Jan. 26, 1960 A. F. DEAM 2,922,299

BUILDING

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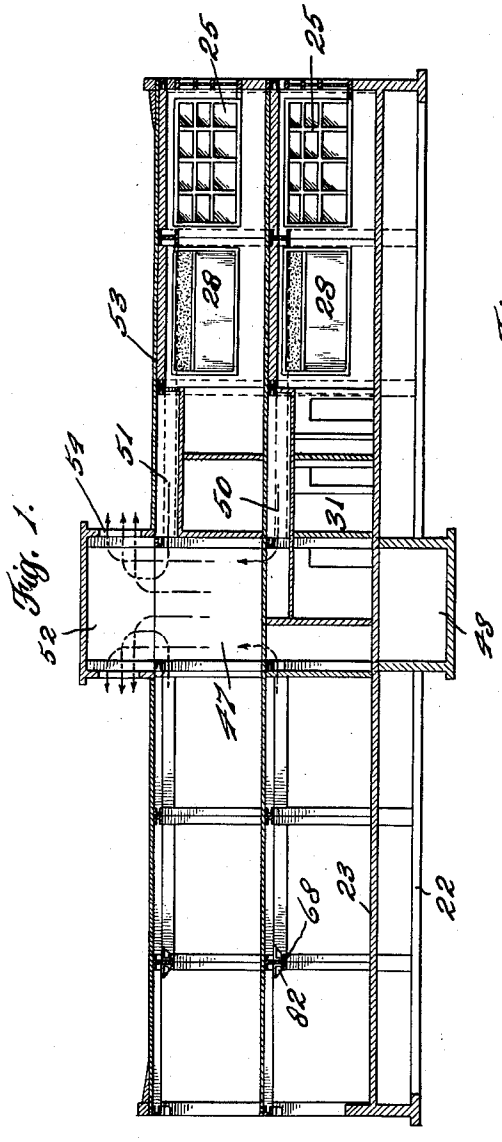

