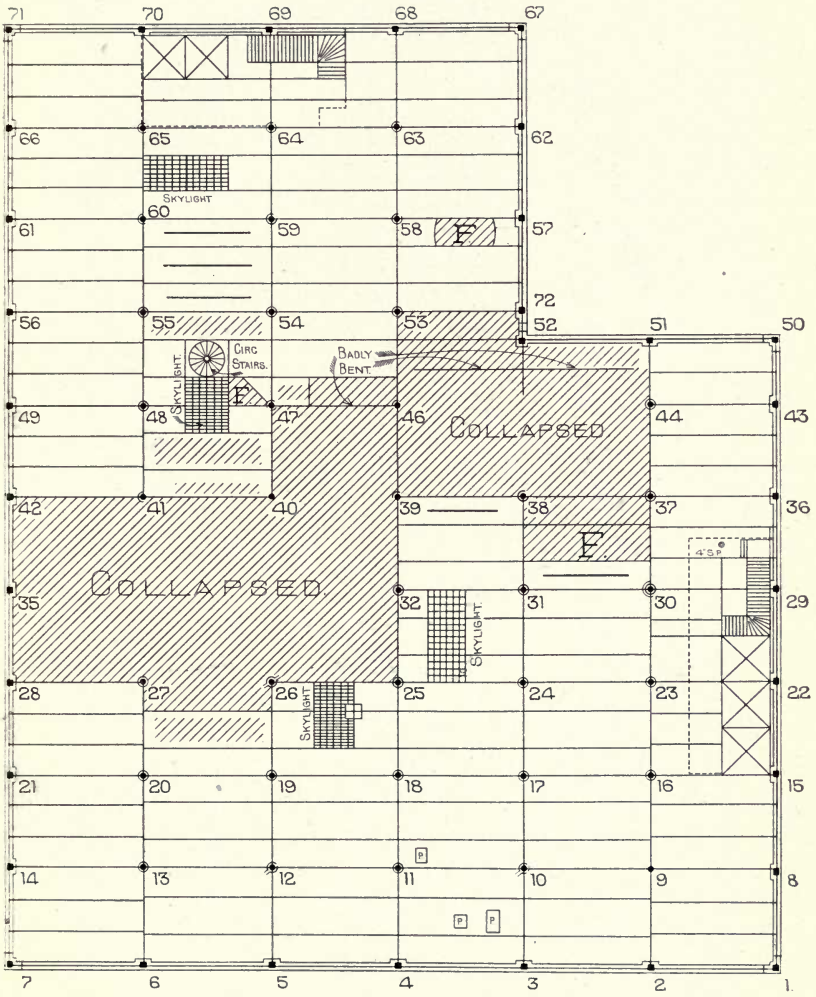
TENTH FLOOR PLAN.



ELEVENTH FLOOR PLAN.

