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⑤④ **Building structure.**

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Description

The invention relates to a building structure as described in the preamble of claim 1.

Such a building structure is known from "Sonderdruck aus der S.B.Z., Jahrgang 91, Heft 94" of December 6, 1973. The calculation of prestressed flat slabs is based on the assumption that the slabs are plate-shaped and deposited on the columns without taking into account of clamping between columns and slab.

Although this known floor can be constructed with a low rate of concrete and steel the invention does have for its object to save even more material while maintaining the same quality of the structure or to improve the quality of the structure without using more material.

To this aim the structure according to the invention is characterised as described in the characterising clause of claim 1. Due to the fact that the tension cables are concentrated in the regions of the columns, the support strips can be considered as supporting elements sufficiently describing the main static behaviour of the floor. Once having dimensioned these support strips the remaining parts of the floor can be easily dimensioned by considering the remaining parts to be elastically supported by the support strips.

The design can be based on a chosen column dimension. A maximum saving of material, however, can be obtained by selecting the rigidity of columns and support strips so as to match one another. This is described in claims 2 and 3.

Preferably the support strips and the floor slabs constitute a plate-shaped monolith of substantially uniform thickness.

Preferably, the tension cables are bent over outwardly, viewed from the upward direction, at least into a horizontal direction near the rims of the floor above the columns in this area. By said bending, part of the load is directly transferred to the column standing at the edge of the building structure, so that shear stress due to punching effect is reduced.

The invention will be described more fully hereinafter with reference to a drawing.

The drawing schematically shows in:

figure 1 a side elevation of a part of a building structure embodying the invention,

figure 2 a plan view of the part shown in figure 1,

figure 3 a perspective view of a calculation model corresponding with detail III of figure 1,

figure 4 an enlarged sectional view taken on the line IV—IV of figure 2,

figure 5 an enlarged sectional view taken on the line V—V of figure 2,

figure 6 a variant of the structure of figure 5,

figures 7 and 8 a plan view and a side elevation respectively of a diagram of the tension cables of a floor of the building structure shown in figure 1,

figures 9 and 10 each a diagram of the floor

load corresponding to the prior art dimensions and to the dimensions according to the invention respectively,

figure 11 on an enlarged scale detail XI of figure 1,

figure 12 a diagram of load-partition according to figure 11 and

figure 13 on an enlarged scale detail XII of figure 5 during the building operation.

The building structure 1 embodying the invention comprises a plurality of columns 2, 3, that is to say, inner columns 2 and peripheral columns 3, and a plurality of floor slabs 4. When calculating the dimensions of floors 4 and columns 2, 3 each floor 4 is considered to comprise a grating of support strips 5 connected with the columns 2, 3 and floor slabs 6 supported by the support strips 5.

Figure 3 shows a calculation model in which the support strips 5 form a grating having recesses 11, which are covered by floor slabs 6 (not shown) supported by the support strips 5, said support strips 5 and said floor slabs 6 constituting a plate-shaped monolith of substantially uniform thickness as is illustrated in figures 1 and 2.

The support strips 5 extend through the punch region 8 indicated in figure 4 by dot-and-dash lines 7 across the columns 2, 3 and have uninterrupted tension cables 9 and 10 respectively, which extend preferably, but not necessarily from one edge 12 to the opposite other edge 12 of the floor 4. If the support strips 5 form a monolith with the floor slab 6, they have a width of about 1/6th to 1/3rd of the span between the columns 2, 3 so that some of the tension cables 9, 10 may extend outside the punch region.

As shown in figure 8, the tension cables 9, 10 with sufficient concrete coating extend in the middle of the support strips 5 at the lowest possible level and above the columns 2, 3 at the highest possible level, so that they have a slight S-bend on either side of the middle 13 of the columns 2. Likewise on the inner side of the middle 14 of the peripheral columns 3 the tension cables 9, 10 have an S-shaped bend, of which figure 6 only shows the upper part. In other words, the tension cables 9 and 10 are bent over near the edges 12 above the local peripheral columns 3-viewed in outward direction- from the upward direction 15 at least to a horizontal direction 16 (see figure 11). Thanks to this bend the tension cables 9, 10 directly transfer part of the load to the columns 2, 3 so that shear stress due to punch effect near line 7 in the concrete 2 is reduced (see figure 12). The tension cables 9 and 10 are arranged in envelopes 18 and stuck to said envelopes 18, as the case may be, by means of an adhesive introduced through hoses 17 after the tension cables 9, 10 have been pre-stressed and fixed to anchors 19.