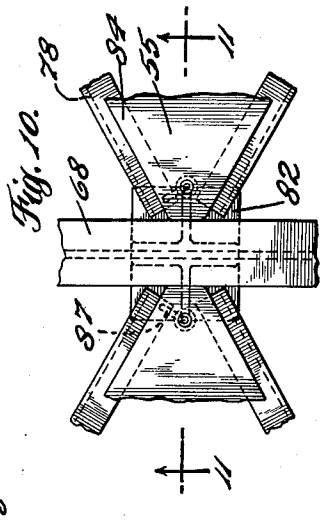

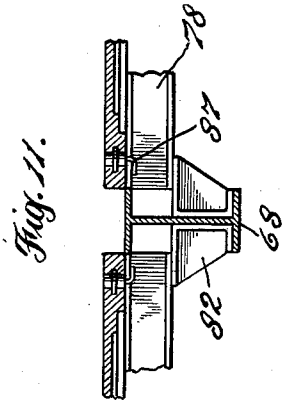

INVENTOR.
Arthur F. Deam

ATTORNEYS

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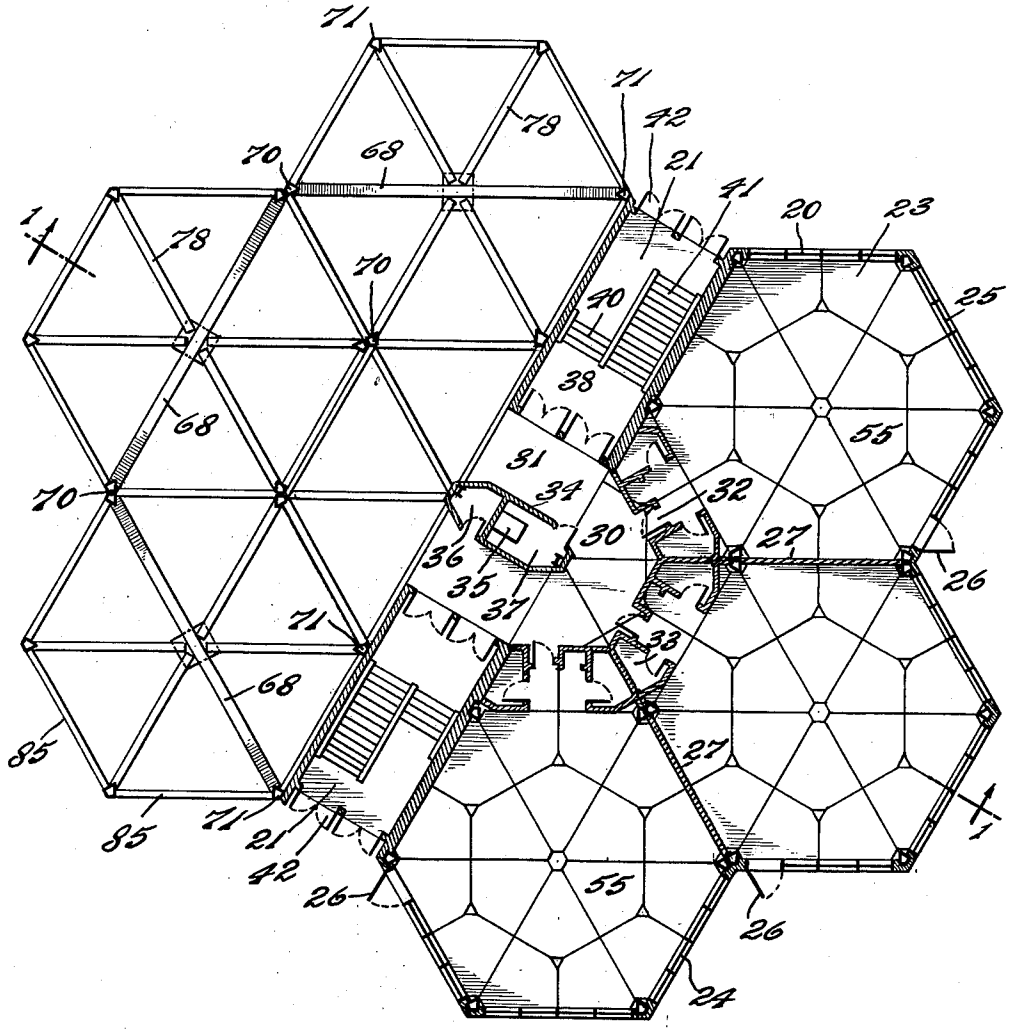
Fig. 2.



