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(54) **COLUMN BASE TO PODIUM SLAB ANCHORING**

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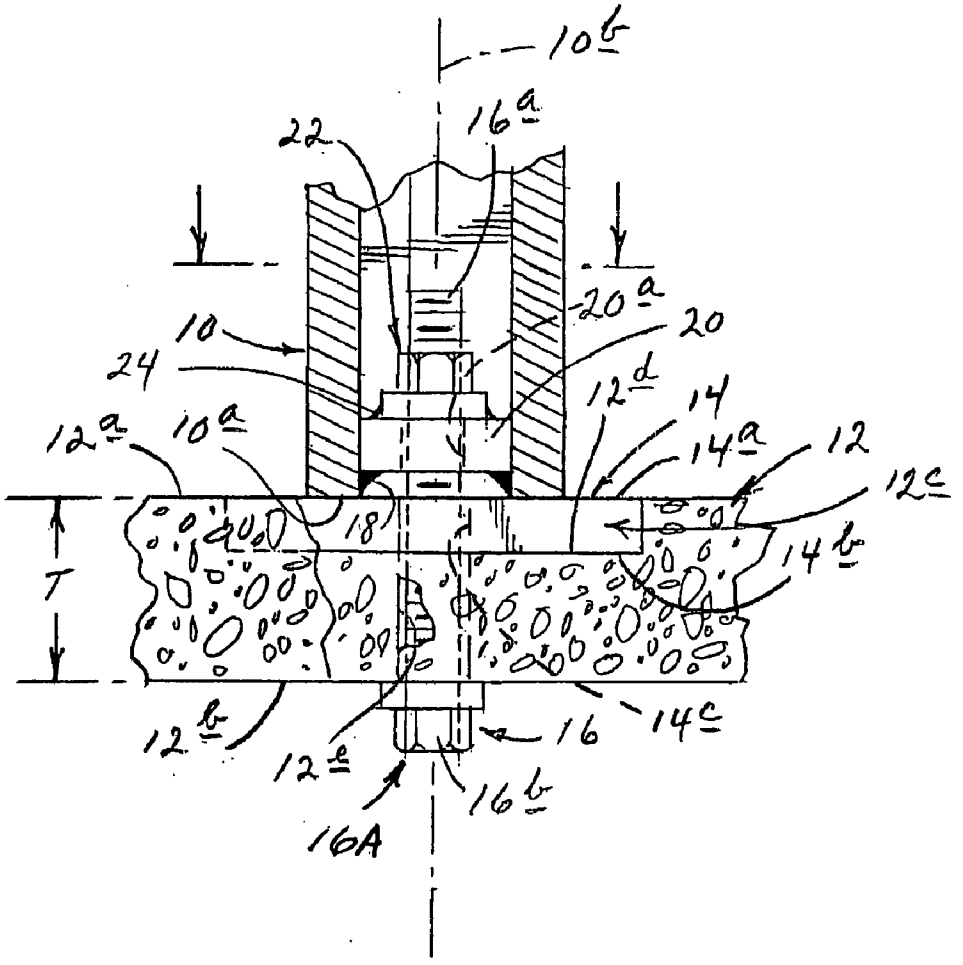
(57) **ABSTRACT**

Concealed anchoring structure interconnecting (a) the base of an elongate, upright, tubular (hollow), structural building-frame column having a long axis, and (b) a generally planar and horizontal podium slab having a body with upper and lower surfaces which collectively define slab depth, with the long axis of the column being substantially normal to the plane of the slab. This anchoring structure includes elongate, nut-and-bolt structure which is disposed substantially on the column's long axis, with upper portions of the nut-and-bolt structure being concealed within the hollow base of the column, above the slab's upper surface, and the lower portions of the nut-and-bolt structure being disposed adjacent the slab's lower surface, whereby the nut-and-bolt structure anchorably interconnects the column and the slab.



