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Dwelling Houses

A Code of Suggestions

FOR

Construction and Fire Protection

RECOMMENDED BY

THE NATIONAL BOARD OF FIRE UNDERWRITERS

NEW YORK

TO SAFEGUARD HOMES AND LIVES
AGAINST THE RAVAGES OF FIRE

SECOND EDITION

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PART V.

MAJOR STRUCTURAL REQUIREMENTS TO PROTECT LIFE AND PREVENT SPREAD OF FIRE.

Section 34. Structural Features Which Every Dwelling Should Possess.

1. There are three fundamental structural features that should be incorporated into every dwelling in order to safeguard properly the lives of the occupants, and to resist destruction of the building by fire. These are:

(a) Proper protection of stairways and other vertical openings.

(b) Introduction of a secondary means of exit from upper stories.

(c) Providing a fire-resistive horizontal cut-off between the cellar or basement and the story above.

2. These three requirements are so inter-related, the accomplishment of one to a certain extent removes the hazard of the others. Whether they are given in the order of their relative importance is difficult to say, and is really immaterial. They will be discussed in the order here given.

Section 35. Danger from Open Stairways.

1. Even in fire-resistive houses of good construction there is always danger of intense fires due to burning contents. Furniture, hangings, bric-a-brac, and floor coverings, are always present sufficient to make a hot blaze if well ignited. The danger is that the smoke, heat and sparks from such a fire in any lower story room may be carried upward through the house by an open stairway, and thus imperil lives and property on the floors above. Once the gases and air surrounding a fire attain the combustion temperature of wood and fabrics, they become very dangerous

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because they will ignite everything inflammable they touch. Under such circumstances a fire will jump from floor to floor through an open stairway with incredible rapidity, even though the latter be quite free of combustible material.

2. It is for this reason that stairs and stair hallways should, wherever practicable, be separated from the balance of the house by incombustible partitions and fire doors.

3. Complete enclosure of stairs and hallways is the ideal method of protection against vertical spread of fire, but it is recognized that such separation of rooms from entrance hallway upon the first floor would be in some cases an objectionable interference with architectural effect and artistic furnishing. As fires are less likely to originate in the reception and living rooms than in other portions of a house, there would doubtless be occasional justification for open connection between such rooms and the entrance hallway, provided they are cut off from the kitchen, dining-room and other more hazardous parts of the house by incombustible partitions. It is very essential that all other portions of the house be separated from the main hallway by substantial fire-resistive partitions and doors.

4. Dwelling house fires most dangerous to life are those which occur in the cellar, basement, or first story. The smoke and heat ascend through all possible channels and always concentrate in the stairway if it is accessible. When such a fire happens at night and the occupants are asleep, the danger of the stairway being clogged with smoke or filled with flames before discovery is very great. When this occurs, if other means of exit from the upper floors is not provided, the only possible escape is by jumping from the windows. Many lives are lost in dwelling house fires annually from this cause and too much stress cannot be laid upon the extremity of the hazard and the necessity for removing it.

NOTE.—Experience has shown that people compelled to jump from a third or higher story of a building are almost invariably killed or dangerously injured. Death has frequently resulted from a jump from even a second story window, and serious injury, such as broken limbs are very likely to be received. Stone pavements and frozen ground are especially perilous.

5. This logically leads to a consideration of the second fundamental structural safety requirement, which will be discussed before methods of construction to overcome these defects are described.

Section 36. Necessity for Secondary Exits.

1. It must be recognized that the protection herein indicated for main stairways could not be efficient under all circumstances

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and at all times. There would always be the possibility of fire within the stair hallway itself or in rooms not isolated from it, also in rooms supposed to be properly separated from the stairway but temporarily connected with it through a doorway accidentally left open. *For these reasons it is absolutely necessary that at least one additional means of safe exit be provided from the upper stories of every dwelling. In very large houses more than one may be necessary.*

2. The character of such exits is immaterial provided they will afford safe egress in an emergency. For most dwellings, the logical and natural solution of the problem is the introduction of an additional stairway. Such stairway is a great convenience in every house, and is especially desirable where servants are employed. Many houses have such back stairways, but when arranged as they frequently are, to connect on an upper landing with the entrance stairway and therefore are contained in the same hallway space, they have no value as emergency exits. A fire that rendered the entrance stairway useless would involve the rear stairway at the same time, and vice versa. Furthermore, rear stairways as ordinarily constructed and connected with the kitchen or other rear rooms where fire is liable to occur, constitute a distinct menace in that they afford a direct passageway for smoke and fire to all upper floors and the front stairway.