INVENTOR
Arthur F. Deam

ATTORNEYS

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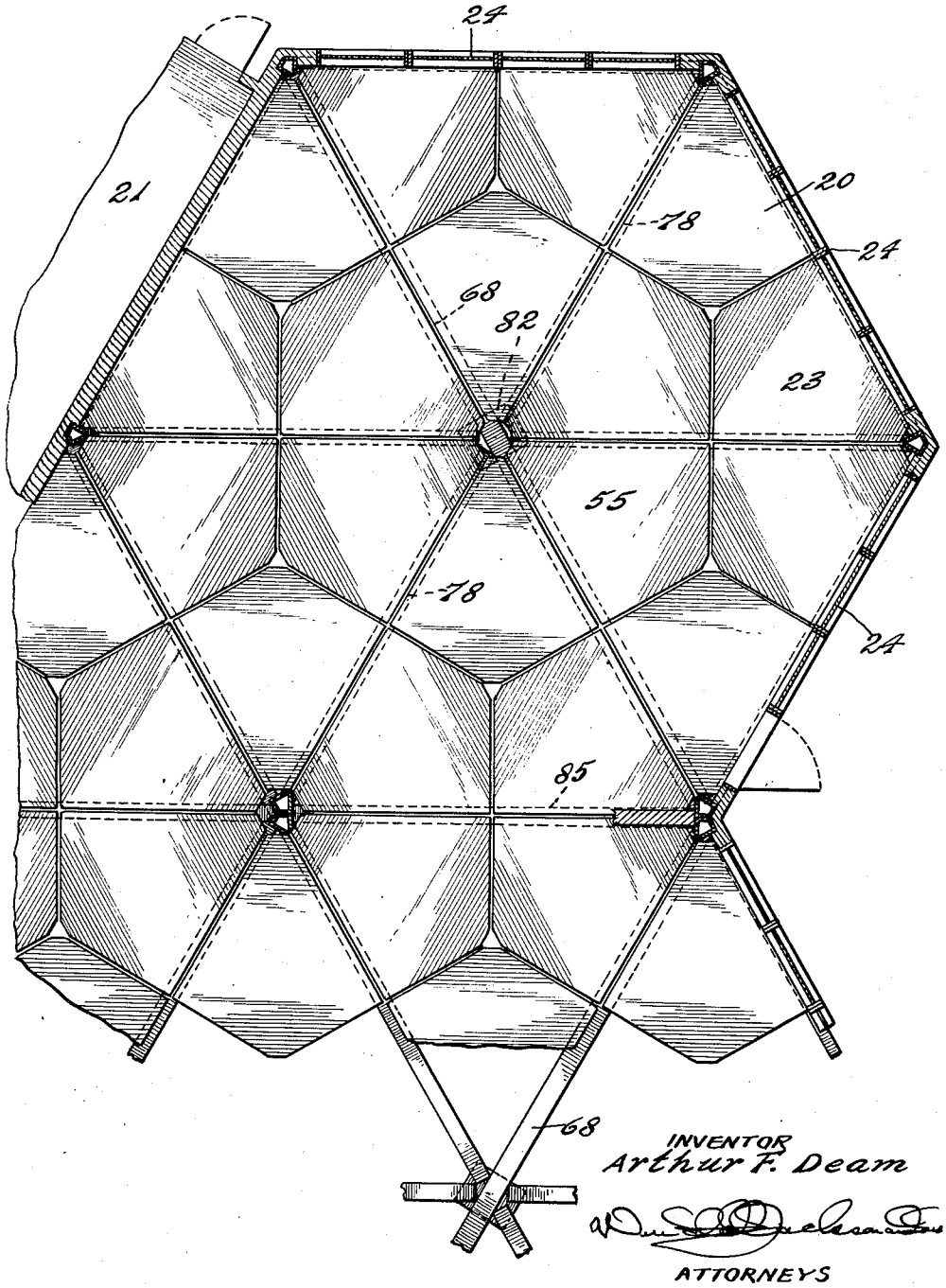
Fig. 3.



INVENTOR
Arthur F. Deam

ATTORNEYS

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Fig. 4.

