

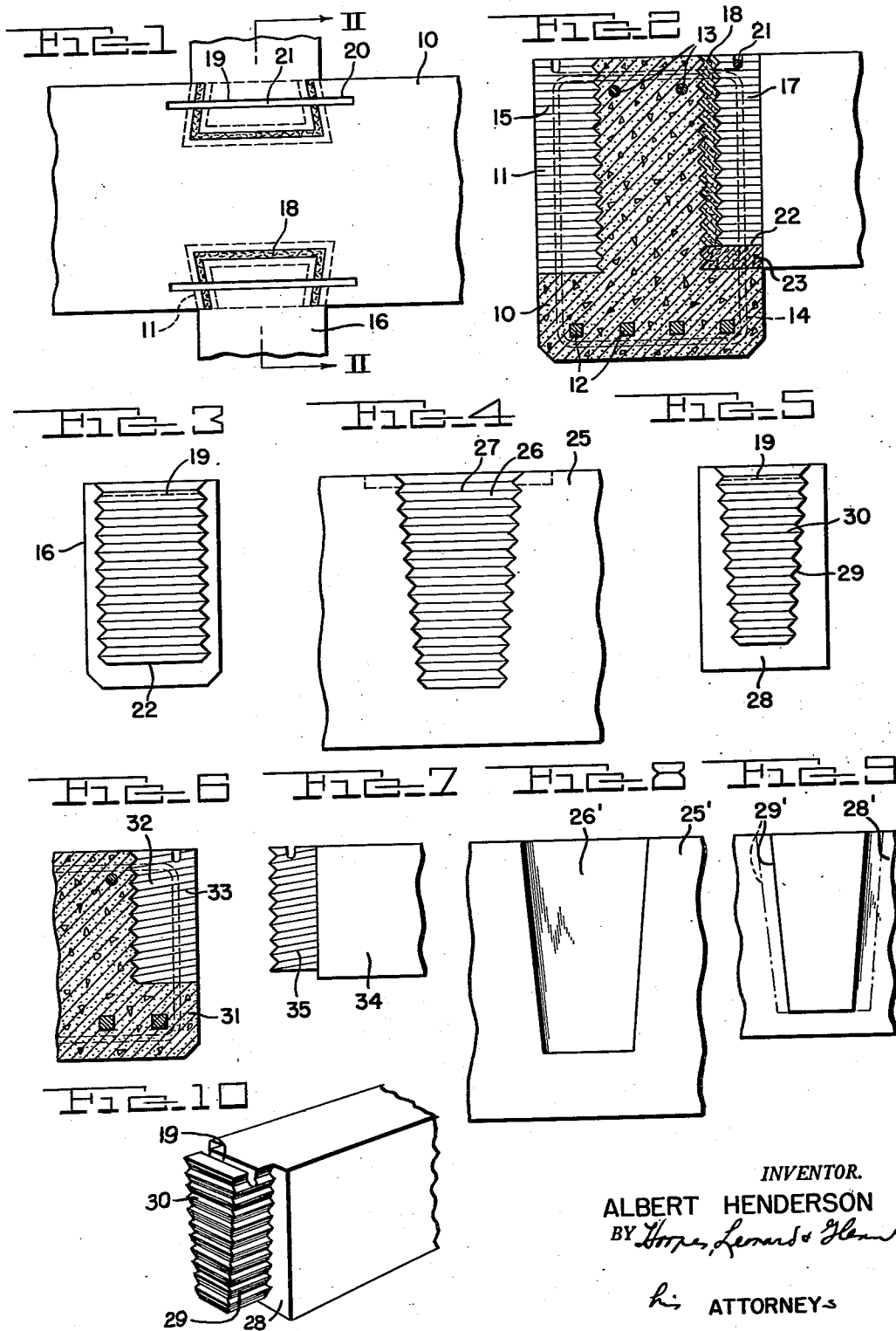
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CONNECTION FOR PRECAST CONCRETE GIRDERS AND BEAMS

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CONNECTION FOR PRECAST CONCRETE
GIRDERS AND BEAMS

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This invention relates to a building construction utilizing precast concrete members as girders and beams, and, in particular, to a connection between the girders and beams. This application is a continuation of my copending application Serial No. 629,797, filed November 20, 1945, now abandoned.

