(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 December 2011 (08.12.2011)

PCT

(10) International Publication Number
WO 2011/152741 A1

(51) International Patent Classification:
E04B 1/16 (2006.01) *E04B 1/30* (2006.01)
E04B 1/28 (2006.01) *E04C 3/36* (2006.01)

(21) International Application Number:
PCT/PL2010/000046

(22) International Filing Date:
2 June 2010 (02.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(72) Inventors; and
(71) Applicants : **SEMENIVSKYI, Pavlo** [UA/PL]; ul. Zielona 11, PL-43-502 Czechowice-Dziedzice (PL). **DIDENKO, Igor** [UA/UA]; ul.l. Franka 42/24 m. 7, Kiev, 01030 (UA). **VOLGA, Volodymyr** [UA/UA]; ul. Miru 17, Selo Krasne Pershe, Obukhovskiy rayon, Kievska oblast (UA).

(74) Agent: **BALINSKA, Ewa**; POLSERVICE Patent and Trademark Attorney's Office, ul. Bluszczanska 73, PL-00-712 Warszawa (PL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*
— *with amended claims (Art. 19(1))*

WO 2011/152741 A1

(54) Title: CONSTRUCTION SYSTEM FOR BUILDING INDUSTRY, ESPECIALLY IN THE TECHNOLOGY OF FAST ASSEMBLING OF SKELETON TYPE BUILDINGS

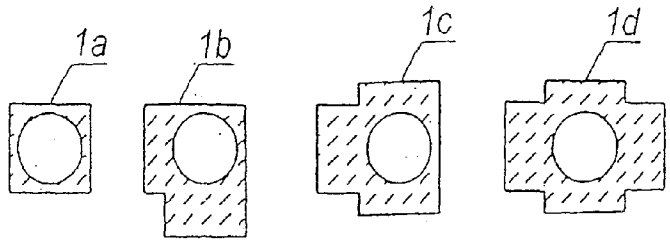

fig. 1

(57) Abstract: A construction system for building, particularly for construction in a fast assembling of skeleton type buildings for various applications, founded on a foundation part (11), comprising supporting skeleton pillars consisting of at least one or more closed- section hollow beam elements (1) each defining an inner central space, a floor structure, wall structures and a roof structure, characterized in that at least one closed- section hollow beam element (1) or more closed- section hollow beam elements forming the supporting skeleton pillars are made of a composition comprising at least filling material consisting of particulate, ground or short -fibre material of natural origin, preferably a comminuted and/or broken -up wood material and at least one binding substance containing a thermoset resin, which composition is extruded by a continuous extruding method using an extruding device, preferably such as a screw extruder.

Construction system for building industry, especially in the technology of fast assembling of skeleton type buildings

Field of the invention

An object of the invention is a construction system for building industry, especially in the technology of fast assembling of skeleton type buildings, particularly skeleton-wall type buildings for different applications, which can be founded on a foundation part, which system includes supporting skeleton pillars. The invention relates generally to the field of three-dimensional building structures, including skeleton-wall type supporting structural systems made of different structural elements, combined in a way which facilitates constructing of the superstructure of the building keeping optimum level of all dynamic and technical factors, during construction of houses up to four floors high for various purposes such as for residential and industrial applications, both in normal and/or complex land conditions, for example in areas of ground settlements, mining damages, seismic hazards and in areas which are subject to extremely high winds. Moreover, the invention relates to the construction of buildings using the system of the above described type.

Background of the invention

Technologies for fast assembling of buildings for various purposes, including cost efficient construction of residential houses, industrial and public utility buildings of a height of no more than 4-stores, including utilization of prefabricated units are widely used in the building industry and developed all over the world. In those technologies the following criteria are important: fast assembling of building, the possibility to build during a whole year i.e. during four-seasons, low weight of a building construction and use of relief foundation, low labour consumption and as low as possible cost of building while maintaining high thermal resistance of external walls and low general energy-consumption during exploitation of buildings, as well as keeping high ecological standard of either used structures or materials used for assembling of buildings.