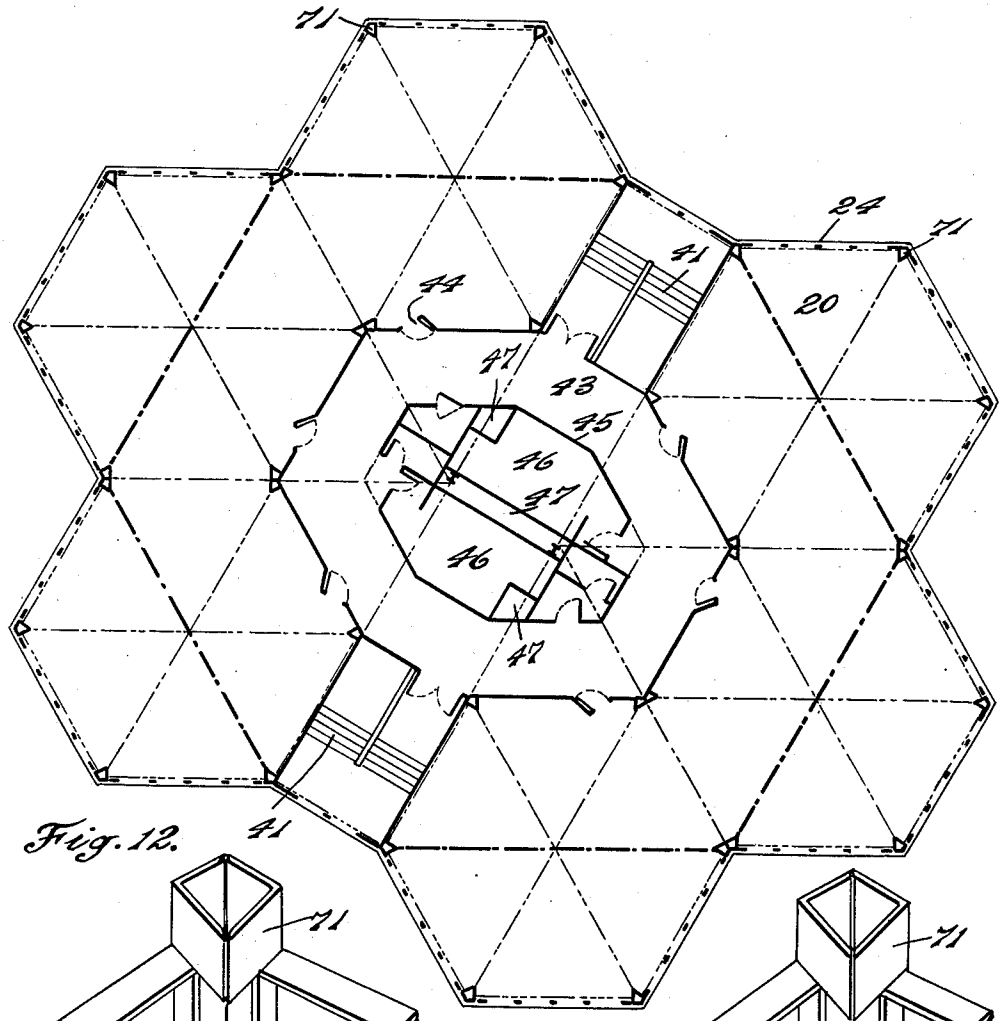


Fig. 12.

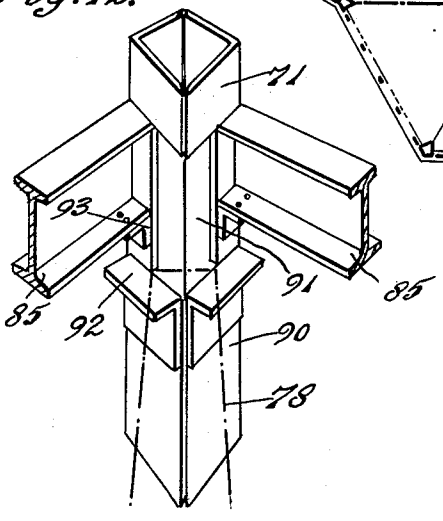
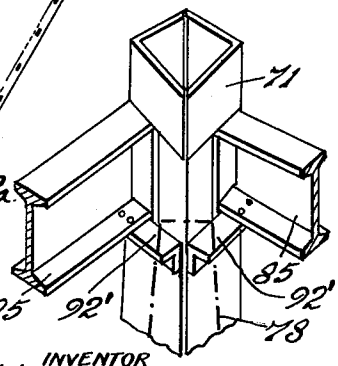


Fig. 12a.



INVENTOR
Arthur F. Deam

ATTORNEYS

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Fig. 5.

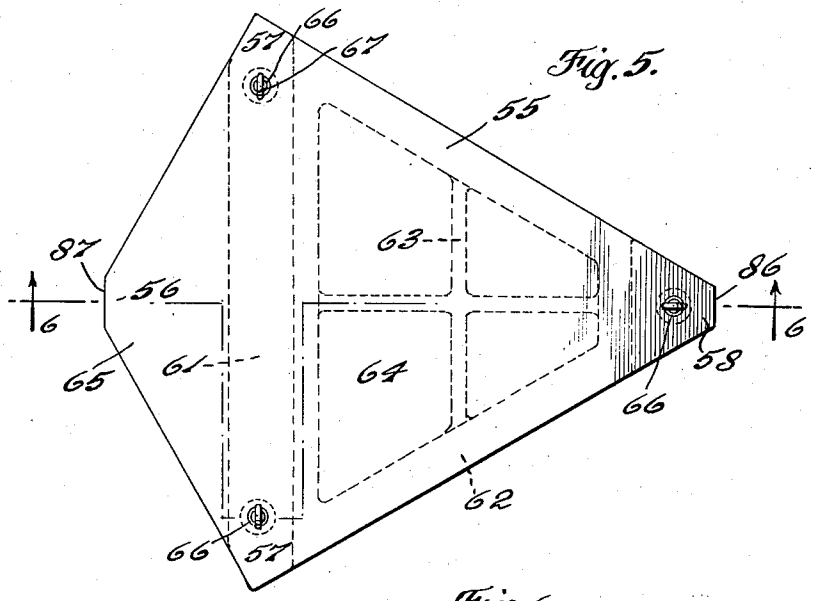


Fig. 6.