It is desirable in constructing buildings of precast concrete members to have the upper surfaces of the floor beams flush with the upper surfaces of the girders on which they are supported. A simple manner of accomplishing this result is to form pockets in the girders adapted to accommodate the ends of the beams. This practice has always been considered objectionable heretofore, however, because the voids or pockets required to receive the beam ends involve a reduction in the sectional area of the girder available to withstand compression and shear stresses. I have invented a novel connection by which beams may have their ends disposed in pockets spaced along the girders without substantial loss in the compression area or the strength of the girder in resistance to shear.

I provide for compensating for the loss of strength in the upper portion of the girder due to the recess. I provide for placing of the beam end in compression between the opposed faces of the recess in the girder when the beam is loaded. I preferably supportingly connect the beam end with the girder only at the generally vertically extending faces of the recess.

My invention may comprise a building structure comprising a precast reinforced concrete girder having a recess formed intermediate its ends in the upper portion thereof, the recess having generally vertically extending faces, and a beam end lying in the recess, the beam end being supportingly connected with the girder only at the generally vertically extending faces of the recess and being in compression between the opposed faces of the recess when the beam is loaded whereby all of the load which is transmitted from the beam end to the girder is transmitted through the generally vertically extending faces of the recess and the loss of strength in the upper portion of the girder due to the recess is compensated for. The side faces of the beam end disposed within the recess are preferably in supported relationship with the side faces of the recess while the bottom of the beam end disposed within the recess is preferably out of supported relationship with the bottom of the recess. I may position the side faces of the beam end disposed within the recess in face-to-face relationship

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with the side faces of the recess and interpose between the side faces of the beam end disposed within the recess and the side faces of the recess means for supportingly connecting the beam end with the side faces of the recess. The side faces of the beam end disposed within the recess may be in surface-to-surface contact and supported relationship with the side faces of the recess.

The recess may have generally vertically extending faces which converge toward each other in a generally downward direction, and the beam end may have similarly disposed faces. The vertically extending faces of the recess and the opposed faces of the end portion of the beam may both have substantially horizontally extending corrugations. Load transmitting means may be disposed in the gap between the opposed faces of the end portion of the beam and the recess. The load transmitting means may comprise preformed load transmitting members or a filling formed in situ and filling the gap between the opposed faces of the end portion of the beam and the recess. The filling may be a cementitious filling, such, for example, as grout, and in certain cases expanding grout may be used.

The recess in the girder is open at the top and at least one side of the girder and has generally vertically extending faces. The recess may be of dovetail shape in the horizontal direction, being narrower at its mouth than at a portion inwardly from its mouth, and the beam end lying in the recess may be of dovetail shape conforming generally to the dovetail shape of the recess.

Means may be provided interengaging the beam end and girder preventing endwise displacement of the beam from the recess. Compressible non-load transmitting filling material may be disposed between the bottom of the beam and the bottom of the recess or the bottom of the beam may simply be spaced from the bottom of the recess.

In a preferred embodiment of my invention I provide pockets or notches spaced along both sides of a girder adapted to receive the ends of beams disposed normal thereto. The sides and inner end of each notch or pocket may have horizontal corrugations formed therein. The ends of the beams and the sides thereof adjacent the ends may likewise be corrugated. When the beams have their ends disposed in the pockets in the girder the space therebetween may be filled with load transmitting means such as a cementitious filling formed in situ. The filling may be grout; as an example material, expanding grout may be employed, although it is not neces-

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sary to use expanding grout. When expanding grout is used it expands as it sets and firmly fixes the beam ends in the girder pockets under compression, thus making up for the loss of sectional area which would otherwise result from the formation of the pockets in the girder. The corrugations in the pockets and beam ends make up for the loss of shear strength which would otherwise result from the presence of the pockets although in certain structures the corrugations may be dispensed with.

As above indicated, compressible material may, if desired, be disposed between the bottoms of the beams and the bottoms of the pockets so that the load on the beams will be transmitted to the girder substantially exclusively through the sides of the pockets, the beam ends being in compression therein.