Different technologies and systems for quick assembling of buildings are known, for example there are systems of monolithic supporting structures made in a lost-shuttering technology, structures of constructional clay tiles, concrete elements of porous concrete, aerated concrete, expanding concrete or silica concrete, framework structures of glued wooden beams or

wooden framework, as well as utilizing metal framework of thin-profiled metal structural sections with wall cladding of sheet cladding material, wherein inner wall spaces defined between opposite sheets of cladding material are filled in with efficient insulation material constituting a wall filling, as well as structures made of expanded polystyrene in a lost-shuttering technology and of "Sandwich" type panels.

Widely known construction system employing lost-shuttering technology from monolithic reinforced concrete structures is "Velox" system, in which a lost shuttering is made of pressed chipboards (called "Velox" formwork boards). In a structure of supporting walls the expanding polystyrene is laminated on "Velox" formwork boards, and after pouring the concrete three-layered wall structure is formed, which demonstrates suitable thermal-insulating and sound-proofing properties. In such a system a floor slab is made as a finned structure employing "Velox" boards or other similar boards performing a function of the lost-shuttering and being arranged to define zones that are filled-in with a concrete. The system requires temperature of over-zero value for erecting of buildings and it can be hardly employed for a building structures having large extension of floor slabs and large distance between supporting walls bearing the slabs. However, this is very efficient system, ensuring high speed of assembling, as well as adequate stiffness and strength of a building.

Further, there are known systems in which a framework construction system made of glued beams is employed, which skeleton wall structure is covered with a sheet- or board covering material, for instance such as OSB board or veneer board. For applications of those types construction systems, for instance such as "KRONOPOL I-BEAM" system it is necessary to use high quality wood, i.e. of relatively expensive sort, whereas a fire resistance of such structures is relatively low.

Another widely used fast-assembling system for erection of several-storey buildings is, for instance, the system known as STEICO system, in which a building skeleton is formed of a structural I-joists elements having spaced apart opposite flanges made using calibrated wooden board which are connected by a web of a pressed fibreboard or chip-board material, for instance OSB of 10 mm thickness or a hard fibreboard. I-joists in STEICO system are used as supporting elements of skeleton pillars, in a construction of floor slabs and as truss elements of a roof structure. After being constructed a skeleton is covered with a suitable cladding material, usually in a form of sheets or panels, and internal spaces of walls are filled with insulating material, for instance wood-fibre material or mineral wool. During constructing of a roof structure the I-joists structural beams are fastened to a roof ridge by

metal junctions and further webs of I-joists are reinforced by additional insert of wooden or chip-board material. A construction system of such type demonstrates many advantages resulting mainly from large flexibility, quick making and ease of assembling either the buildings or internal installations. Whereas, drawbacks of such system are relatively poor acoustic insulation of a building and some "instability" of a floor. The STEICO system demonstrates especially good techno-economic efficiency in relation to a monolithic structure of a multi-layered floor slabs made using the system, especially the one which is made in a lost shuttering technology, in which I-joists forming structural frame being filled with insulation material are utilized. Similar type of a structure of multi layered floor slabs is disclosed also in UA 82634 patent.

Additionally there is known the solution utilizing a framework structure made of metal elements in quick assembled buildings, for instance light thin-walled metal structures, such as KCE. In this technique a basic structural element is three-dimensional frame of profiled galvanized steel and metal framework of similar, profiled elements and utilizing roof panels made in a form of a frame of the same profiled elements and being provided with cladding of OSB panels. The junctions of the construction are made by means of galvanized sheet-metal screws. The skeleton of the building structure in such system is then covered by sheet- or panel cladding material, wherein filling of internal spaces is provided utilizing thermal insulating and soundproof material. The said system presents a good structural strength and stiffness, even in the case of higher i.e. several stores buildings, but it creates difficulties in elimination of thermal bridges, particularly in areas of door and window opening frames. But in the KCE system a frame structure of a roof of thin-walled galvanized steel profiles is especially efficient both in economical and technical aspects.

