The present invention relates to an improved precast reinforced concrete column with spaced shear-head sections. More specifically, there is provided a unitary precast column design and construction which integrates vertically spaced shear-head sections of steel framing members at the floor and/or roof levels.

The use of precast beam and girders sections is becoming quite prevalent in all kinds of structures; however, there have been problems in utilizing precast reinforced concrete columns or simple composite columns in the erection of certain types of structures, particularly multi-story buildings. For example, one major construction problem arises in the means for making a quick and structurally sound connection between the floor sections and column sections. The use of haunches involves reinforcing and forming problems, while the use of supporting collars around columns to hold beams can require expensive steel fabrication costs and connection problems.

It is a principal object of the present invention to provide a precast column section having laterally projecting shear-head beam sections integrated therewith at spaced positions to accommodate floor and/or roof sections.

It is also an object of the present invention to construct a composite precast column section that will have, in addition to steel shear-head sections, an indented or notched area around the periphery of the column at the shear-head zones to accommodate the keying-in of concrete which is subsequently poured around each shear-head section for each of the floor levels and the roof level.

In one embodiment, the present improved form of composite precast column, with shear-head sections, comprises in combination, reinforced concrete column section with internally placed longitudinal reinforcing steel and a support-connector means at each end thereof, at least one laterally extending shear-head section spaced along the length of said column sections, with each shear-head section comprising at least one projecting steel framing member which is cast into and fixedly connected with the reinforced column section, said steel framing member(s) in turn having a plurality of dowel members projecting therefrom and connecting into the body of the column section such that there is a bonding and splicing with said longitudinal steel reinforcing therein, and said steel framing member(s) being positioned to have web portions set back from the periphery of the column to provide thereby a resulting peripheral notched section for at least the depth of said steel framing member(s) entirely around the body of said column at each shear-head section, whereby concrete subsequently being poured around the column over each shear-head section will key into the column periphery at each floor level.

The shear-head framing members to be integrated with the reinforced concrete column section may be standard T-beam sections, channel sections or a combination thereof. Actually, of course, the size of the particular structures and loading conditions to which the respective columns at each floor or roof level will have a direct bearing on the size and/or arrangement of the beam sections at each shear-head level. Thus, it is not intended to limit the shear-head steel to any one type of framing member or to any one arrangement of projecting beam sections. However, in accordance with the present invention, there shall be dowel members or anchor means welded or otherwise connected perpendicularly with respect to the flanges of the steel framing members within the cross sectional area of the column such that the dowels will provide adequate bonding of the shear-head beam members with the concrete column each side of the shear-head zone.

The support-connection means referred to in the embodiment shall comprise suitable base plate means for bolting the composite column to a footing, as well as splice plate means, for fixedly attaching an upper column section to the top of a next lower column section. The splice plate means and the base plate means shall, in all cases, be adequately connected or bonded to the end portions of the column sections by perpendicularly or angularly positioned dowel members which are welded or otherwise attached to the respective plate members.

Reference to the accompanying drawing and the following description thereof will serve to clarify the construction features of the present precast column sections and the advantages of using them in the rapid erection of a building structure.

FIGURE 1 of the drawing is a diagrammatic elevational view of a precast composite column section with shear-head beam sections and end connector means.

FIGURE 2 of the drawing shows in a sectional plan view one form of making a support-connection between two precast column units, as indicated by the line 2-2 in FIGURE 1.

FIGURE 3 of the drawing is a sectional plan view of a shear-head section of the precast column unit.

FIGURE 4 of the drawing is a partial sectional view illustrating the connection of a shear-head beam section with the longitudinal reinforced concrete column portion.

FIGURE 5 of the drawing indicates diagrammatically in a plan view a modified precast column unit with an integral shear-head section adapted for being positioned along the outside wall of a building structure.

Referring now particularly to FIGURES 1 and 3 of the drawing, there is shown a precast column section having a plurality of longitudinal reinforcing bars and vertically spaced ties, with such bars and ties being spaced and sized in accordance with design requirements for the particular column. The lower end of the column unit is provided with a suitable base plate member which is connected or bonded to the ends of the column by dowel members. The latter are indicated as being welded in a perpendicular position with respect to plate member and of such length as to provide an adequate splice or overlap with the longitudinal bar member.

The base plate shall, of course, be designed to accommodate the bearing and bending forces of the column unit, as well as have holes to accommodate anchor bolts in a foundation.