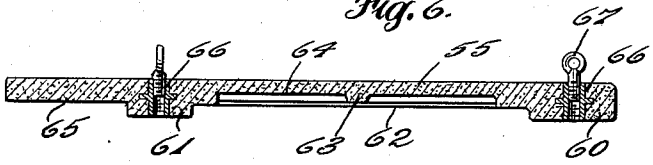


Fig. 7.

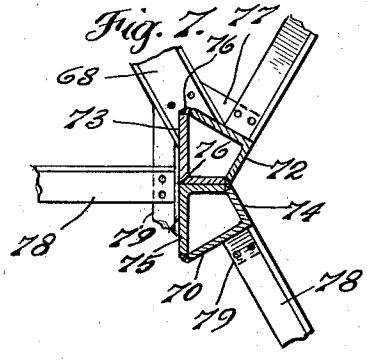


Fig. 8.

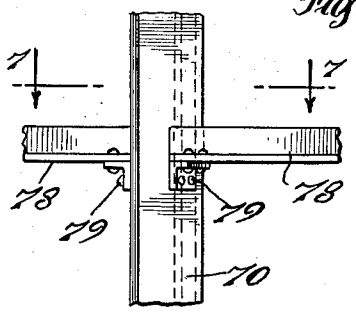
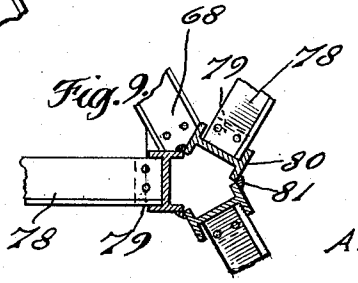


Fig. 9.



INVENTOR
Arthur F. Deam

ATTORNEYS

United States Patent Office 2,922,299 Patented Jan. 26, 1960

2,922,299

BUILDING

Arthur F. Deam, Philadelphia, Pa.

Application October 8, 1953, Serial No. 384,916

3 Claims. (Cl. 72—1)

The present invention relates to elementary schools, and suitably to other buildings in which the principles are applicable, such as other public buildings.

A purpose of the invention is to standardize and mass produce a building so as to reduce cost, obtain a superior structure at a permissible cost, and secure uniformity of good construction.

A further purpose is to provide a building which will be substantial but which can readily be disassembled and reassembled at another location with maximum reuse of building elements.

A further purpose is to secure a diversity of possible exterior appearances and treatments in a building of standardized construction.

A further purpose is to make most effective use of a land plot while providing a maximum of outside exposure in various rooms.

A further purpose is to avoid the waste of interior space in long halls by providing a short common hallway for a nest of rooms.

A further purpose is to employ irregular tetragonal slab units, desirably of the 120, 60, 90, 90° variety, which will form substantially the complete floor or roof slab of each hexagonal building unit.

A further purpose is to mount the irregular tetragonal building units on a girder which extends from one outside corner to the opposite outside corner of each polygon (hexagon), and radial beams extending to the center of each polygon (hexagon).

A further purpose is to expose at least three sides of each polygonal building unit to the outside of the building and have one side common between units.

A further purpose is to group utility rooms around the hall, either immediately on the outside or immediately on the inside.

A further purpose is to centralize mechanical engineering equipment for efficiency, simplicity and economy with minimum lengths of ventilating ducts and pipes.

A further purpose is to employ special columns at outside corners of two hexagon units, the columns preferably being formed by two sets of facing angles secured together or by three I-sections secured with the interior flanges connected together.

A further purpose is to build a building in units each of which preferably consists of three and one-half hexagons.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a sectional elevation of a building construction in accordance with the invention, the section being taken substantially on the line 1—1 of Figure 2.

Figure 2 is a first floor plan of the building of Figure 1, the half at the right of the hallway showing the floor plates and room arrangement and the half at the left of the hallway showing the column, girder and beam arrangement.

Figure 3 is an enlarged plan section of one full room and portions of an adjoining room and hallway of Figure 2 with the partitions omitted.

Figure 4 is a diagrammatic second floor plan of the building of Figure 1.

Figure 5 is a plan view of one of the floor slabs in accordance with the invention.

Figure 6 is a section of Figure 5 on the line 5—5.