Constructional solutions utilizing modular construction of the building skeleton made of metal supporting framing of the building, including supporting beams with rectangular cross section made of metal profiled have been also disclosed, for example, in patents No. US 5,289,665, US 4,054,392 and US 5,493,834.

Further known construction system of a supporting wall panel of Sandwich-type with a hidden framing in which said panels comprise a frame made of bent galvanized C-shape profiled metal, in which profiled arms are turned outwards, and when connecting panels together, a free space of rectangular cross-section is formed between them, which space is filled with concrete and in case of need to increase strength parameters an additional reinforcing framing is provided. External frames are covered with the sheet cladding material, and the inner spaces

are filled with insulating material, for example, a fibrous one. In the construction of buildings in such system the inner spaces of vertical supporting pillars and the upper contour of the metal profiled are cemented, thereby a reinforced concrete frame is formed, which houses a three-layered wall structure. The similar type of building structure consisting of prefabricated sections comprising flat frame wall, floor and roof elements which are connected with the fasteners is known from teachings of the international application publication WO95/02097.

Construction systems of buildings described above are suitable for erection of buildings of varying durability and very high fire performance only in the normal ground conditions in terms of geological and climatic conditions. They all have too low structural strength preventing utilizing them in harsh conditions, for example, in seismic hazard areas, landslide areas, areas of mining damages, hurricane winds and ground deformation.

US patent No. 5,537,786 discloses, for example, using strengthening of building structures, in particular reinforcing of the roof truss framing structure, particularly in buildings of skeleton-wall construction types by means of additional fastening straps, which are anchored on its ends by means of the tensioning device in the foundation on opposite sides of the building, which straps are provided on the outer side of the building and around the roof, above the ridge in the special guiding elements under appropriate pre-tension. Another solution for strengthen the building structures, especially the roof, in case of hurricane wind is disclosed in patent US 5570545, in which reinforcing bars are utilized arranged around the roof of the building and mounted on opposite sides of the building beyond its contour.

Purpose of the invention

The aim of the present invention is to develop a system for building construction, particularly for skeleton-wall type buildings in a rapid mounting technology, providing good technical and dynamic factors of erected buildings, particularly up to 4 stores high, such as especially, good structural strength and reliability of the structure during erecting of houses in both normal and complex ground conditions, such as land settling, areas of mining damages, seismic hazards areas, hurricane winds areas and landslide areas. Furthermore, the object of the invention is to develop a construction system providing increased fire resistance of the superstructure, as well as ensuring good soundproof properties and thermal insulation of building barriers and increased thermal resistance of external walls. The aim of the present invention is further providing a construction system for building, which would enable the quick construction in all-year-round construction system with a minimum number of "wet" processes *in situ*, low workload and low material and energy consumption, at the same time guaranteeing low

energy consumption of finished buildings during the operation, as well as also to provide buildings of the durability which is required by respective regulations and repair capabilities of the design as a whole and with regards to its individual structural elements while ensuring ecological characteristic parameters of used structures and materials.

In addition, by applying an internal coverings made of board elements with a smooth surface, a significant reduction in a labour and costs associated with finishing works, especially works connected with finishing of internal walls is achieved.

Summary of the invention

The above objects and advantages of the invention are achieved by providing the system, described through specific features indicated in the attached claims, for building construction, especially for erecting of buildings in the fast-mounting technology of skeleton-wall type buildings for different purposes, which may be supported on the foundation.

The construction system for building according to the present invention includes supporting skeleton pillars consisting of at least one or more closed-section hollow beam elements, each defining an inner central space, called "hollow beams"; floor structure; walls structures and a roof structure, wherein in the inventive system the supporting skeleton pillars comprising one or more closed-section hollow beam elements i.e."tubular hollow beams" are made of a composition comprising at least a filling material in a form of particulate, ground or short fibre material of natural origin, preferably comminuted and/or broken-up wood material, and at least one binding substance containing a thermosetting resin, which composition is extruded by a continuous extruding method by means of an extruding device, preferably such as a screw extruder.