Figure 13 shows the disposition known *per se* of the anchor with respect to a casing plate

20 prior to pouring of the concrete 21. Apart from the tension cables 9, 10 the floor 5 comprises mild steel reinforcing networks 23. The columns 2, 3 comprise steel reinforcing bars 24, each extending throughout the column 2, 3 concerned.

The support strips 5, and their reinforcement, in particular the tension cables 9, 10 are proportioned on the assumption that the support strips 5 are each clamped tightly in the columns 2, 3 taking into account the rigidity of the columns 2, 3.

In the diagram of bending moments of figure 9 the floor is assumed to be disposed on the support strips 5 and hence the maximum bending moment M_1 on the support strips in the peripheral region 25 will be about $1/12 ql^2$ for a span l and a theoretically uniformly distributed load g . On the contrary, in the case of a perfectly rigid clamping as shown in figure 10 in the peripheral region 26 the maximum moment M_2 is equal to about $1/24 ql^2$. In proportioning the support strips 5 and their reinforcement in accordance with the invention neither about $1/12 ql^2$ nor about $1/24 ql^2$ are taken into account, but an intermediate moment is considered, because presumably the columns 2, 3 will not be perfectly rigid. Their rigidity is accounted for in the calculations. This results in that the support strips 5 and their reinforcement according to the invention can have smaller dimensions, which implies considerable saving the material. Preferably the floor 4 has a uniform thickness d throughout its surface. Therefore, the aforesaid peripheral region 26 is determinative of the floor thickness d . It is even more preferred to construct the inner columns 2 and particularly the peripheral columns 3 with such a rigidity that the calculation concerned is a near approximation of that of figure 10. It is still more preferred to choose an optimum situation in which the cost of the columns 2, 3 and the support strips are minimized. This can be achieved by selecting the rigidity of the support strips 5 and that of the floor columns 2 and 3 and/or the span between the columns 2, 3 so as to match one another. Comparing figures 5 and 6 it will be obvious that the invention can be applied in the case of a rim 12 protruding like a collar or not protruding.

Claims

1. A building structure (1) comprising a plurality of columns (2, 3) and at least one monolithic concrete flat slab (4) supported by said columns (2, 3), said slab (4) being provided with tension cables (9, 10) mainly extending inside punch regions (8) above the columns (2, 3), characterised in that the slab (4), its tension cables (9, 10) and its reinforcement (23) are dimensioned by replacing the slab (4) by an approximation model of a frame of support strips (5) bridging the spans between columns

(2, 3), and of plates between the support strips, said support strips (5) comprising said tension cables (9, 10) and having widths of about $1/6$ th to $1/3$ rd of the span between columns (9, 10), whereby assuming that the support strips (5) are each clamped in at least one of the columns (2, 3) taking the rigidity of the columns (2, 3) concerned into account.

2. A building structure (1) as claimed in claim 1, characterised in that the support strips (5) as well as each column (2, 3) in which said support strips (5) are clamped and their reinforcement (19) are proportioned on the assumption that the support strips (5) and the columns (2, 3) are clampingly interconnected, taking the rigidity of the column (2, 3) concerned and the rigidity of the support strips (5) concerned into account.

3. A building structure (1) as claimed in claim 1 or 2, characterised in that all support strips (5) and their reinforcement (19) are proportioned on the assumption that the support strips (5) are also clamped in columns (2, 3) standing at the edge (12) of the slab (4), the rigidity of said columns (2, 3) being taken into account.

4. A building structure (1) as claimed in claim 1, 2 or 3, characterised in that the support strips (5) and the floor slabs (6) constitute a plate-shaped monolith of substantially uniform thickness (d).

5. A building structure (1) as claimed in any one of the preceding claims, characterised in that the tension cables (9, 10) are bent over near the edges (12) of the floor (4) above the local columns (3) -viewed in outward direction-out of an upward direction (15) at least to a horizontal direction (16).

Revendications

1. Une structure de bâtiment (1) comprenant plusieurs colonnes (2, 3) et au moins une dalle monolithique plane en béton (4) portée par lesdites colonnes (2, 3) ladite dalle (4) étant pourvue de câbles de tension (9, 10) qui s'étendent principalement à l'intérieur de zones perforées (8) au-dessus des colonnes (2, 3), caractérisée en ce que la dalle (4), ses câbles de tension (9, 10) et ses armatures (23) sont dimensionnés en remplaçant la dalle (4) par un modèle d'approximation d'une structure faite de bandes de support (5) qui portent les intervalles entre les colonnes (2, 3) et de plaques entre les bandes de support, lesdites bandes de support (5) comprenant lesdits câbles de tension (9, 10) et ayant une largeur qui varie de $1/6$ à $1/3$ de l'intervalle entre les colonnes (2, 3) grâce à quoi les bandes de support (5) sont fixées chacune dans au moins une des colonnes (2, 3) en prenant en compte la rigidité des colonnes (2, 3).