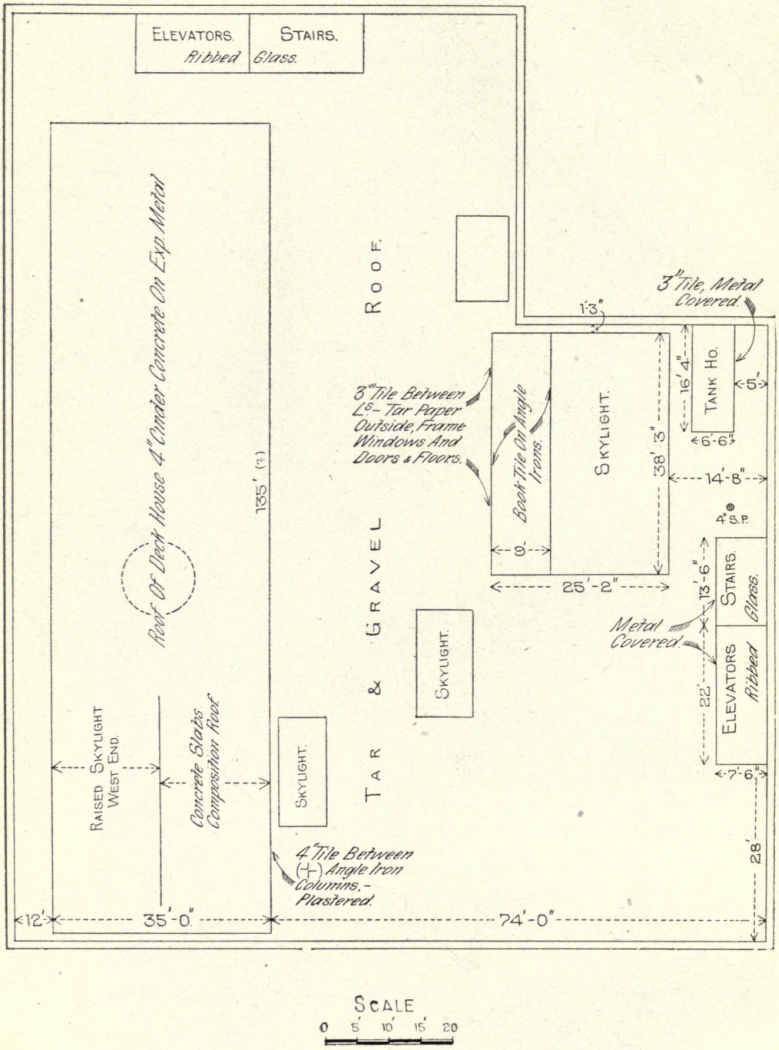


TWELFTH FLOOR PLAN.



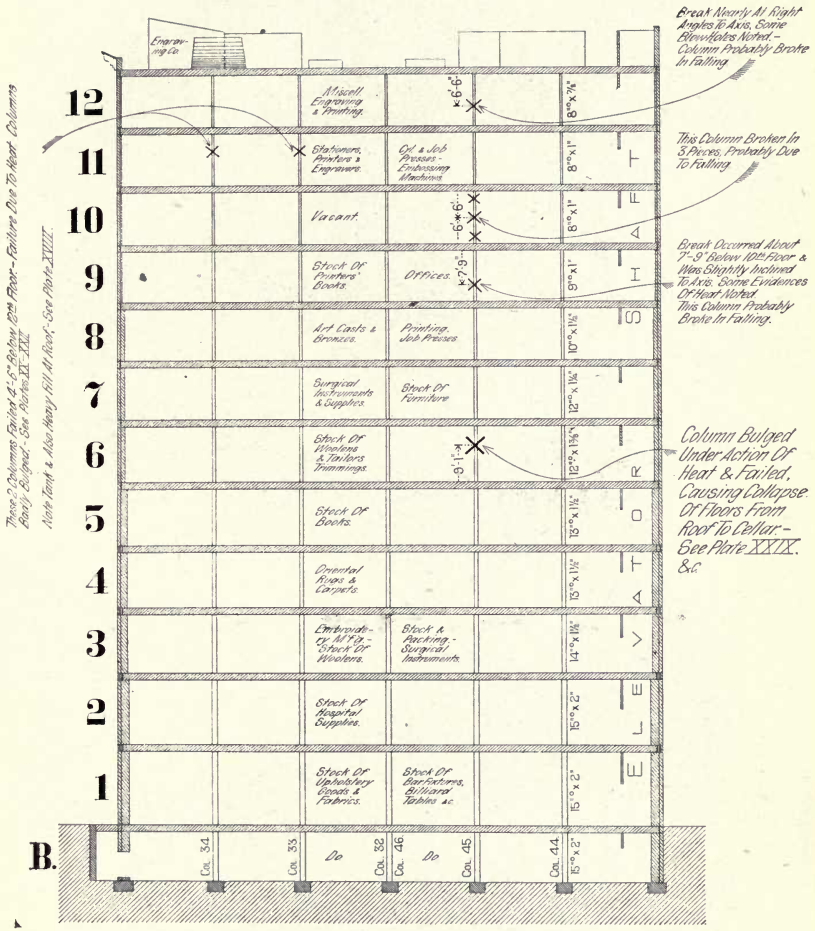
SCALE
0 5' 10' 15' 20'

ROOF PLAN.