According to one aspect of the invention in the construction system an inner central space defined within close-section hollow beam elements constituting the supporting pillars has a shape of a longitudinal channel of substantially circular cross section, whose surface is provided with a continuous groove in the form corresponding to the thread shape, extending along a screw line over entire length of a close-section beam element.

According to another aspect of the invention in the closed-section hollow beam element a cross-sectional area of the internal channel is about half of the entire area of the total transverse cross-sectional area of said hollow beam element.

In further aspect of the invention, in the closed-section hollow beam element at least one thermosetting resin, selected from the group consisting of urea-formaldehyde resins, phenol formaldehyde resins, melamine-formaldehyde resins and/or urea-melamine-

formaldehyde resins in a total amount from 4% to 30% by weight is used as a binding substance.

According to another aspect of the invention in the construction system the filling material used in the composition for the production of closed-section beam elements comprises wood particles or pieces and/or short fibre bulk materials of plant origin, preferably cellulose fibres and/or fibres obtained from natural minerals, preferably basalt or glass fibres.

According to another aspect of the invention, in the construction system, supporting pillars consisting of one or more closed-section hollow beam elements with an empty inner central space have an external shape of miscellaneous shaped cross-sections, which shape is adapted to the construction of the serial, corner, T-shape and/or cruciform constructional joints, while the inner central space defined within closed-section hollow beam elements is provided with a filling comprising at least one filing material selected from the group consisting of: insulating material, concrete, reinforced concrete and/or high-quality, pre-tensioned reinforcement, preferably tension-member, which filling facilitate the erection of buildings up to 4-stores high in the normal geological conditions, as well as difficult geological conditions, for example in the areas of ground settlements, mining damages, seismic hazards, landslide areas, as well as in areas of hurricanes occurrence.

According to yet another aspect of the invention, in the construction system, walls are made from cladding panels are constructed of a cladding in a form of sheet cladding particleboards mounted on both opposite sides to the supporting skeleton pillars, wherein said wall spaces defined between the cladding panels is filled with high-performance insulation material, whereas the distance between the cladding panels is determined on the basis of thermal calculations while ensuring the wall thermal resistance of at least Rs = 3.0 $m\ ^0C/W$ or more and the fire resistance of at least 50 REI. A variety of filling materials can be used which are arranged between the cladding panels, as well as such materials can be used to fill the inner central space of the close-section hollow beam elements, for example such as, selected from the group consisting of mineral wool, basalt wool, foamed polystyrene panels, bulk insulating material and similar materials commonly used in construction for the purpose of filling and thermal- and sound-insulation of external and internal walls.

In further aspect of the invention the wall structure can be made of closed-section hollow beam elements, each defining inner central space that are arranged between supporting skeleton pillars and forming a filling of walls, said closed-section hollow beam elements can be stacked in pile horizontally in perpendicular direction to said skeleton pillars and/or they

can be arranged in side-by-side configuration parallel to said skeleton pillars. In preferred embodiment said closed-section hollow beam elements arranged to form wall structures can have said central inner space defined therein filled with insulating material, for example such as selected from the group consisting of mineral wool, basalt wool, perlite, foamed polystyrene, as well as other insulating bulk and/or granulated material exhibiting good thermo insulating and soundproof properties.

According to further another aspect of the invention, the floor structure comprises monolithic, reinforced-concrete ribbed floor slabs made utilizing a lost-shuttering method in which the lost shuttering is made in the form of "sandwich" type panels in which I-beams (I-joists beams) are utilized that are provided with a clean ceiling lining of sheet material boards, and wherein inner space which is defined between the opposed boards is filled with soundproof and thermo insulating material, the thickness of said "sandwich" type panels and the distance between the opposed boards facilitate to obtain T-type cross section of the concrete beam adjusted to withstand the required load and span of the panel up to maximum 9 meters, ensuring the required standards of bending strength and tensile strength, as well as stiffness, soundproof, thermal insulation and the fire resistance of the structure higher than the REI 60.

In further aspect the roof structure is, preferably, constructed from metal profiles in the form of trusses, particularly made of thin-walled bent galvanized metal profiles.