3. The remedy for these defects is to place the rear stairway in a separate fire-resistive enclosure, with doorway connection to the front stairway or hallway in each story above the first, and connect as many of the upper story rooms as possible with the rear stairway so that entrance to it could be gained without passing through the front stair hallway. This is the simplest and most desirable method of securing safe emergency exit, as it furnishes egress for the occupants of the upper story rooms by either stairway. It is important that such secondary stairway be provided with a door at the bottom.

Under some circumstances it would be acceptable to place the secondary stairway outside the building, but there are objections. If the stairway is of wood it adds to the outside exposure hazard; if of incombustible construction it is more or less expensive, and in either case it would not be ornamental. Such stairways should be enclosed, otherwise they might be dangerous to use in winter weather. Steel fire escapes consisting of balconies connected by steps may in some cases be permissible on existing buildings, but they are treacherous in bad weather and at no time suitable for the use of young children or infirm persons. They are also liable to be rendered useless by fire issuing from the window of a lower story. Outside stairways or fire escapes are also objectionable as offering possible entrance to un-

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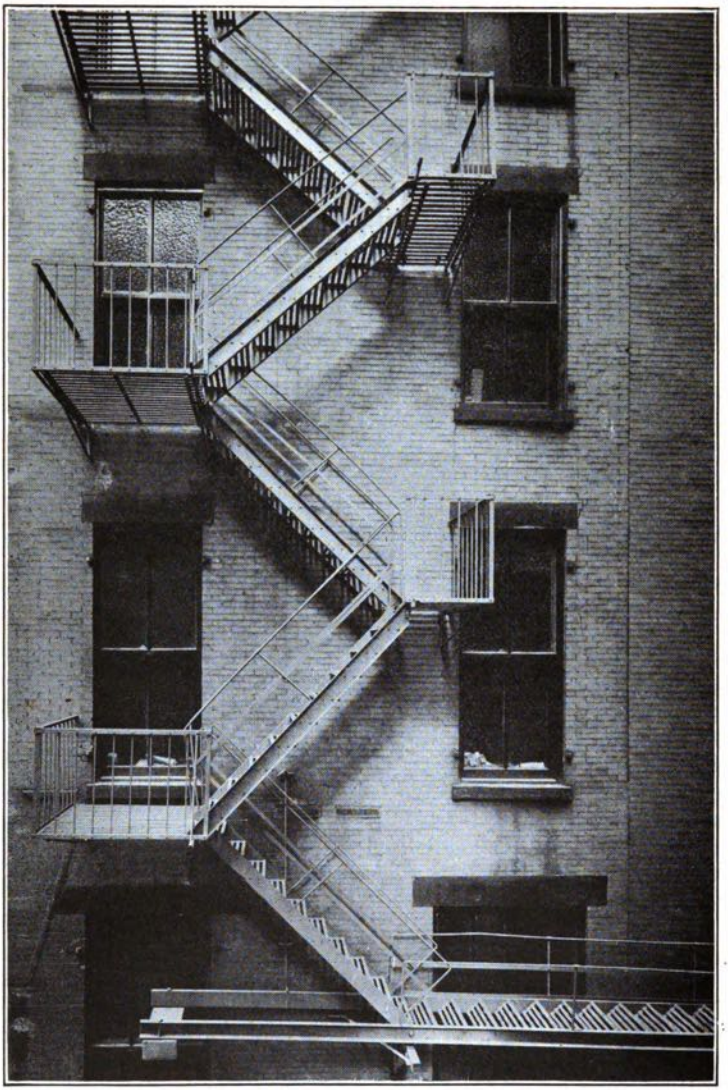

PLATE III.

A simple type of outside fireproof exit stairway or fire escape entirely supported by brackets, and suitable for either a new or an existing building. The balanced flight of stairs at the bottom could be replaced by a fixed flight if desired. An enclosed stairway would be better. The windows are wired glass in metal frames.

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desirable callers. However, with all their faults outside stairways or fire escapes are a thousand times better than having no secondary means of egress. See Plate III.