Extending laterally and at right angles to the column unit, are one or more shear-head sections which comprise a plurality of beam members as being positioned on the diagonal with respect to the orientation of the square column section and the use of standard channel members in a back-to-back relationship in the extending portions. The channel members are bent prefabricated sections that are arranged and sized such that a portion of each beam shall be encased within the body of the column unit. As best shown in FIGURE 4 of the drawing, there may be perpendicular dowel members such as 10 and 10' attached to the flanges and/or web portions of the channels such that there
may be a fixed and rigid bonding of the shear-head beam sections with the column itself. The members 10' are indicated as rectangular bars connecting between the bent corners of adjacent beams 9. Such dowel members 10 and 10' shall be of sufficient length as to provide an adequate bonding and splicing with the main longitudinal reinforcing bars 2. FIGURES 1 and 3 also show how the reinforcing bars 2 extend adjacent to and through the collars formed by the backs of the beams 9 of shear-head sections 8.

It is also a particular feature of the present improved composite precast column construction to effect a joining of the shear-head beam sections 9 such that they are spaced internally within the confines of the column unit 1 and a continuous peripheral notch 11 is provided around the column 1 for the height of beam members 8. This construction is of particular advantage in providing a notched or keyed section to accommodate concrete which is ultimately poured around the shear-head beam sections 8 at each floor level during subsequent building construction stages. In the present embodiment, there are shown connector plate members 12 across the ends of adjoining beam members 9 that are adapted to readily connect with beam or girder members of the steel framing for each floor section. The use of such plate members 12 is, however, optional. The beam members making up the shear-head 8 shall, of course, have adequate depth and strength to effect the transfer of the shear or floor loadings into the column unit 1 at each of the respective floor levels.

It is not intended to limit the design and constructions of the spaced shear-head sections 8 to any one type of structural framing members or to any predetermined number of laterally extending beam sections. However, in a preferred design and construction there are at least four projecting beam members, such as 9, that are positioned on the lower floor level of the building to connect with the girders that will straddle the rows of columns in a building structure and thus be able to carry the shear loadings into the column from the adjoining portion of floor sections.

As best shown in FIGURES 1 and 2, there is indicated means for joining the upper end of the column unit 1 with the lower end of a column 1'. In other words, in a manner similar to a base plate construction, there are a plurality of anchor bolts 13 provided from the upper end portion of the column 1 along with a bearing plate 14. The latter may be attached to the column 1 by a plurality of dowel members 15 that are embedded into the concrete of the lower floor level. In contact with bearing plate 14 is an upper bearing plate 16 that is in turn bonded to the end of column 1' by perpendicular dowel members 15. Each of the plate members 14 and 16 have holes to accommodate the anchor bolt members 15 and preferably the latter are positioned adjacent to the corner portions of the columns 1 and 1'. Also, as shown in the present embodiment, there may be diagonally positioned structural members, such as the channel sections 18, that serve to provide notched corner segments in the concrete at the lower end of column section 1'. Such notched-out corner segments may be filled in with cement grout after the joining of the adjacent column sections and the tightening of the nuts 19 on anchor bolts 13. The present embodiment also indicates dowel members 20 attaching to the web portions of the diagonal channel sections 18 so as to provide suitable bonding with the column unit 1', particularly with the portion of the beam members 18 connect with the anchor bolt members 15. Here again, the number and size of anchor bolts 13 shall be determined by the design stresses which may be involved in providing a fixed connection and continuity between the ends of the adjacent column units 1 and 1'. Accordingly, there may be more than four anchor bolt members 15 in some precast column units.

In FIGURE 5 of the drawing, there is indicated a column unit 21 having specially positioned beam members 22, 23 and 24 arranged to provide a shear-head framing at the side of a building structure. In other words, beam framing members 23 project diagonally with respect to the column section 21 to accommodate beam or girder members of adjacent panel sections in a floor or roof framing to be built in the structure. The beam member 24 together with portions of bent framing members 22 in turn provide means for connecting to the ends of outside beam or girder members in a building structure so that the shear-head section may in turn carry all end loads or shears into the column unit. Again, it should be noted that regardless of the number of beam members projecting from the column to form the shear-head section and regardless of the number and size of the framing members, the latter shall be connected into the column by suitable dowels that overlap and splice with longitudinal reinforcing bars extending for the length of the column unit, or optionally, such beam members may connect to a steel column member 25 and to connector plates 26 where there is a composite construction. The portions of the steel framing members within the confines of the column unit shall be spaced inwardly from the faces of the column so as to provide the required peripheral notched section around the column for the depth of the respective framing members in the shear-head section.