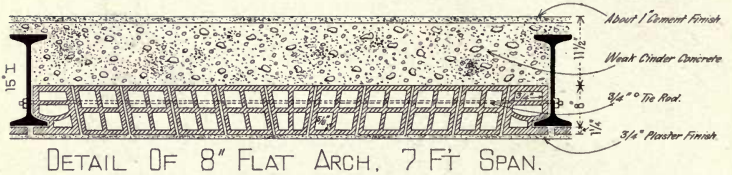
SCALE
0 5' 10' 15' 20

PLAN SHOWING ROOF-HOUSES.



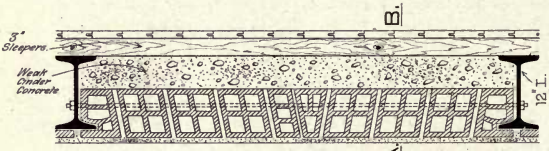
SECTION THROUGH COLUMNS 35-32-46-43.

FIG. 1.



DETAIL OF 8" FLAT ARCH, 7 FT SPAN.

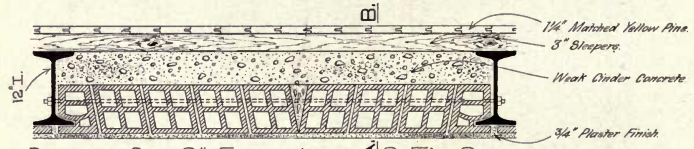
FIG. 2.



NOTE:- Detail Of 8" Flat Arch On 4'-6" Span Similar To Arch Shown For 6'-0" Two Blocks Being Omitted.

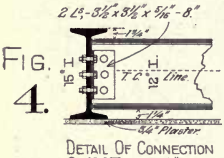
DETAIL OF 8" FLAT ARCH, 6 FT SPAN.
(SHOWING ONE METHOD OF KEYING ARCH.)

FIG. 3.



DETAIL OF 8" FLAT ARCH, 6 FT SPAN.
(SHOWING ANOTHER METHOD OF KEYING ARCH.)

FIG. 4.



DETAIL OF CONNECTION OF 12" I. TO 15" I.

DETAIL SHOWING FIRE PROOFING OF (CAST IRON) COLUMNS.

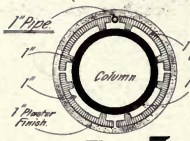
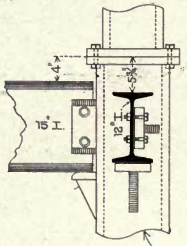


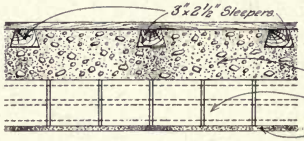
FIG. 5.

FIG. 6.