4. Every dwelling over one story high, either new or old, and irrespective of size, should be provided with some second means of exit from the upper stories. It is particularly important where attic rooms are occupied. This is a matter for serious consideration. Think it over and adopt some plan to accomplish it.

5. In connection with the subject of safe egress from a dwelling it is proper to call attention to the "horizontal exit" as a means of escape from fire. This is described in Section 25, par. 5, in connection with fire walls. Another form of such exit may be used where dwellings are built in a row. Windows of upper stories of adjoining houses can be connected by a balcony which affords an excellent emergency exit around the party wall, but the obvious objections to such connection between houses occupied by different families would in most cases prevent its use.

Section 37. Structural Requirements for Protecting Stairways and Shafts.

1. Enclosure partitions for stairways in dwellings of Types I and II, as defined in Part I, should be entirely of fireproof construction.

Materials suitable for such construction would be brick, hollow tile, solid concrete, or concrete tile, gypsum blocks, cinder plaster blocks, solid metal lath and plaster, or hollow metal lath and plaster on steel studding, or any incombustible material or combination of incombustible materials forming a rigid partition and having fire-resistive qualities equivalent to those named. The thickness of such partitions should be not less than 3 inches. While in some cases a slightly less thickness might suffice, we consider that the additional stability and fire-resistance secured by the thicker material well warrant the small additional expense. All doors in such partitions should be of metal or metal covered, and in set frames of like material. It is highly desirable that such doors should be made self-closing, to insure their being always shut. In any case doors connecting the two stairways, or doors at the bottom of stairways, should always be shut at night.

It is also recommended that fire doors be used to protect entrances to the art gallery or valuable library which frequently is found in high class residences.

NOTE.—The Underwriters' Laboratories have tested and approved a wide variety of fire doors, many of which are as artistic in appearance as wooden doors. Lists of such doors can be obtained upon application.

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2. In buildings of Types III and IV the stairway enclosure partitions should preferably be the same as for Types I and II, except that in some cases the weight of such construction might be objectionable. For this reason, and the fact that the wooden construction of these two types would offer less resistance to a fire, the thickness of the stair enclosure partitions in unpretentious dwellings might be reduced to 2 inches, though 3 inches is better and is advisable in elaborate dwellings. When such reduced thickness is used in tile or block construction, care must be exercised to insure perfect mortar joints; the corners should be held by metal clips or anchors, and the whole construction properly secured to floor and ceiling. It would also be permissible in such buildings to construct the partitions of wooden studding with metal lath and plaster, or its equivalent on each side. Under no circumstances should wooden lath be used. Such partitions carefully built will resist a hot fire for a considerable time, and the additional expense of the construction would be small. When hollow partitions are used, they should be fire-stopped at each floor level as prescribed in Part VIII, and the whole surface of the wall on each side from floor to ceiling should be plastered before the base-board or other trim is applied. Incombustible lath is recommended in all parts of wooden constructed buildings when the extra expense can be afforded.

3. In moderate priced dwellings of Types III and IV, where the additional expense of approved fire doors in the stair enclosure partitions would prevent their use, substantial wooden doors without sunken panels may be substituted. A panel effect on such doors is obtained by application of surface mouldings. The doors should be selected for the purpose, be extra heavy and especially well made. Such wooden doors will of course burn, and therefore are not the equivalent of fire doors, but they would prevent the passage of flame and smoke for a short time, and therefore protect life and property for a limited period. The same precautions regarding closing the doors should be observed as specified in paragraph 1. Such doors if open at time of a fire would add fuel to the blaze instead of retarding it.

4. So far as possible windows or fan lights in stair enclosure partitions should be excluded. If glass is really necessary it should be wired in fixed metal frames and sash, or ¼-inch plate glass will serve.

NOTE.—Fixed frames and sash are necessary to prevent possibility of the window being open at time of a fire and so nullify its value.

Ordinary glass either thick or thin, breaks and falls from the sash very quickly when attacked by fire. It is self-evident that if openings were thus formed in such a partition its value would immediately be lost. Wired glass or plate glass in metal frames will stay in place until the glass melts, and it requires a severe fire to do that.

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Wired glass will also stay in place even though water be thrown upon it while hot, but will not withstand the full force of a fire engine stream. Plate glass is likely to fall out if sprayed by water when hot. Neither glass will prevent heat being radiated through it, hence there is always danger that combustible material, even though some distance away from the opposite side of the glass may be ignited from this cause.