According to one embodiment of the invention said roof structure, is made in the form of framework of different configurations, wherein in the supporting part of the framework structure a metal plate is arranged having a hole for passing the reinforcement, preferably a tension member and its attachment to the building structure, said tension member passes through the inner central space of said supporting pillar closed-section hollow beam element and it is fastened to a foundation part of the building.

In addition, in yet one embodiment of the invention, any possible spacing between the skeleton structure vertical supporting pillars comprising one or more said closed-section beam elements defining an inner central space can be used, depending on the architectural solution of the building, but not exceeding 9 meters distance, while maintaining the condition that in the transverse cross-section of the building said supporting pillars, said reinforced concrete ceiling beams, provided between the lost shuttering of "sandwich" type plates and said trusses made of thin-walled galvanized metal profiles of said roof structure are arranged in one plane.

Short description of the drawings

The object of the invention is illustrated in preferred embodiments in drawings, in which:

Figs. 1a-1d show top views of the first embodiment of skeleton structure vertical supporting pillars consisting of closed-section hollow beam elements defining inner central space in various variants used in a construction system according to the invention, wherein fig. 1a shows a serial vertical supporting pillar, fig. 1b shows a corner supporting pillar, fig. 1c shows T-type vertical supporting pillar and fig. 1d shows a cruciform vertical supporting pillar;

Figure 2 shows the essential scheme of the arrangement of supporting pillars of the building skeleton in one embodiment of the invention in a top view;

Figs. 3a-3c show supporting pillars of the building skeleton in top views for various types of buildings in the embodiment according to the invention, wherein fig. 3a shows supporting pillars for single store buildings (one floor), fig. 3b shows supporting pillars in second embodiment for two stores buildings, fig. 3c shows supporting pillars in second embodiment for four stores buildings and for buildings in complex land conditions;

Figs. 4a-4b show supporting pillars in second embodiment for the building skeleton according to the invention for areas of seismic hazards and hurricane winds, wherein fig. 4a shows top views of corner, T-type and cruciform joint of the structure, and fig. 4b shows a fragment of the building facade with window opening according to the invention;

Figs. 5a-5b show top view, in cross section, of a structure of the external and internal walls in the embodiment according to the invention, where fig. 5a shows top view of a cross section fragment of the structure of the external and internal walls for a building of the height up to two stores, fig. 5b shows top view of a cross section fragment of the structure of the external and internal walls for a building of the height up to four stores, and fig. 5c shows a fragment of a wall for a building with window opening in a top view and in a cross section;

Figs. 6a-6c show cross section of structures of "sandwich" type panel for a ribbed reinforced-concrete floor slab in the embodiment of the invention, wherein fig. 6a shows a plan of the panel, fig. 6b shows a cross section of the panel along line 1-1 in fig. 6a, fig. 6c shows a cross section of the panel along line 2-2 in fig. 6a, and fig. 6d shows embodiments of beam structural elements for structures of frames of "sandwich" type panel;

Figs. 7a-7d show ribbed floor slab of "Sandwich" type panels in one embodiment of the invention in cross section, and

Fig. 7e, f show the embodiment according to the invention of the junction of the ribbed floor slab with vertical supporting walls and a vertical cross section of the junction of the reinforced-concrete floor slab in a position of a cementing of the central inner space of the supporting pillar.

Detailed description of embodiments according to the invention

Construction system for building, especially for erecting in the technology of fast assembling of skeleton-wall type buildings according one embodiment of the invention includes the following main structural elements that are joined together in an appropriate manner, provided by the invention, for obtaining a compact and durable construction of the building. Namely, said main structural elements include: supporting pillars of the skeleton consisting of at least one or more of closed-section hollow beam elements, inside which an inner free central space is defined; floor structure, preferably made of monolithic reinforced-concrete ribbed floor slabs, manufactured utilizing the lost shuttering method; walls made of cladding panels with filling the space defined between the external and internal cladding panels with lightweight thermo insulating filling material; and the roof structure, preferably truss construction.