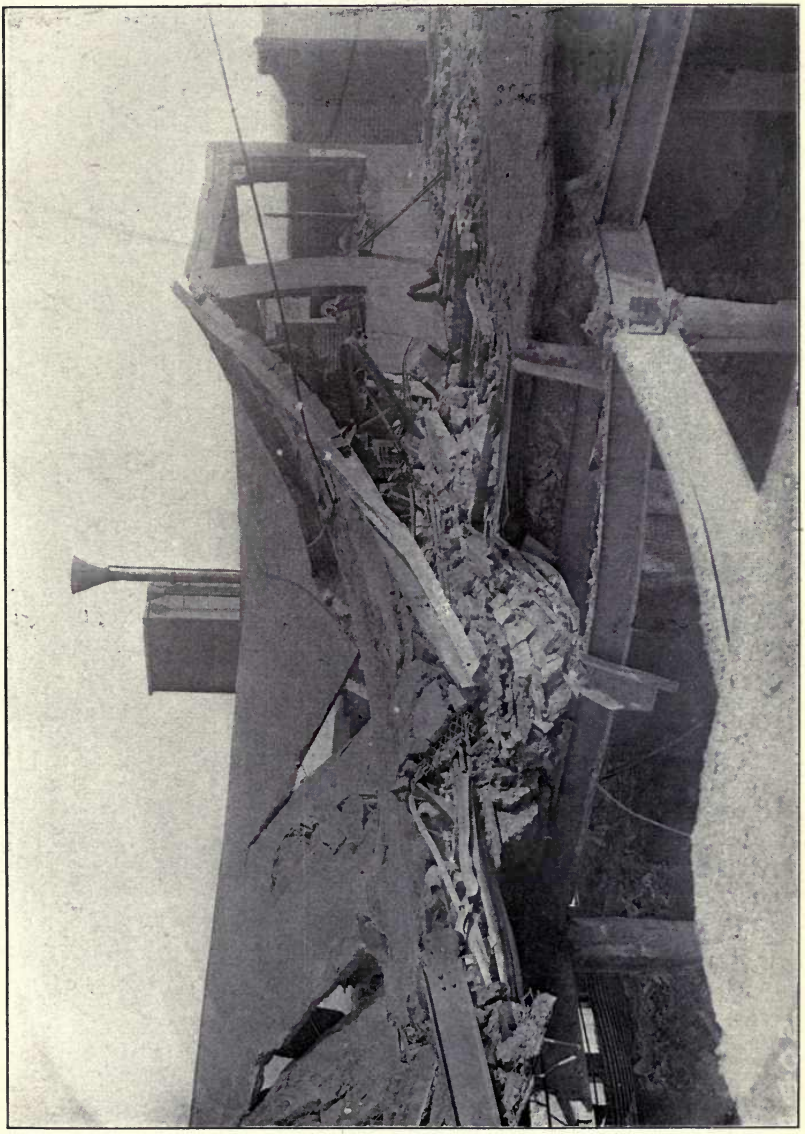


DETAIL SHOWING CONNECTION OF BEAMS & GIRDERS TO (CAST IRON) COLUMN.

FIG. 7.