5. Stairways leading to cellar or basement should be completely enclosed in such story the same as in the upper stories, and should be protected by a fire door at the bottom. This is very important, for there is always great danger of a fire starting in the lower story and passing to the upper stories by this channel. Cellar fires are always difficult to subdue because of their inaccessibility, therefore every precaution should be taken to confine them there. Avoid glass in a partition enclosing the stairway, or in the fire door. If a window is necessary for light, put it in the outside wall if the stairway follows the wall, otherwise use wired glass in fixed metal frame.

If a stairway leading directly from the cellar into the house can be avoided it is safer. This is often accomplished by making a side enclosure or entry surrounding the kitchen door, utilizing one end for the refrigerator and the other for a stairway leading to the cellar. It is a convenient arrangement and permits entrance to the cellar without going out of doors.

6. Passenger elevators, if placed in dwellings, should be enclosed with the same construction as required for stairway enclosures, including the doors. Dumbwaiter shafts should also be similarly enclosed and have self-closing fire doors at all openings. In buildings not exceeding three stories in height the thickness of the enclosing material may with propriety be reduced to 2 inches. The same precaution should be taken regarding joints and corners as specified in paragraph 2. Shafts which extend into a cellar or basement should be enclosed in that story with walls not less than 3 inches thick, and have substantial self-closing fire doors. This is a seat of danger, and great care should be exercised to prevent a fire being distributed upward through the house by the shaft serving as a flue. For this reason masonry walls are usually specified in building codes for enclosing shafts in such locations, and are to be recommended.

7. Care must be taken to protect in like manner any other shafts or chutes connecting different floors, such as linen chutes, elevator fuel supply boxes, and similar devices. They should be avoided so far as possible, for unless very carefully protected by fire-resistive material, they are sure to act as flues for the quick distribution of a fire.

NOTE.—Such devices can be made safe, but it is somewhat expensive to do so; as a matter of fact they very seldom are safe. It is better to omit them.

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Section 38. Horizontal Cut-Off for Cellars.

1. As the heating equipment of most dwellings is located in the cellar or basement, where subject only to occasional supervision; and as that space is also usually a storeroom for fuel and all sorts of combustible material, the chances of a fire are evident. There is also the additional hazard of defective lighting appliances in such location, either from improperly protected fixtures or in the use of lamps, candles or matches. Be the cause what it may, whether an overheated furnace which being "out of sight is out of mind"; or carelessness in handling lights or matches; or possibly spontaneous combustion in rubbish; the fact remains that records show an excessive number of cellar fires. As such fires frequently attain considerable headway before discovery, they are liable to involve the whole house by working upward through all open connections, and the many small hidden channels due to ignorant design or defective workmanship, whose existence are unknown to the occupants. The remedy is to confine such fires at the place of origin by a cut-off between the cellar and the story above by making the separating floor as fire-resistive as possible consistent with the type of construction, and to properly protect all openings through same as herein provided.

2. The best possible cut-off is a fireproof floor. Such floors are a requisite for dwellings of Types I and II. They are equally applicable to dwellings of Type III, and to the highest grade buildings of Type IV, such as are often seen in city suburbs and on country estates. They should be used wherever possible, for they constitute a distinct safeguard. Such floors may be constructed of steel I beams with stone or cinder concrete, hollow tile, or other approved fireproofing between them with suitable protection for the bottom of the beams; or steel beams may be omitted, and the floor be constructed entirely of reinforced concrete: or a composite construction of reinforced concrete beams filled between with hollow tile, or metal or plaster forms with a concrete covering may be employed.

3. In buildings where steel beams are not otherwise used, it is probable that some variety of concrete floor construction would be the simplest and most economical. The forms could be easily supported, no hoisting of concrete would be necessary, and as the floor would be laid before the rest of the builidng was erected, all the form lumber could be used again for other purposes. In order to reduce the span and thickness of the floor slab, and thereby lessen the expense, the floor could be divided into panels by having beam supports at one or more intervals. A steel beam would be best suited to the purpose, but even a heavy wooden girder resting on brick piers, pipe-concrete columns, or substantial wooden posts, might be permissible if necessary.