According to the invention skeleton supporting pillars are made of closed-section hollow beam elements, called "hollow beams", produced by continuous extrusion method using a screw extrusion device from a composition containing filling material consisting of at least particulate material of natural origin, preferably of wood particles material and at least a binder substance, such as a thermosetting resin with various optional additives.

Said close-section beam element 1 which is included in a supporting pillar in the preferred embodiment of the invention is provided with a longitudinal central opening 1', preferably of circular cross section, the surface of which is provided with protrusions formed by turns of the screw line extending along longitudinal axis of the opening 1'. Further embodiment is possible, in which the screw line is the line with one, two or more turns.

The hollow beam element 1 is manufactured by continuous extrusion of a composition containing as the basic component at least the filling material, which may be selected as material containing particles or fibres from minerals and/or fibrous or particulate material of plant origin, in particular comminuted wood material, ground pieces and particles originated from wood or composite wood products, usually post-working or wood waste material, as well as wood which is not commercially valuable, and other cellulose particulates and fibres, and also fibres from stems and another parts of plants. The filling material on the basis of minerals can be fibrous elements of natural or mineral origin such as basalt fibres, glass fibres, slag wool and similar material fibres and particulates. As the filling material can be also used a selected chemically inert mineral, for example an asbestos material. According to the invention, a filling material can be one kind of above mentioned ground and comminuted

material, or a mixture containing two or more various above mentioned particulate or fibres elements both mineral or plant origin.

An additive of a cement or gypsum can be also used, which will have additional function as a binding agent to give the specific functions and features to beam elements, such as closed-section hollow beams.

Especially recommended and beneficial in terms of cost and availability of raw materials the embodiment of the closed-section beam element 1 according to the invention includes use as a filling material a ground or comminuted wood material in form of chips, shavings or particles, including the wood fuel, industrial wood chips, wastes from sawmills and wood processing plants or industrial production of wood products, for example, furniture and furniture parts, plywood and various types of boards containing the wood material, as well as waste from felling trees in a shredded form, such as wood chips, sawdust, cuttings boards, skirting boards or scrap in the form of coarse-lump of waste and small-particle wastes.

The second essential component of the said composition is a binding agent and/or substance, such as at least one resign, which resigns under influence of heat and pressure are able to join, bind or glue together particles of filing material comprising woody particles and shavings firmly. Recommended in particular are thermosetting resins, which while heating pass initially from liquid to suspended state, and then irreversibly to the solid state, with thermosetting resins can be selected from groups including urea-formaldehyde resins, phenol formaldehyde resins, melamine-formaldehyde resins and urea-melamine-formaldehyde resins, as well as poly-ether resins. By binding of filling material particles using binding substances based on said thermosetting resins mentioned above hollow beam elements can be manufactured by a method of continuous extruding, said beam elements 1 exhibit high stiffness and mechanical strength. The most suitable for the manufacture of beam elements with increased resistance to weather conditions are phenol-formaldehyde resins, which are also resistant to activity of biological agents, fungus, mould, insects, etc. However, due to cost optimization is recommended to use phenol-formaldehyde resins for the manufacture of beam elements for specialized uses, for example in construction, as well as urea-melanin-formaldehyde resins. However, urea-formaldehyde resins, which give relatively lower operating parameters to beam elements, are significantly cheaper and more cost efficient in production.

To the extruded composition comprising filling material and a binding agent discussed above can be optionally added additives such as catalysts, promoting speed up reaction, lubricants and other additives giving specific properties to produced beam elements 1 depending on the

requirements of their application, the composition may contain one or more additives simultaneously. They can be, for example, hydrophobic additives such as paraffin, ceresin, petrolatum or wax, which are added to the chips in the manufacturing process in a form of melt or emulsion or as a component of the resin. Optionally, aseptic additives are applied, such as pentachlorophenol in an amount of 1-2% by dry weight of filling material, or sodium fluoride and sodium fluorosilicate and mixture of sodium fluorosilicate with copper (II) sulphate pentahydrate or zinc chloride, and further additives reducing friction during extrusion. For special requirements in relation to fire resistance the additives to the binding substance may be used to increase fire resistance, in particular, flame retardants such as orthoboric acid, ortophosphoric acid or their salts or mixtures, also with other substances, for example zinc chloride. Extruded composition may also contain a certain amount of hardening agent

According to the invention, the composition used for manufacture of the close-section beam elements 1 has the total content of 4% to 30% by weight of the binding substance/agent in the form of the above mentioned types of resin depending on the moisture content of filling material used.