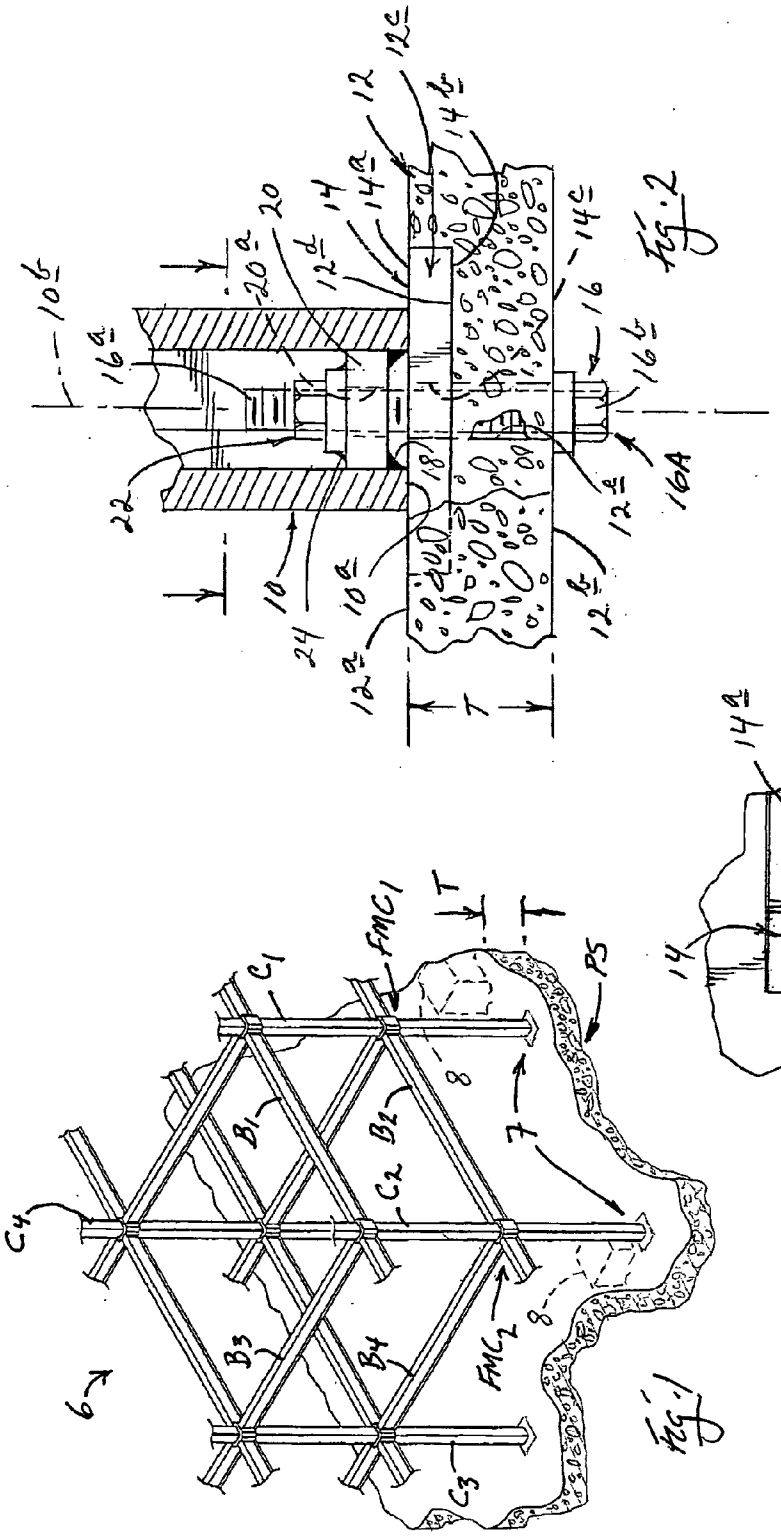


Fig. 1

Fig. 2

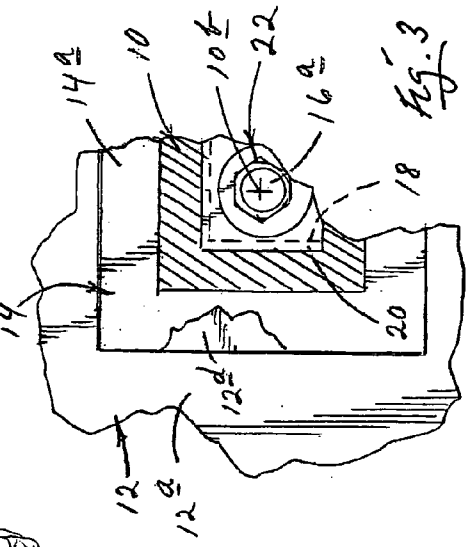


Fig. 3

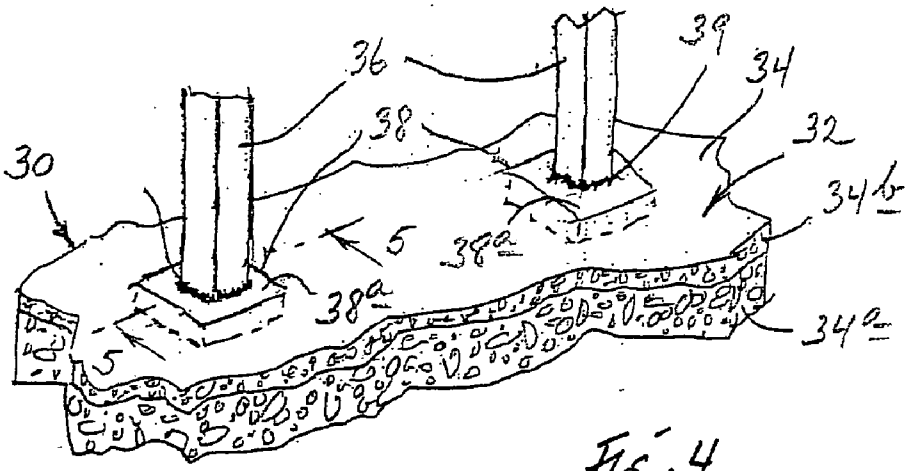

36
39
34
38
32
30
34b
5
38b
38a
34a
5

Fig. 4

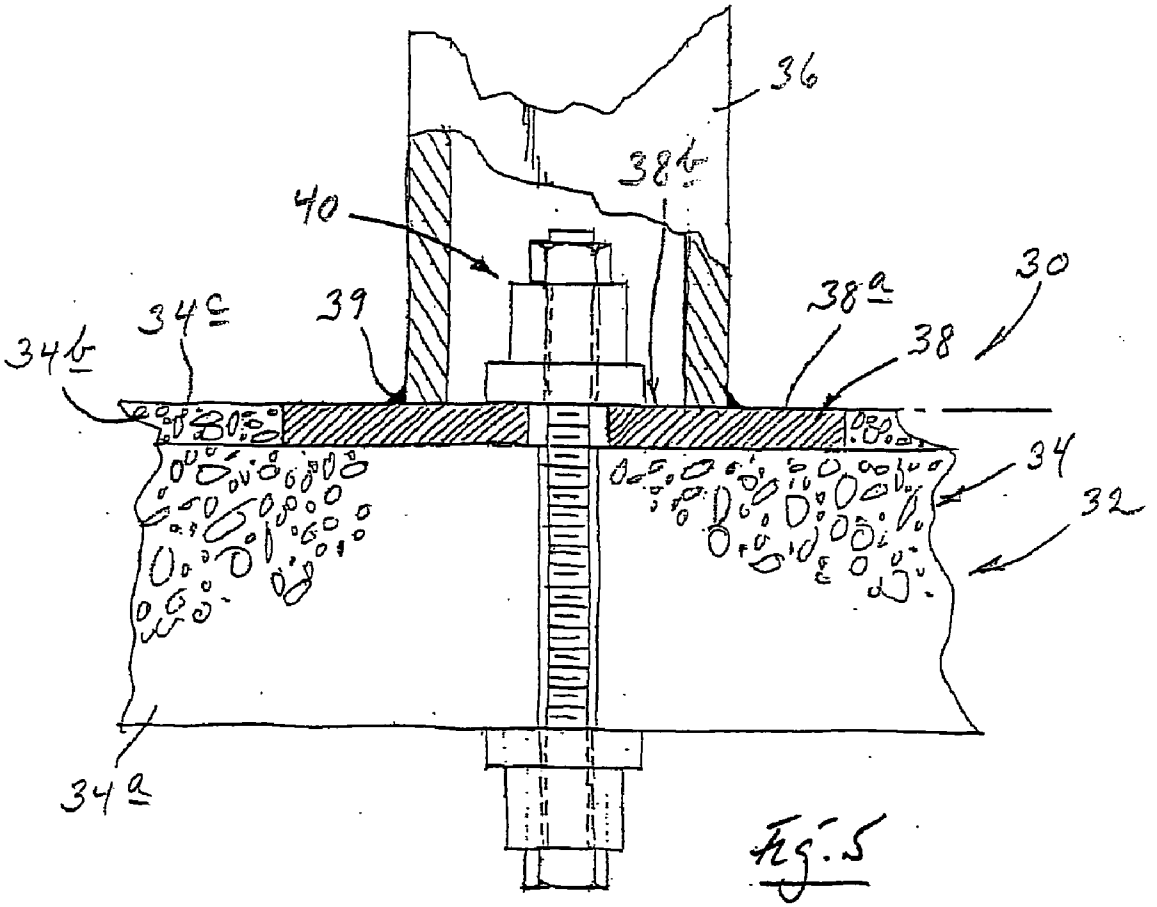

36
38b
40
34c
39
38a
30
34b
38
34
32
34a

Fig. 5

COLUMN BASE TO PODIUM SLAB ANCHORING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to two currently pending, prior-filed U.S. Provisional Patent Applications Ser. Nos. 60/605,730, filed Aug. 30, 2004, for "Full-Depth Podium-Slab Anchor for Column Base", and 60/605,839, filed Aug. 30, 2004 for "Column Base to Slab Anchoring Using Central Concealed Anchor Bolt". The entire disclosure contents of these two provisional applications are hereby incorporated herein by reference.

BACKGROUND AND SUMMARY OF THE INVENTION

[0002] This invention relates generally to plural-story building-frame structure, and more particularly, to structure which is employed to anchor the base of an elongate, upright column in such a frame structure to what is known as a podium slab, typically formed of poured concrete, which itself is supported either directly above the ground, or above yet additional under-structure, through appropriate podium-slab columns or pillars.

[0003] There is a recent development which is generally described in U.S. Pat. No. 6,837,016 relating to a full-moment-frame column-and-beam, plural-story frame structure which is uniquely suited to be anchored to, and to rise from, the-upper surface of such a podium slab, without there being any requirement that the vertical load paths defined by upright columns in the frame structure be aligned with the