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4. Reliable building constructors state that such concrete floors can be built in most localities at practically the same price as first class wooden construction. Owing to the fact that the fireprcof floor is also waterproof, vermin proof, and thoroughly rigid, it would justify increased cost. If desired, a wooden finish flooring may be laid over the concrete. See Section 29, par. 2. The supporting beams under the floor, whether steel or wood, must be protected; the former by 2 inches of fireproofing, and the latter by at least ½ inch of metal lath and plaster, plaster board, or ¼ inch asbestos mill board.

NOTE 1.—An unprotected steel beam when attacked by fire is not as reliable as a wooden beam. The reason is that steel loses its strength very rapidly when heated in excess of 500 to 600 degrees F., and such temperatures are easily attained in an ordinary fire. On the other hand a wooden beam of large cross section would burn fiercely over its whole surface, but the actual rate of penetration would be slow, consequently considerable time would be required for the beam to burn sufficiently to produce collapse even in a hot fire. This fact indicates the necessity for protecting steel beams, but does not warrant the substitution of wooden beams for steel. Other considerations may at times justify the use of timber construction instead of steel work, but unless protected by sprinklers, or covered with some non-flammable material it adds to the fire hazard in the room in which it is exposed. If necessary to use a heavy wooden beam in a cellar as above suggested, it is recommended that if not protected by sprinklers, it be covered with metal lath and plaster, or with asbestos or plaster board. For sprinkler suggestions see Section 74.

NOTE 2.—For the reason herein explained, it is necessary that all metal structural members used in dwelling house construction should be fully encased in fireproof material the same as would be required in other buildings.

5. In dwellings of Type III, where it may be impossible to secure the high degree of protection afforded by a fireproof floor for a cellar cut-off—also in frame dwellings of a grade which would not warrant the expense of such a floor—it is still very essential that efficient temporary protection be provided, and that every precaution be taken to prevent a cellar fire spreading to floors above, at least long enough to afford reasonable time to subdue it. This can be accomplished by protecting all communicating openings as elsewhere provided, and by covering the ceiling with fire-resistive material.

6. A high grade fire-resistive ceiling construction is one with about 2 inches of mineral wool, gypsum block, magnesia block, or other non-combustible fibrous material securely attached to the joists for sound deadening or heat insulating purposes before the application of metal lath and plaster. There are firms which specialize in such construction.

In pretentious dwellings, where large boilers are necessary in the heating plant, substantial hanging ceilings are sometimes employed to insulate the floor above and prevent its becoming unpleasantly warm. An efficient type of such ceiling is a light

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steel framework supporting magnesia blocks about 1½ inches thick and covered with a layer of metal lath and plaster. Such construction under a wooden floor is a superior fire-barrier, provided no openings communicate with the air space between the hanging ceiling and the floor joists. If such space were not thoroughly cut off, a fire would get in and burn behind the ceiling, and the construction would be a distinct disadvantage. No woodwork should be allowed in the construction of the hanging ceiling.

NOTE.—A floor deadened with incombustible material placed between the rough and finished flooring as is frequently done, is of little value as a fire-stop. Even though the deadening material is 2 inches thick as sometimes specified, it would leave the joists and under flooring free to burn, and would offer no opposition to the fire until the under flooring were burned through.

7. An excellent ceiling protection is obtained by first applying double layers of ¼ inch fibrous asbestos mill board securely nailed to the joists, and laid with broken joints; then cover this with metal lath and a coat of asbestos plaster which will give a smooth, attractive surface. Instead of metal lath and plaster, a covering of sheet metal over the mill board would give good fire-resistance, except that any wooden furring strips would be objectionable. If the lath and plaster or metal covering be omitted, the ceiling protection will still be quite satisfactory, though not so strong nor so pleasing in appearance. In this case all joints should be filled with asbestos cement.

NOTE.—Use large nails (not less than 2 inches long) to attach the mill board to the joists. The reason for this is explained in paragraph 8. Screws would be far superior to nails for the outside layer, though their use would increase the labor somewhat. The screws should be 1½ inches long and spaced on about 8 inch centers.