Figure 7 is a plan section on the line 7—7 of Figure 8 showning a column, girder and beams at one of the outside meeting corners of the hexagon units, built up of angles.

Figure 8 is a fragmentary elevation of the column, girder and beams at an outside meeting corner of two hexagon units.

Figure 9 is a modified construction of a column shown in plan section similar to Figure 7.

Figure 10 is an enlarged fragmentary plan illustrating the manner of supporting the beams and floor slab units from the girder at the center of a room.

Figure 11 is a section on the line 11—11 of Figure 10.

Figure 12 is a fragmentary perspective showing a method of seating a girder in a column, together with alternate use of I-beams.

Figure 12*a* is a view similar to Figure 12 showing beams of equal web height seating in a column.

Describing an illustration but not in limitation, and referring to the drawings:

An extensive demand exists at the present time for elementary schools and to some extent for other public or semi-public buildings such as libraries, community houses, industrial plants, offices, laboratories, and the like. In building elementary schools and other such buildings by traditional methods, in which substantially all fabrication is done at the site, a very high cost results, and it is difficult to obtain uniformly good construction.

The present invention is designed to make available the advantages of prefabrication and mass production, while at the same time avoiding sameness in exterior appearance, and permitting great adaptability to the purpose intended.

In accordance with the invention, polygonal units preferably hexagons, are nested together with one common side at least on each adjoining pair of units, and with at least three sides exposed to the outside of the building. The hexagonal units are preferably arranged in two groups of three and one-half, separated by stairways, and of course by the appropriate fire walls.

The interior space is not wasted in long hallways, but access to all of the hexagonal units is provided by a common short hallway. The space either inside or outside the common hallway is desirably used for utility rooms. The interior space is also desirably used as a pipe duct and ventilation channel.

The floor and roof of the building are desirably constructed from irregular tetragonal slab units, of concrete or other suitable material, which are identical and can at any time be disassembled and reassembled to construct a similar building. The irregular tetragonal units are all alike throughout the building in each one of the hexagonal units, and the tetragonal units can be arranged in any one of the positions to make up the floor or roof. Each tetragonal unit is desirably a 120, 60, 90, 90° figure. Each one of the tetragonal units has lifting lugs which are desirably used also as tie-down connections. The lugs can be omitted where suction grip-

pers, hooks or other means of lifting are used, and tie down is not required.

Girders run from one meeting corner to the next meeting corner of the hexagonal units around the building and beams extend radially inwardly and are connected at the center of the girders. The tetragonal floor slab units rest at the two sides on the beams.

It is desirable in many cases to employ special corner columns, which may be formed of opposed angles or sets of angles, or of three I-sections if the adjoining flange is joined.

Considering now the structure shown in the drawings, in detail, the building of the invention comprises seven hexagonal units **20** arranged in groups of three and one-half, and separated by a rectangular interior building space having stairways **21**. It will of course be recognized that certain principles of the invention can be applied with six hexagonal units, three on either side. When viewed in Figure 1, it will be evident that there is a suitable foundation construction **22**, and the first floor **23** may be supported directly on foundation units without utilizing the girder and beam construction of the present invention if desired. Each hexagonal building unit has three sides **24** exposed to the outside of the building, and therefore available for light and air. The exterior treatment of these outside sides **24** forms no part of the present invention, and it may consist of base supported walls, prefabricated panels, individually hung walls, or any other desirable exterior construction. As shown in Figure 1, windows **25** are desirably provided in the outside walls, and on the first floor the outside walls may also if desired be provided with doors **26** (Figure 2).

Each of the hexagonal building units also has two sides, which in at least some cases form walls **27** between two building units. These side walls **27** lend themselves to chalk boards **28** in school rooms, or other similar wall uses, such as installation of prefabricated closets.

The group of units provides an interior space **30** which extends directly across between opposing stairways **21** from one group of three and one-half hexagonal units to the other, and also extends out toward the inner wall of each hexagonal unit. This interior structure lends itself to different treatments. In the lower floor plan of Figure 2, a hallway **31** of generally oval form extends around the interior of all of the rooms, common to all of them, and is connected to each room by a doorway **32**. The space at the outside of the hallway in this form provides toilets **33** for boys and girls individual to each of the hexagonal building units, and therefore well adapted for primary grades of a school. At the center of the hallway is provided an enclosure **34** which includes a pipe and ventilating duct **35** and storage space, such as a teacher's toilet **36** and a janitor's room **37**.