columns, or pillars, which underlie and support the podium slab. This development offers the opportunity for very advantageous construction of plural-story buildings on top of underlying podium structures, which podium structures might define, for example, office space, retail space, vehicle parking space, etc., with the bases of the columns in the overhead building frame structure being anchored just to the underlying podium slab per se. Among the advantages attained by such construction is that podium "space" can be completed quickly and easily in a building project, and can be readied for income-generating occupancy while steel-frame, plural-story superstructure is still under way.

[0004] The present invention, recognizing this interesting new moment-frame-over-podium-slab development, proposes, in several illustrated embodiments, structural anchoring arrangements that provide for what can be thought of as robust, neatly concealed, and very simply implemented anchoring conditions between the base ends of overhead frame columns and a podium slab per se, without the employed connections intruding into useable podium space, or delaying the time when such space can begin desirable income productivity. In particular, preferred and best mode embodiments of the invention are described and illustrated herein in a context wherein the base of each such "overhead" frame-structure column is firmly and securely anchored to such a podium slab utilizing, effectively, the full depth (thickness) strength of the slab at each site of anchoring. The proposed anchoring structure is extremely simple and inexpensive in construction, is easily implemented on a job site by relatively unskilled labor, and does not require structural elements which are obtrusive either on the upper or lower sides of such a podium slab.

[0005] The various features and advantages that are offered by this invention will now become more fully apparent as the description which shortly follows is read in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0006] **FIG. 1** is a simplified, downward-looking, isometric view illustrating a fragmentary portion of a building-frame structure wherein, in accordance with the present invention, the bases of elongate upright columns are anchored, to a concrete podium slab which is supported above the ground by its own, underlying column/pillar support system.

[0007] **FIG. 2** is an enlarged, fragmentary, cross-sectional view taken generally along the line **2-2** in **FIG. 1** illustrating one form of the column base to podium slab anchoring structure of the present invention.

[0008] **FIG. 3** is a fragmentary, cross-sectional view taken generally along the line **3-3** in **FIG. 2**.

[0009] **FIG. 4** is a simplified, fragmentary view which is somewhat like **FIG. 1** in the sense that it is a downward-looking, isometric view of a pair of building-frame columns anchored to a podium slab, and which specifically shows another embodiment of the present invention. The scale of **FIG. 4** is slightly greater than that employed in **FIG. 1**, and less than that employed in **FIGS. 2 and 3**.

[0010] **FIG. 5** is a fragmentary, cross-sectional view, presented on about the same scale which is employed in **FIGS. 2 and 3**, and taken generally along the line **5-5** in **FIG. 4**.