8. The minimum ceiling protection is a galvanized metal lath not less than No. 24 gauge, covered with ¾ inch asbestos or cement plaster; or the joists may be covered with strong plaster board not less than ½ inch thick (fibre plaster board preferred), and coated with ¼ inch of gypsum plaster; or the plaster board may be covered with sheet metal. If sheet metal covering be used, the joints between the sheets of plaster board must be first filled with plaster to form a smooth surface with no wood exposed. If the joist spacing is such that the sheet metal can be laid parallel to direction of joists and lap upon them, it is advisable to do so. For convenience in nailing, the location of joists should be marked on the plaster board as it is laid. Heavy nails, not less than 2 inches long, should be used to attach the metal, with a spacing not exceeding 4 inches. When it is neces-

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sary to place furring strips on the plaster board to support the sheet metal, it would be useless to use nails longer than would penetrate the strips, but care should be taken to use heavy nails wherever possible to hit a joist. Warping of the metal when attacked by fire, and charring of the wood around the red hot nails, will cause small nails to pull out and allow the metal to fall. For the same reasons metal lath should be attached with long heavy staples or nails. Metal ceilings are not advised in cellars or basements, which are liable to be damp when the heating equipment is out of commission. Corrosion may make them worthless in time.

NOTE.—A metal ceiling without plaster board or other non-conducting backing is not suitable for any place where considerable fire-resistance is desired. The sheet metal alone, when attacked by fire quickly becomes red hot and will ignite woodwork to which it is attached. It is for this reason that combustible furring strips should be omitted wherever possible between plaster board or other backing and the metal covering.

Section 39. Window Protection.

1. When two portions of a dwelling are placed at right angles to each other, the windows in the angle should be kept as far apart as possible to avoid a fire jumping through them from one wing to the other.

2. Where it is necessary to have such angle windows near each other, or where windows face nearby combustible buildings, it is desirable that they have metal frames and sash and be glazed with fire-resisting glass, or the windows should be protected by fire-shutters.

NOTE.—Such construction might not be practical for cheap dwellings, but the extra cost would be quite justified in expensive dwellings.

3. In dwellings of Types I and II it is recommended that all exterior window openings be protected by metal frames and sash, of which the upper half shall be glazed with wired glass.

NOTE 1.—Such glass can be had in polished plate if desired. Wired glass in the lower sash is sometimes objected to on the ground that the wire interferes with vision, but experience does not appear to sustain the criticism.

NOTE 2.—There is always a tendency for a fire in a building to travel upward from story to story by way of the windows. By making the frame and sash incombustible, and providing wired glass in the upper half, flames in a room, even though they caused collapse of the lower half window, would mushroom against the ceiling and could only get exit by passing downward through the lower sash. This would separate them from the windows above and add materially to the protection.

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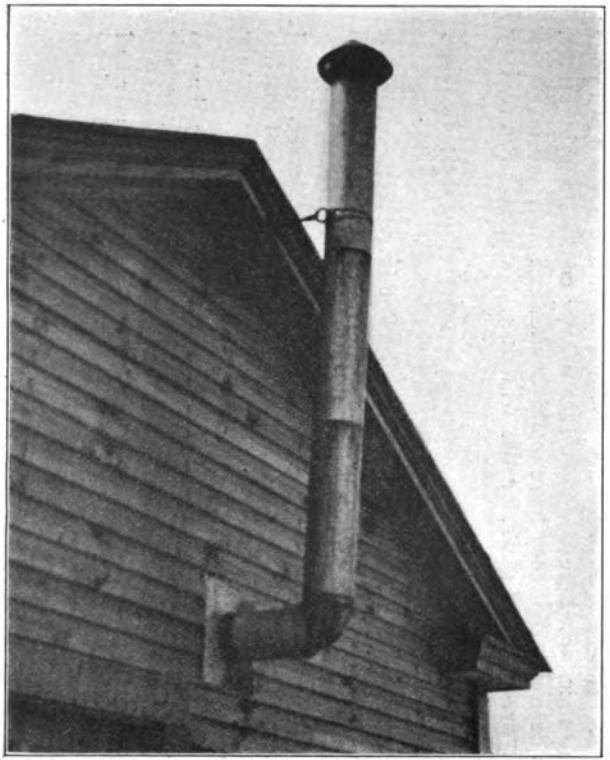

Two forms of cheap chimney construction frequently seen. When in use, each flue in a constant fire menance. Burning of the house in Fig. 2 would seriously endanger its numerous nearby neighbors, and possibly start a conflagration. These examples were found in well-known Eastern cities. There should be a severe penalty for such carelessness.

Unpardonable Substitutes for Chimneys.

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