The stairways communicate with the hallway by landings **38**, and on the first floor there is suitably an entrance stairway **40** and a stairway to the second floor **41** at each end of the building. Main doors are provided at **42** at each end of the building.

The construction just described will suitably be varied on the second floor or upper floors, providing in the interior space of the building as shown in Figure 4, and hallway **43** which is generally oval and connects with each of the rooms by a door **44** on the inner side of each hexagon and an interior enclosure **45** which includes toilets **46**, and interior ventilating and pipe ducts **47**.

The ventilating and pipe ducts are above a cellar **48** which normally will include heating equipment, and it communicates with horizontal ventilating ducts **50** extending above the hallway **31** of the first floor, and ventilating ducts **51** extending above the hallway and toilets of the second floor. These ducts likewise provide ventilation from the toilets. Suitable exhaust fans not shown are provided in a penthouse **52** and exhaust ventilation is discharged above the roof **53** through outlets **54**.

The roof and the floor of at least the second floor and permissibly also of the first floor are composed of tetragonal slab units **55** as shown in Figure 5 of reenforced concrete, each of which has a 120° angle at its corner **56**, 90° angles at the corner **57** and a 60° angle at the corner **58**.

In order to align the structure, it comprises preferably a primary abutment **60** at one end, an integral cross beam **61** between the corners **57** and secondary side beams **62** connecting each corner **57** with the corner **58**. The interior portion also has cruxiform reenforcing beams **63** at the undersurface. At the interior at locations **64** and at the end at location **65**, the structure is desirably somewhat lightened, although the slab at **65** may suitably be of the same order of thickness as the side beam portions **55**. The top of the slab is flat.

Adjoining corners **57** and **58** suitable metallic sockets **66** are cast in the concrete or other material of the slab and they have exterior interlock flanges and threaded interiors, being adapted to receive threaded lifting eyes **67** which are removable and also to engage hold-down bolts as later explained.

The main horizontal structural members are girders **68** which extend from the outside meeting corners of each hexagonal building unit to the next and likewise in the building units which adjoin the stairways, from the corner adjoining the stairway at the outside to the opposite meeting corner with the next unit at the outside. The girders **68** depending upon the span in some cases take the form of trusses. They are supported on double columns **70** at the meeting corners at the outside and single columns **71** at the other corners.

As shown in Figures 7 and 8, the columns **70** desirably comprise four angles **72**, **73**, **74** and **75**, pairs of which are facing one another and meeting at the outer edges of the flanges, while two of the angles are back to back. They are welded together at their meeting outer corners at **76** to form a unitary structure. Thus in angles **72** and **73** the outer edges of the flanges only adjoin and likewise in angles **74** and **75**. Angles **73** and **75** meet at the outer edges of one of their flanges.

The column has the girder **68** connected thereto in any well known manner, and suitably by angle plates **77**. Beams **78** also extend radially to each hexagon corner and are secured to the column as by angle plates **79**.

In some cases it is preferable to make up the column by I-sections **80** as shown in Figure 9, which are welded together at **81** along the inwardly directed edges of their flanges, forming a closed configuration which is tied into the girders **68**.

At the inner end of the common side of the hexagonal building units, columns **70** are also placed, and at various other corners of the hexagonal building units columns **71** are provided. These columns **71** are preferably formed by two facing angles having sides of different lengths as shown, welded together at the corners. At the center of each girder **68** brackets **82** are secured to the opposite sides of the girder **68** and the brackets support one end of each radial beam **78** which extends out to every corner of the hexagonal building unit except those to which the girder extends. Thus as looked at in plan on the left side of Figure 2 there is either a beam or a girder every 60° from the center of the brackets **82**.

The top of the brackets are adjusted as to height so that the tops of the beams and the girders are on the same level as shown in Figure 11.

The slab units **55** rest on the adjoining beams and/or girders as best seen in Figures 3 and 10, each slab unit overlapping the beam or girder by a distance **84** so that it cannot slip off. Thus as seen in Figure 3 there are eighteen of the slab units occupying the floor or roof space of each hexagonal building unit. In addition there are nine of the slab units on each side of the stairway

occupying the interior space above the hall and/or toilets.