[0011] It should be understood that components illustrated in **FIGS. 1-5**, inclusive, are not necessarily drawn to scale.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Turning now to the drawings, and referring first of all to **FIG. 1**, indicated generally at **6** in this figure is a fragmentary and simplified illustration of a plural-story building frame, or building-frame structure, which includes plural, elongate, upright and hollow, or tubular, columns C**1**, C**2**, C**3**, C**4** interconnected through horizontally extending beams, such as beams B**1**, B**2**, B**3** and B**4**. These columns and beams are connected at nodal points of intersection through full-moment connections, such as the two connections of this type shown at FMC**1** and FMC**2** in **FIG. 1**. This frame, for illustration purposes herein, is constructed in accordance generally with the teachings of the above-referred to '016 U.S. patent. It should be understood that the specific construction of frame **6** is not a part of the present invention. However, it should be noted, and as will become more fully apparent hereinbelow, that the columns in this frame structure are hollow, or tubular, and possess square cross sections. With respect to this configuration for the columns, it should also be understood that the structure of the present invention, while illustrated and described herein with respect to hollow, square cross-section, tubular columns, does not depend upon such columns having any particular cross-sectional configuration.

[0013] Frame **6** is shown herein anchored, in accordance with practice of the present invention, with concealed

anchoring structure generally pointed-to at **7**, so as to project upwardly from the upper side, or surface, of a conventional concrete podium slab PS which is supported above underlying structure, typically the ground, through plural, distributed, upright pillars or columns, such as the two pillars shown fragmentarily in dashed lines at **8** in **FIG. 1**. While different specific podium-slab thicknesses may characterize different building-structure installations, slab PS herein has a thickness T of about 12-inches.

[**0014**] Especially to be noted with respect to what is shown in **FIG. 1**, is that the vertical load paths which are substantially aligned with the elongate, upright axes, such as axes A_1, of the building-frame columns are not in vertical alignment with the upright axes, such as axes A_2, of the underlying pillars **8** which support slab PS. This arrangement, thus, illustrates what was described earlier herein as the capability for creating a building-frame structure wherein a full-moment frame, such as frame **6**, can safely and soundly be constructed on top of a podium slab without necessarily aligning the vertical load paths defined by the building-frame columns and the podium-slab columns. This possibility, as will be seen, provides ready access effectively to the undersides of the building-frame columns, and through the lower surface of the podium slab, for implementing, in accordance with the invention, full-depth podium-slab anchoring between the podium slab and the building-frame column bases.

[**0015**] Turning attention now to **FIGS. 2 and 3** in the drawings along with **FIG. 1**, here, in these two additional figures, one sees an illustrative, preferred and best mode embodiment of the anchoring structure proposed by the present invention. In the interest of switching, from alphabetic letters to numbers, reference designators for structural components which have already been described with respect to **FIG. 1**, in **FIGS. 2 and 3**, column C1, which is hollow, or tubular, and which possesses a square cross section, has been redesignated with the reference numeral **10**, and podium slab PS has been redesignated with the reference number **12**. The long axis of column **10** is shown at **10***b* in these two figures.

[**0016**] As can be seen in **FIGS. 2 and 3**, column **10** has a base, or base surface, **10***a* which is anchored, as will be described, to horizontal, poured-concrete podium slab **12** through engagement with the planar, upper surface **14***a* in a planar base plate, or plate structure, **14** which is suitably embedded in slab **12**. Plate **14** lies substantially normal to column axis **10***b*. Plate surface **14***a* is substantially coplanar and coextensive with the upper, horizontal surface **12***a* of slab **12**.

[**0017**] As illustrated in **FIG. 2**, slab **12** has the previously mentioned thickness T of about 12-inches, with a lower slab surface **12***b* lying on the opposite side of the slab from upper slab surface **12***a*. Slab surface **12***b* faces downwardly into the open space (the podium space) immediately beneath slab **12**.

[**0018**] Plate **14** sits embedded in a square-perimeter well **12***c* in slab **12**, the bottom of which well is defined by an upwardly facing surface **12***d*. The bottom side **14***b* of plate **14** rests on surface **12***d*, which, together with well **12***c*, takes shape during embedment of plate **14** within the body of the slab during curing of the initially uncured flowable concrete which forms the slab.