Thus, as noted hereinbefore, the present improved precast column unit has the provision for keying-in concrete to be poured around each shear-head framing section during the placement of the concrete flooring of the structure. FIGURE 5 of the drawing indicates diagrammatically the use of an H-beam or I-beam section 25 with connector plates 26 for the beam members 22 and 24 in the center of the reinforced concrete column to provide a composite precast unit. The use of one or more standard structural sections in the column unit to provide a composite type of construction will normally depend upon the extent of the loadings on the column unit for a particular building. In other words, it may be economically desirable to utilize at least one standard framing section in combination with the concrete rather than depend upon reinforcing bars. It is not, however, intended to limit this invention to the use of an H-beam member in the column unit since there may be channels, angles, pipe sections, etc., positioned in any desired typical column formation. However, where longitudinal structural members are used, then the various structural framing members extending at right angles from the column unit and comprising the shear-head section shall be bolted, welded or otherwise connected to the longitudinal column framing members and there may be an elimination of any perpendicularly projecting dowel members from the flanges of the beam members.

The present drawing indicates the use of a square column unit with a typical rectangular arrangement of reinforcing bars and tie members 3; however, the precast column units may be circular or have polygonal cross sections other than square, with typical arrangements of longitudinal reinforcing bars utilized therein. In connection with such other shapes, the portions of the shear-head beams within the confines of the column shall be formed to have the edges of flanges and web portions spaced inwardly from the face(s) of the column in order to provide the desired notched portion around the perimeter of the column at each shear-head section.

The length of a precast column unit may vary in accordance with its proposed use in the building structure, but generally may be from 30 to 40 feet in length, or perhaps longer where transportation arrangements permit. Thus, there may be two or more shear-head sections, such as 8, spaced throughout the length of any one precast unit. On the other hand, precast column units may be only one story in height and have a shear-head framing section adapted to provide for a concrete or steel framing roof section. In this latter case, the shear-head
framing will be at one end of the column unit and, of course, will have dowel members on one side only to effect bond with the column concrete.

Relatively simple forming means may be provided for precasting the present improved composite column units. For example, a three-sided trough section held horizontally will provide the necessary forming for a square column unit. Such forming may be held by suitable stanchions or support framing at spaced distances from the ground or from the floor of a building so as to permit the placement of the outwardly projecting spaced shear-head framing members along the length of the column in the desired positions. Preferably, all of the shear-head beam members are prefabricated into the desired shapes and lengths and will have the bonding dowel members welded or otherwise attached thereto as necessary such that by proper jigs or holding devices each shear-head framing section will be held in a proper position with respect to the center line of the column unit. Thus, upon the placement of longitudinal reinforcing bars and the pouring of concrete into the form there will be a resulting precast reinforced concrete column with built-in shear-head sections. Suitable braces or support devices may also be provided for holding in place the desired base plate and splice plate members at each of the ends of the column unit. Again, it may be noted that by being able to precast and build all of the column units for any given building structure at the ground level in a manner to incorporate the shear-head sections, there will result labor savings and rapid connections of the floor framing at each floor level, as well as roof level, to in turn provide an economical and monolithic building construction procedure.

I claim as my invention:

1. A composite precast column with shear-head framing integrated therewith in the casting step, which comprises in combination, a reinforced concrete column section with internally placed longitudinal reinforcing steel and a support-connector means at each end thereof, at least one laterally extending shear-head section spaced along the length of said column section, with each shear-head section comprising at least one laterally projecting steel framing member which is cast into and fixedly connected with the reinforced column section to accommodate shear and bending moments, said steel framing member in turn having a plurality of dowel members projecting therefrom at right angles thereto in two directions and connecting into the body of the column section such that there is a bonding and splicing with said longitudinal steel reinforcing therein, and said steel framing member being positioned to have web portions set back from the periphery of the column to provide thereby a resulting peripheral notched section for at least the depth of said steel framing member entirely around the body of said column at each shear-head section, whereby concrete subsequently being poured around the column over each shear-head section will key into the column periphery at each floor level. 2. The composite column of claim 1 further characterized in that said projecting steel framing member of each shear-head section shall be positioned and arranged to have at least portions thereof embedded in the column and that such portions of said framing member are in turn positioned to provide a resulting set-in collar form of arrangement within the cross-section of said column, with said notched-column of the latter extending around the periphery of said collar-form portions of said shear-head framing members. 3. The composite column of claim 1 further characterized in that said projecting framing member of said shear-head sections shall be in turn formed of channel members in a spaced back to back arrangement and each of the channel members are bent to provide portions thereof which are set-in within the cross sectional portion of said column.

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