Fig. 1 shows, for example, in top view, the cross sections of the supporting pillars utilized in first embodiment of the invention i.e. consisting from close-section hollow beam elements used as corner elements 1b (fig. 1a) utilized in corner constructional joint "1" in corners of the building at a location of junction of perpendicularly extending external and/or internal walls in corner positions, as serial elements 1a (fig. 1b) in serial constructional joint "2" in a structure of straight parts of building walls, both internal and external, as T-type elements 1.c (fig. 1c) used especially in T-type constructional joints "3" at a location of joints of perpendicularly extending walls, both external and internal, and as cruciform element 1.d (fig. 1d) used in cruciform constructional joints "4" at a locations of joints between perpendicularly extending walls, usually internal ones, which internal walls can be supporting walls. Exemplary arrangement of supporting pillars in the embodiment of construction of a building in one embodiment of the present invention is shown in Figure 2, and the appropriate arrangement of supporting pillars in the form of corner "1", serial "2", T-type "3" and cruciform "4" constructional joints is presented.

The constructional joints, such as corner "1", serial "2", T-type "3" and cruciform "4" joints in another embodiment according to the invention can have a form which is presented in a cross section in figs. 3b-3c, in which above mentioned constructional joints are presented in

the second embodiment of supporting pillars composed of at least two or more closed-section hollow beam elements 1 in a form of serial elements 1.a comprising in the following manner: two beam elements located in series "side by side", creating the serial constructional joint "2"; three serial beam elements 1.a located side by side, creating a corner constructional joint "1"; four serial beam elements 1.a located in relation to each other in the way constituting T-type constructional joint "3" and five serial beam elements 1.a located side by side in such a way, that they create a cruciform constructional joint "4".

In the embodiment presented as an example in fig. 3b, constructional joints "1", "3" and "4" constituting the supporting pillars being provided with reinforcement, so that they can be used in construction of the lower store e.g. ground floor of multi-storey buildings, for example, up to four stores high, or in the construction of buildings erected in areas of difficult geological and whether conditions such as hurricane wind hazards or so. In preferred embodiments of the present invention, vertical supporting pillars of the skeleton, depending on requirements relating to strength of the structure arising from the number of stores of the building or the requirements arising from the terrain, as well as arising from requirements related to thermal and/or sound insulation of the building can be used with various types of filling of an inner central space defined inside said close-section beam elements that form those supporting pillars. For example, in one-store buildings, free-standing supporting pillars are used with thermo insulating filling 10 containing Siopor-concrete or thermo-acoustic cement-expanded polystyrene mortar "Polytech" or other similar thermo- and sound insulating material (see Figure 3a).

In another embodiment according to the invention (see Figure 3b) the central space of hollow beam elements 1 forming the supporting pillars can be filled with heavy concrete 20, for example, in the case of supporting pillars of the ground floor construction of the two-stored or multi-stored building. In said embodiment, the central space of hollow beam elements 1 forming supporting pillars for the second and subsequent stores of the building can be filled with thermal insulating material 10 such as Sipor-concrete (Sioporbeton), Polytech or another bulk insulating material, for example such as expanded perlite, foamed polystyrene and similar insulating material, in particular in the form of granules or bulk material.

In the case of multi-storey buildings, including up to four stores, as well as for buildings, in which the axial span between pillars is increased, for example distance up to 9 m, the supporting pillars located at axes of the building have the central space of hollow beam elements filled with heavy concrete 20, in the preferred embodiment, the central spaces of

hollow beam elements are filled with heavy concrete at least in supporting pillars used at a ground floor of the building, while at the second and optionally subsequent stores the filling with thermo-insulating material such as Siopor, Siopor-concrete, Polytech and similar materials can be used. During erecting of four stores buildings it is preferred to use filling of inner central spaces of hollow beam elements 1 of all supporting pillars with heavy concrete.