[**0019**] Suitably formed in slab **12**, and extending toward and opening to each of surfaces **12***b*, **12***d*, is an elongate throughbore **12***e* (see particularly **FIG. 2**) which is designed to accommodate the clearance passage therethrough of the elongate, threaded shank **16***a* in a bolt **16** which forms part of a nut-and-bolt set (or structure) **16**A that is used to assist in anchoring column **10** in place with respect to slab **12**. The long axis of throughbore **12***e* (not specifically labeled) is axially aligned with column axis **10***b*. A similar, and properly axially coaligned throughbore **14***c* extends through plate **14**, and opens to plate surfaces **14***a*, **14***b*. The head of bolt **16** is shown at **16***b*. The portion of nut-and-bolt structure **16**A which lies above plate **14** is referred to herein as its upper portion, and the portion which lies below plate **14** is referred to as its lower portion.

[**0020**] Joined, as by a weld connection shown at **18**, within the lower, hollow inside of the base of column **10**, immediately above base surface **10***a*, is a sturdy spanner plate, or plate spanner portion, **20** which includes a central throughbore **20***a* whose long axis (not specifically labeled) is also aligned with column axis **10***b*. Throughbore **20***a* is also designed to allow clearance through-passage for previously mentioned bolt shank **16***a*. Anchoring of column **10** to slab **12** herein includes what is referred to as engagement (effectively) between nut-and-bolt set **16**A, and plate **20**.

[**0021**] As can be seen, the components just described which thus involve attachment of the base of column **10** to podium slab **12** through plate **14**, especially with respect to what is visible on the upper side of the overall structure, is neatly concealed and hidden effectively within the base of the column and beneath the slab.

[**0022**] Securement of the column takes place through a suitably apertured and threaded, nut-like receiver **22** which is appropriately anchored, by a weld connection, such as that shown at **24** in **FIG. 2**, to the top surface of spanner plate **20**. The long axis of the threaded aperture in receiver **22** is also properly aligned with column axis **10***b*. The threads in the aperture in receiver **22** are configured appropriately to mate with the threads on shank **16***a* in bolt **16**. Tightening of bolt **16** and receiver **22** from a position beneath podium slab **12** is all that is required to effect firm anchoring of column **10** to the slab.

[**0023**] During construction of slab **12**, preferably pre-apertured plates, such as plate **14**, are appropriately located and embedded in the slab at the time of slab pouring. After curing of the slab, appropriate slab throughbores, such as throughbore **12***e*, are prepared in the correct diametral size, and with the correct alignment in relation to the throughbores provided in plate(s) **14**. These slab throughbores may, of course, and if desired, be formed as a part of, and during, the slab-pouring and curing process.

[**0024**] All columns which are to rise directly from the top surface of one of these embedded plates are prepared in their bases with internal anchored components, such as those shown at **20**, **22**, with these components being secured respectively in place through welds, such as previously mentioned welds **18**, **24**.

[**0025**] To anchor a column in place (through its base) immediately above slab **12**, the column is disposed appropriately upright and in correct alignment over a plate, such as plate **14**, and the shank of a bolt, such as the shank **16**a

in bolt **16**, is passed upwardly through the slab and through the associated embedded plate **14**, next through the associated spanner plate, such as plate **20**, and is then appropriately screwed into, and tightened with respect to, the associated receiver **22**.

[**0026**] Thus, secure anchoring of an upright column in place is accomplished effectively from the underside of a slab, such as slab **22**, with a fully anchored-in-place column being secured through what can be thought of as being full-depth slab securement. From the upper side of this overall arrangement, and as can be seen clearly in **FIG. 1** (as was mentioned earlier), column anchoring/attachment is essentially concealed and blind. It thus presents a very "clean looking" appearance from the perspective of one looking from above the upper surface area of slab **12** and plates **14** downwardly toward the bases of anchored columns. The lateral sides of a column base, so anchored, thus appear to terminate cleanly in an intersecting horizontal plane.

[**0027**] Turning attention now to the embodiment of the invention shown in **FIGS. 4 and 5**, here, while various employed anchoring componentry is similar in some respects to what is shown in the embodiment of **FIGS. 2 and 3**, there are differences, including slab-construction differences. As a consequence, structural components illustrated in **FIGS. 4 and 5** which are similar to certain components in **FIGS. 2 and 3**, are designated with independently different reference numerals and characters.