SECTION ON LINE A.-B. FIGURES 2 & 3

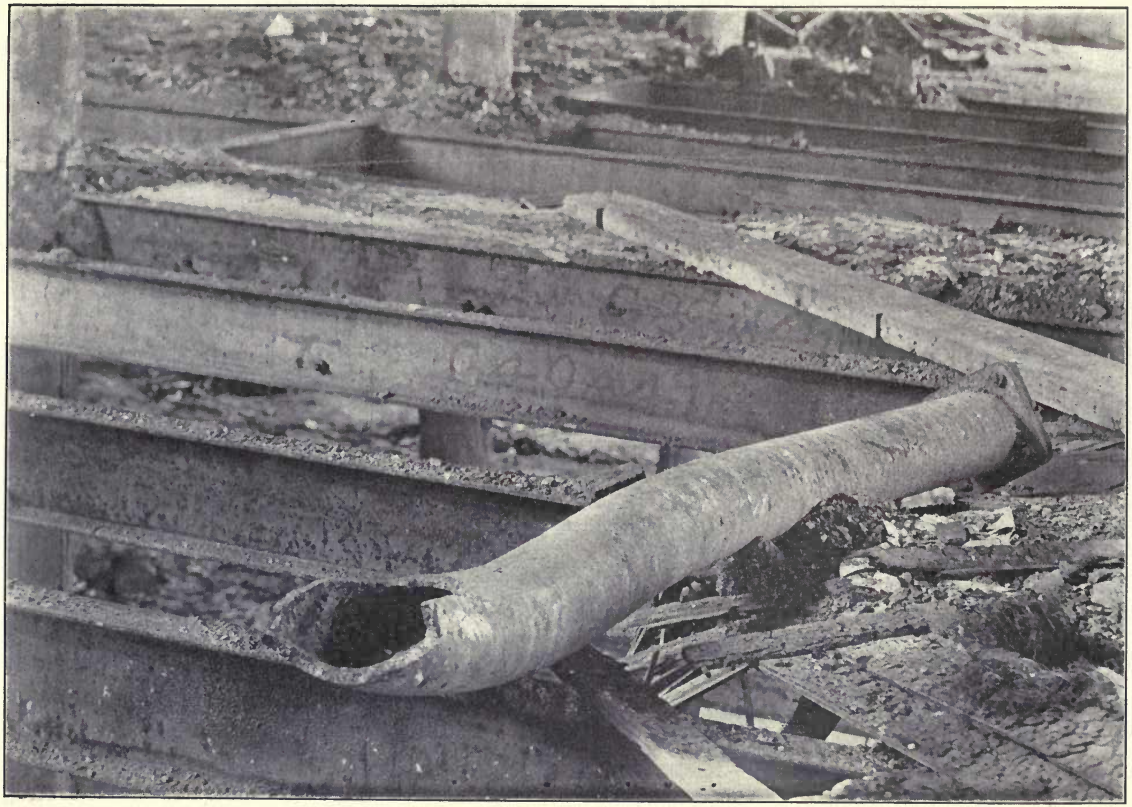


Roof, Looking Northeast, Showing Collapsed Roof-House and Depth of Fill Over Beams.

TWELFTH STORY, Looking North, Showing Collapsed Portion of Roof, Vicinity of Columns 33 and 34, Damaged Cornice, Exposed Wall Columns, etc.

Collapsed Column (33 or 34), Eleventh Story, Showing Fracture and Effect of Heat. View Inverted.

Collapsed Column (34 or 33), Eleventh Story, Showing Fracture and Effect of Heat. View Inverted.



Collapsed Column (33 or 34), Showing Fracture and Deflection Due to Heat.

PLATE XXII.

TENTH STORY, Looking North, Showing Condition on Eleventh Floor on Account of Collapse of Columns 33 and 34. Cylinder Press Hanging in Eleventh Floor Shown in Rear.

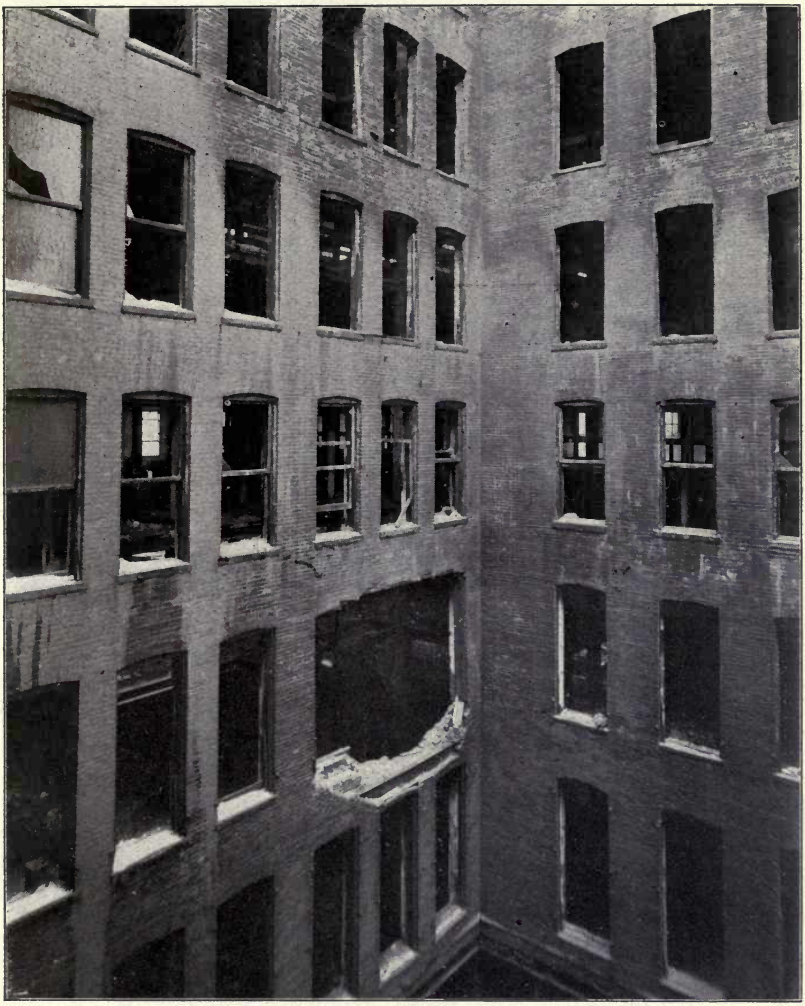
PLATE XXIII.