A complete understanding of the invention may be gained from the following detailed description which refers to the accompanying drawings illustrating certain present preferred embodiments thereof. In the drawings,

Figure 1 is a partial plan view of a girder and aligned beams extending from opposite sides thereof;

Figure 2 is a transverse section through the girder along the plane of line II—II of Figure 1 with the beam on one side of the girder omitted;

Figure 3 is an end elevation of one of the beams;

Figure 4 is a partial side elevation of a girder showing a modified form of pocket;

Figure 5 is an end elevation of a beam adapted to have its end disposed in the pocket of the girder shown in Figure 4;

Figure 6 is a partial transverse section through a further modified form of girder;

Figure 7 is a partial side elevation of a beam having its end adapted to be disposed in the pocket at the side of the girder of Figure 6;

Figures 8 and 9 are views corresponding respectively to Figures 4 and 5 showing a girder and beam of further modified construction; and

Figure 10 is a perspective view of the end of the beam shown in Figure 5.

Referring in detail to the drawings, a precast reinforced concrete girder 10 has recesses or pockets 11 in the sides thereof spaced along its length. The girder has lower reinforcing bars 12 and upper reinforcing bars 13 with stirrups 14 extending around the bars and spaced longitudinally of the girder. As shown in Figure 1, the pockets 11 may be of dovetail form in plan although this is not necessary and the generally vertical transverse walls of the pockets may be at right angles to a vertical plane extending longitudinally of the girder. The pockets 11 are shown as having horizontal corrugations 15 in their sides and inner ends.

The pockets 11 are adapted to receive the ends of precast reinforced concrete beams 16. The ends of the beams as shown are also of dovetail form in plan, this form of beam end being employed when the pockets are of dovetail form. The ends of the beams and the sides thereof adjacent the ends have corrugations 17 which when the beams are in position with their ends in the girder pockets extend generally horizontally or parallel to the corrugations 15.

When the ends of the beams have been disposed in the pockets 11 the spaces between the beam ends and the pocket walls, indicated at 18, are filled with expanding grout. This material expands as it sets, thereby developing compres-

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sion between the sides of the pockets and the sides of the beams adjacent the ends thereof as well as between the ends of the beams and the inner walls of the pockets. In order to prevent the beam ends from being pushed out of the pockets I may provide transverse slots 19 in the upper faces of the beams adjacent the ends thereof and longitudinal slots 20 in the upper face of the girder on opposite sides of each pocket 11. A key or tie rod 21 disposed in the slots 19 and 20 as shown in Figures 1 and 2 prevents endwise displacement of the beams. When the grout has set the dovetail shape of the beam ends and the pockets prevents displacement of the beams outwardly of the pockets.

The ends of the beams are preferably stepped as shown at 22 so that the bottoms of the beams do not bear directly upon the bottoms of the pockets 11. If desired, a compressible filler 23 may be disposed below the beam ends, although the space between the bottoms of the beam ends and the bottoms of the pockets may simply be left void. In either case the load applied to the beams is transmitted to the girder exclusively through the generally vertically extending faces of the girder recesses or pockets and, in a corrugated structure such as that shown in Figure 2, through the corrugations in the adjacent surfaces of the beam ends and the girder pockets and the grout therebetween. The effect of this arrangement is that when the beams are loaded their ends and the surrounding grout compensate for the loss of section of the original girder caused by the formation of the pockets therein. It will be apparent that the grout filling, either by virtue of the pressure resulting from its expansion or the compression introduced therein by the load on the beams, will transmit the compression stress on the upper portion of the girder section from one side of each pocket through the beam end positioned therein to the other side of the pocket. Similarly, by virtue of the corrugations formed in the walls of the pockets and on the ends and sides of the beams, the beam ends compensate almost entirely for the loss of strength of the girder in resistance to shear which would otherwise result from the presence of the pockets.

Figure 4 shows a girder 25 having pockets 26 in its sides, spaced lengthwise thereof. The pockets 26 have corrugations 27 formed in the sides and inner ends thereof. The sides of the pockets converge downwardly.

Figure 5 shows a beam 28 having downwardly tapering end portions 29 provided with horizontal corrugations 30. The end portions of the beam are adapted to fit in pockets such as the pockets 26 of the girder 25. The resulting construction is thus generally similar to that shown in Figures 1 and 2 except that the sides of the girder pockets and the beam ends slope inwardly toward the bottom instead of being vertical. This construction provides increased compression on the grout filling the space between the walls of the girder pockets and the side and end faces of the beams when the latter are loaded.