2. Une structure de bâtiment (1) selon la revendication 1, caractérisée en ce que les bandes de support (5) ainsi que chaque colonne (2, 3) dans laquelle sont fixées lesdites bandes de support (5), et leur armature (23) sont

proportionnées en fonction de l'hypothèse que les bandes de support (5) et les colonnes (2, 3) sont fixées entre elles, en prenant en compte la rigidité de la colonne (2, 3) concernée et la rigidité des bandes de support (5) concernées.

3. Une structure de bâtiment (1) selon la revendication 1 ou 2, caractérisée en ce que toutes les bandes de support (5) et leur armature (23) sont proportionnées en fonction de l'hypothèse que les bandes de support (5) sont aussi fixées dans les colonnes (2, 3) qui se dressent au bord (12) de la dalle (4), la rigidité desdites colonnes (2, 3) étant prise en compte.

4. Une structure de bâtiment (1) selon la revendication 1, 2 ou 3, caractérisée en ce que les bandes de support (5) et les dalles de planches (6) constituent un monolithe en forme de plaque d'épaisseur à peu près uniforme (*d*).

5. Une structure de bâtiment (1) selon l'une quelconque des revendications précédentes, caractérisée en ce que les câbles de tension (9, 10) sont courbés vers le haut à proximité des bords (12) du plancher (4) au-dessus des colonnes locales (3) d'une direction ascendante (15) au moins jusqu'à une direction horizontale (16), vue dans une direction orientée vers l'extérieur.

Patentansprüche

1. Baukonstruktion (1) mit einer Vielzahl von Stützen (2, 3) und mindestens einer monolithischen Betonplatte (4), die durch die Stützen (2, 3) getragen wird, wobei die Platte (4) mit Zugkabeln (9, 10) versehen ist, die sich in Durchgangsbereichen (8) im wesentlichen über den Stützen (2, 3) erstrecken, dadurch gekennzeichnet, daß die Platte (4), ihre Zugkabel (9, 10) und ihre Armierung (23) dimensioniert werden durch Ersetzen der Platte (4) durch ein Annäherungsmodell eines Rahmens von Träger-

streifen (5), die die Spannweite zwischen den Stützen (2, 3) überbrücken, und von Platten zwischen den Trägerstreifen, wobei die Trägerstreifen (5) die Zugkabel (9, 10) enthalten und eine Breite von 1/6 bis 1/3 der Spannweite zwischen den Stützen (9, 10) aufweisen, wobei angenommen wird, daß die Trägerstreifen jeweils in mindestens einer der Stützen (2, 3) festgelegt sind, wobei die Starrheit der betroffenen Stützen (2, 3) berücksichtigt wird.

2. Baukonstruktion (1) nach Anspruch 1, dadurch gekennzeichnet, daß die Stützstreifen (5) sowie jede Stütze (2, 3) in welcher die Stützstreifen (5) festgelegt sind und ihre Armierung (19) unter der Annahme proportioniert sind, daß die Stützstreifen (5) und die Stützen (2, 3) starr miteinander verbunden sind, wobei die Starrheit der betroffenen Stützen (2, 3) und die Starrheit der betroffenen Stützstreifen (5) berücksichtigt werden.

3. Baukonstruktion (1) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß alle Stützstreifen (5) und ihre Armierung unter der Annahme dimensioniert werden, daß die Stützstreifen (5) auch in den Stützen (2, 3) festgelegt sind, die an den Kanten (12) der Platte (4) stehen, wobei die Starrheit der benutzten Stützen (2, 3) berücksichtigt wird.

4. Baukonstruktion (1) nach einem der Ansprüche 1, 2 oder 3, dadurch gekennzeichnet, daß die Stützstreifen (5) und die Bodenplatten (6) einen plattenförmigen Monolith mit im wesentlichen einförmiger Dicke (*d*) bilden.

5. Baukonstruktion (1) nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Zugkabel (9, 10) in der Nähe der Kanten (12) der Platte (4) über die örtliche Stütze (3) gebogen sind — in Auswärtsrichtung — aus einer Aufwärtsrichtung (15) in mindestens eine Horizontalrichtung (16).

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