TENTH STORY, Looking North, Showing Damaged Beams, Collapsed Floor Arches, etc.

NINTH STORY, Looking North, Showing Damaged Soffits of Arches, Collapsed Arches, Deflected Beams, Damaged Column Covering, etc.

NINTH STORY, Column 25 in the Foreground, Deflected about One Inch.

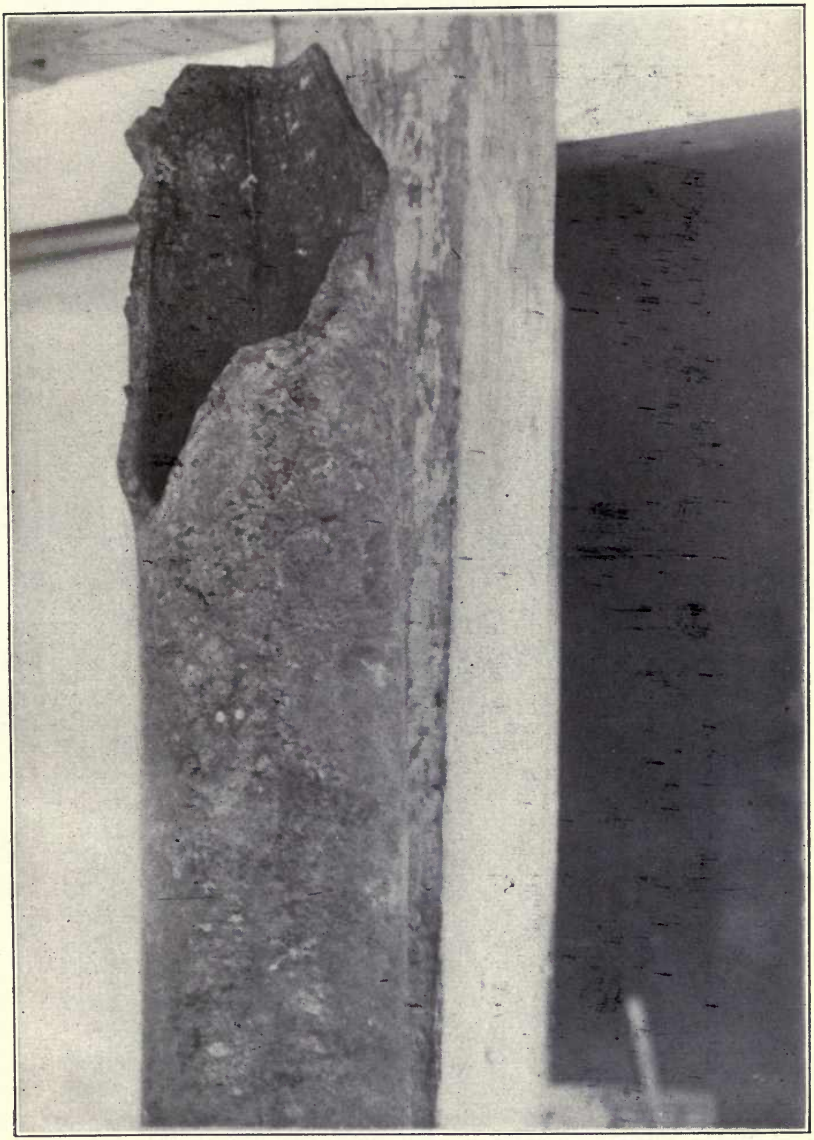
Eighth Story, Looking Northeast, Showing Deflected Beams, Broken Lugs on Columns, etc.



Rear of Building Overlooking One-Story Extension in Southeast Corner, Showing Window Mullions Knocked Out by Falling Material and Unprotected Window Openings in Angle Walls, through which Fire Communicated from Story to Story.

Column 45, Sixth Story, Showing Fracture, etc. The Failure of this Column Caused the Main Collapse.

PLATE XXIX.



Column 45, Sixth Story, Showing Fracture; the Failure of this Column Caused the Main Collapse, the Break Occurring about 4'-0" Below the Seventh Floor Level.

STEARNS & BEALE
20 Murray Street
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