As a further modification of the construction of Figures 4 and 5, the corrugations 27 and 30 may be omitted, i. e., the sides and inner ends of the pockets 26 and the ends of the beams 28 and the sides thereof adjacent the ends may be plane surfaces. Such a structure is shown in Figures 8 and 9 in which parts corresponding to parts in Figures 4 and 5 are designated with the same reference numerals but each with a

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prime affixed. In each case the bottom of the beam is preferably spaced above the bottom of the pocket as in Figure 2. In the structures of Figures 4, 5, 8 and 9 the downwardly converging sides of the beam ends exert lateral pressure on the sides of the pockets through the grout filling when the beams are loaded, thus transmitting nearly the full compression in the upper portion of the girder across the pockets. The tight fit between the girder and beam, furthermore, largely compensates for the shear strength lost by forming the pockets in the girder. Grout or other load transmitting means may be disposed between the beam ends 23' and the pockets 26' in use of the structures of Figures 8 and 9 or not, as desired. The result sought is accomplished by the tight wedging of the beam ends into the pockets since the beam ends and pockets are made to conform to each other in shape and compression in the upper portion of the girder is transmitted continuously across the beam ends. When grout or other load transmitting means is to be disposed between the beam ends 23' and the pockets 26' in use of the structures of Figures 8 and 9 the beam ends will have the proportions indicated by the solid lines 29' in Figure 9 while when no grout or other load transmitting means is to be disposed between the beam ends 29' and the pockets 26' in use of the structures of Figures 8 and 9 the beam ends will have the proportions indicated by the chain lines 29' in Figure 9.

Figure 6 shows a girder 31 having pockets 32 therein with corrugations 33 in the walls thereof. The corrugations, as shown, are sloped instead of horizontal. Figure 7 shows a beam 34 generally similar to the beam 16 except that the corrugations 35 on the ends and the sides adjacent the ends thereof are sloping instead of horizontal. The slope of the corrugations 33 and 35 provides increased resistance to pulling out of the beams from the girder pockets in which their ends are disposed. The corrugations on the beam ends may slope in the same direction as those on the girder pockets or in the opposite direction.

It will be understood that the modified forms of girder and beam construction shown in Figures 4 through 9 have the same advantages as the construction of Figures 1 and 2. Since the compression area of the girder section and the strength of the girder in shear are restored by the construction disclosed almost to the full original values, i. e., those of a girder without pockets, it is possible for the pockets to extend clear across the full width of the girder. This is desirable in some cases. It will be understood that, in such a modification, the ends of aligned beams extend inwardly substantially to the central longitudinal vertical plane through the girder.

Although I have illustrated and described certain embodiments of my invention, it will be recognized that changes in the details disclosed are to be comprehended within the scope of the following claims.

I claim:

1. A building structure comprising an elongated reinforced concrete structural member oriented generally horizontally with a portion thereof adjacent its upper edge in compression, the structural member having a recess formed in said portion thereof, the recess having opposed generally vertically extending faces each of which has at least a portion extending generally downwardly and inwardly, the recess weakening the

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structural member, and a second elongated precast reinforced concrete structural member oriented generally horizontally having a part thereof disposed within the recess of the first mentioned structural member, said part of the second structural member having opposed generally vertically extending faces each of which has at least a portion extending generally downwardly and inwardly opposed to a similarly extending portion of one of the faces of the recess of the first mentioned structural member, the structure having connections under compression between said respective opposed face portions of the recess of the first mentioned structural member and of said part of the second structural member through which said part of the second structural member is supported entirely, said connections and said part of the second structural member transmitting compression across the recess longitudinally of the first mentioned structural member to at least largely compensate for the weakening of the first mentioned structural member by formation of the recess therein.

2. A building structure comprising an elongated reinforced concrete structural member oriented generally horizontally with a portion thereof adjacent its upper edge in compression, the structural member having a recess formed in said portion thereof, the recess having opposed generally vertically extending faces each of which has therein generally horizontal corrugations, the recess weakening the structural member, a second elongated precast reinforced concrete structural member oriented generally horizontally having a part thereof disposed within the recess of the first mentioned structural member, said part of the second structural member having opposed generally vertically extending faces each of which has therein generally horizontal corrugations, the faces of the recess of the first mentioned structural member being respectively opposed to the faces of said part of the second structural member, and cementitious material in load-transmitting relationship between the faces of the recess of the first mentioned structural member and the respective opposed faces of said part of the second structural member through which said part of the second structural member is supported entirely, said cementitious material and said part of the second structural member transmitting compression across the recess longitudinally of the first mentioned structural member to at least largely compensate for the weakening of the first mentioned structural member by formation of the recess therein.

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