[**0028**] Accordingly, in **FIGS. 4 and 5**, a fragmentary portion of a building-frame and podium slab structure incorporating this embodiment of the invention is shown generally at **30**. This structure includes a podium **32** having horizontal, and generally planar, poured-concrete slab structure **34** which is formed with two layers, including a base layer **34***a*, and a fill over-layer **34***b*. Slab structure **34** is suitably supported above the ground by spaced pillars/columns (not specifically shown) like those illustrated in, and described with respect to, **FIG. 1**.

[**0029**] Anchored to slab structure **34** in accordance with this second embodiment of the present invention are the bases of plural, upright, tubular and square-cross-section, steel columns **36**, the bases of which are joinied through weld connections to the upper surfaces **38***a* of generally square base plates **38**. Such weld connections are generally shown at **39**. These base plates are in turn, embedded, as will be described, in the upper-layer fill over-layer, or portion, **34***b* of slab structure **34** Plates **38** are generally planar, and are disposed with their flat, upper surfaces **38***a* lying substantially flush and co-extensive with the flat, upper surface **34***c* of over-layer **34***b*. The central portions **38***b* of plates **38** are referred to herein as being spanner portions of these plates, and the laterally outwardly exposed perimeter portions of the plates are said to circumsurround the long axes of the associated columns.

[**0030**] Podium slab base layer **34***a* is the main structural podium layer, with a depth herein of about 10-inches, and fill over-layer **34***b* is a thinner layer, with a depth herein of about 2-inches. Those skilled in the art will recognize that these layer thicknesses may vary from structure to structure.

[**0031**] Although not specifically so illustrated in **FIG. 4**, it should be understood that columns **36** form part of a moment frame like that illustrated in and described with respect to, **FIG. 1**. These columns are disposed with their vertical load axes (not shown) non-aligned with the underlying vertical support axes of the columns/pillars (also not shown) which support podium slab structure **34**.

[**0032**] **FIG. 5** furnishes details of what has so far just generally been described with respect to column base anchoring in **FIG. 4**, and shows that, according to this embodiment of the invention, base plates **38** are themselves "full-depth" anchored to main podium layer **34***a* through suitably tightened nut-and-bolt arrangements, such as the one shown generally at **40** in **FIG. 5**. These nut-and-bolt arrangements are, as can be seen particularly in **FIG. 4**, concealed from view from above, and are tightenable during column installation from below podium slab structure **34**. Fill over-layer **34***b*, after curing of main layer **34***a*, is poured to have a depth which causes its upper horizontal surface **34***c* to be (as mentioned earlier) substantially flush and coextensive with the previously mentioned upper surfaces **38***a* in plates **38**.

I claim:

1. Concealed anchoring structure interconnecting (a) the base of an elongate, upright, tubular, structural building-frame column having a long axis, and (b) a generally planar and horizontal podium slab having a body with upper and lower surfaces which collectively define slab depth, and with the long axis of the column being substantially normal to the plane of the slab, said anchoring structure comprising

elongate, nut-and-bolt structure disposed substantially on the column's long axis, with upper portions thereof concealed within the hollow base of the column above the slab's said upper surface, and the lower portions thereof disposed adjacent the slab's said lower surface, said nut-and-bolt structure anchorably interconnecting the column and the slab.

2. The anchoring structure of claim 1 which further comprises generally planar plate structure joined to said column's base with the plane of this plate structure being disposed substantially normal to the column's long axis, and including a spanner portion extending generally across the column's long axis, and wherein said nut-and-bolt structure anchorably engages said spanner portion.

3. The anchoring structure of claims **2**, wherein said spanner portion includes an elongate throughbore having a long axis which is substantially normal to the plane of said plate structure, and said nut-and-bolt structure includes a bolt with an elongate shank which extends through said throughbore.

4. The anchoring structure of claim 3, wherein said spanner portion substantially fully defines said plate structure, and is disposed within the hollow interior of said column's base, with said column and plate structure joined via a weld connection.

5. The anchoring structure of claim 3, wherein said spanner portion forms a central portion of said plate structure which further includes a perimeter portion extending

laterally outwardly of said column's base in a manner circumsurrounding said column's said long axis.

6. The anchoring structure of claims **1** which further includes a generally planar, slab-contacting base plate having a generally planar upper surface which is substantially co-planar with said slab's said upper surface, with the base of said column engaging said base plate's said upper surface.

7. The anchoring structure of claim 1, wherein, when viewed from above, the anchored connection existing between said column and said slab presents the appearance of the base of the column terminating cleanly with a plane which contains the upper surface of said slab.

* * * * *