At the outside walls and generally around the outside of the hexagonal building unit, beams are provided at **85** which cooperate with the adjoining beams **83** to hold the adjoining slab units.

It will be noted that at the corner **58** the slab units are cut off at **86** to avoid interference with the columns, and at the corner **56** the slab units are cut off at **87** to avoid a feather edge and permit better access to electrical equipment.

Since there is a possibility of exerting cantilever force on the thin portion **65** of the slab unit, it is desirable to tie the opposite end of the slab unit to the steel work, and this is done by tie bolts **87** (Figure 11) which thread into the sockets **66** after the lifting lugs are removed and suitably have hook ends to engage under the steel work.

It will be evident of course that any space in the floor left by cutting off the corners at **86** or **87** will desirably be filled, as by concrete and then suitable flooring applied in the case of a floor, or suitable roofing in the case of a roof.

Figure 12 shows a convenient means of tying in a girder to a column **71** of the opposed angle type. In this case a portion of the opposed longer flanges **90** is cut away at **91** so as to allow the ends of the beams to extend in and also rest on angle plates **92** secured to the column. Separate angles **93** support girders **85**. Where all girders are of the same height of web, a single set of angles **92'** will support all girders, as shown in Figure 12*a*.

It will be evident that any one of the 120, 60, 90, 90 degree irregular tetragonal units can be placed in any one of the eighteen positions in any one of the hexagonal building units. Therefore if it is necessary to dissemble the structure, the floor and roof can simply be removed, and the lifting lugs screwed back in after removal of any tie-down bolts, after which the slab units can be lifted by a crane and treated as interchangeable units to be employed in a new building.

It will also be evident that since the major load is borne by direct downward bearing of the tetragonal units on the beams and girders there is no danger of displacement, and the tetragonal slab units can be very simply removed merely by elevating them, after any tie-down bolts are removed.

It will further be evident that the tetragonal slab units will desirably be produced under mass production conditions, and merely shipped to the location of use. However, if the job is large enough to warrant it, the tetragonal units can be produced on the job.

While special columns have been shown for use at the meeting corners of the hexagonal units, it will be understood that standard columns can be used if desired.

It will, of course, be understood that where desired the almost semicircular grouping of three hexagonal units can be separated more widely than in the form shown, or can be grouped to form an end of a building of some other type, offering the advantage of light on three sides and standardized construction.

It will also be understood that in special cases the interior construction need not function as a hallway, as in auditoriums and the like, in which case the utility rooms provided at the center and the pipe and ventilation duct can be omitted if desired.

It will furthermore be evident that while the invention has been illustrated in a building of two stories, the stories can be multiplied as desired, using a portion of the interior space for elevators.

It will also be evident that a single one of the hexagonal units can be employed as a separate building where desired.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I therefore claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described by invention, what I claim as new and desire to secure by Letters Patent is:

1. A building comprising a generally circular cluster of six identical hexagonal units on a level and arranged around a center, each of the units having one side which is common with respect to one of the other units, each of the units having three sides exposed to the outside of the building, the units being arranged in groups of three units which are spaced between the groups, a hallway in the space interior of the groups, there being columns at the corners of the hexagons, radial beams within each hexagon and supported to the columns, and slabs resting on said radial beams.

2. A building comprising a generally circular cluster of six identical hexangonal units on a level and arranged around a center, each of the units having one side which is common with respect to one of the other units, each of the units having three sides exposed to the outside of the building, the units being arranged in groups of three units which are spaced between the groups, a hallway in the space interior of the groups, there being columns at the corners of the hexagons, radial beams within each hexagon and supported to the columns, and slabs each having a plurality of slab units, and said slab units having sides resting on said radial beams.

3. A building comprising a generally circular cluster of six identical hexagonal units on a level and arranged around a center, each of the units having one side which is common with respect to one of the other units, each of the units having three sides exposed to the outside of the building, the units being arranged in groups of three units which are spaced between the groups, a hallway in the space interior of the groups, there being columns at the corners of the hexagons, radial beams within each hexagon and supported to the columns, and slabs each having a plurality of slab units, said slab units affording sides resting on said radial beams and each of said slab units having one angle of approximately 120°, two angles of approximately 90° and one angle of approximately 60°.

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