The types and ways of filling the central space of hollow supporting pillars and their arrangement discussed above are applicable to the erection of buildings under normal field conditions, which do not require higher strength or resistance of buildings to shocks or hurricane forces.

However, according to embodiment of the invention, in the case of erecting buildings using inventive construction system of the building skeleton, in any case the supporting pillar in the form of the cruciform constructional joint "4" should be always arranged as a stopper constructional joint in the middle of a skeleton structure, particularly in a case of extensive span between neighbouring constructional joints, and especially in a case of the large span between the pillars (beams) of up to 9 meters.

Figure 3c shows an embodiment of the present invention, in which the structure is adapted to erection of four stores buildings or buildings in the difficult field conditions, for example, in seismic hazard areas, landslide areas, ground settlements and/or mining damages. In this embodiment, the central inner space in hollow beam elements 1 forming supporting pillars is filled with a heavy concrete, in which reinforcing skeleton 30 made of a reinforcing steel is embedded.

In areas with higher requirements for mechanical strength design of buildings, for example in areas of seismic disturbance or threat of damage due to mining works, as well as vulnerable to hurricane winds, is used, preferably, for example, the building structure shown in Figure 4a and 4b, in which as a filling of inner central spaces defined inside said hollow beam elements 1 of supporting pillars for corner constructional joint "1" (see Fig. 4a), in the area of a corner elements, tension members 40 are used made of pre-tensioned reinforcement and filling 50 material, such as said bulk thermo insulating material, whereas in adjacent hollow beam elements 1 creating arms of said corner constructional joint "1" central spaces are provided with said reinforced skeleton 30 which is surrounded with heavy concrete filling 20. In the case of T-type constructional joint "3" (fig. 4a), in said inner central space of the centrally placed hollow beam element, the tension member 40 made of pre-tensioned reinforcement is arranged and the space is filled with thermo insulating filling 50, whereas in adjacent hollow

beam elements forming said constructional joint (supporting pillar) the central spaces are provided with reinforcing skeleton 30 and with heavy concrete filling 20. Similarly, a cruciform constructional joint "4" in said inner space of a central hollow beam element the tension member 40 is arranged made of the pre-tensioned reinforcement and a filling 50 consisting of thermo insulating material is provided, whereas in inner spaces of remaining hollow beam elements forming such constructional joint (supporting pillar), in a preferred embodiment, a reinforcing skeleton 30 and heavy concrete filling 20 are used.

In such construction of constructional joint, after appropriate distribution of forming them supporting pillars according to the particular design of the building, said tension members 40 of the pre-tensioned reinforcements in all relevant supporting pillars are mounted at their lower ends by an anchoring method in a concrete foundation of the building, and at their upper ends said tension member is passed through a beam 15 which reinforces a bond, mounted along the contour, then is passed through said monolithic ribbed reinforced-concrete slab 16 of the floor slab and finally it is connected by means of tensioning element 7 to truss construction 8 of the roof, preferably made of bent metal profiles, by means of supporting panels 9 made of steel sheet (see fig. 4b).

In one embodiment of the invention, in the case of such reinforced structures, the inner central space of a central supporting pillar is filled with reinforced concrete 20, and in adjacent pillars, preferably in each and/or at least one of neighbouring pillars, i.e. in one or more adjacent pillars tensioning members 40 made of the reinforcement of high strength can be placed, which members are anchored at lower ends in a concrete of foundation slab, extend along full height of the building, and next they extend to a supporting part of a roof structure, where they are tensioned by means of a rigging screw 7 while creating appropriate pre-tension of said members and necking of the pillars of a skeleton along a full height of the building. The empty space around the tensioning members 40 in said inner spaces of hollow beam elements of said supporting pillar is filled with efficient thermo insulating material, for example with a bulk material 50 such as perlite, Siopor, polystyrene beads and the like, so as to ensure good thermal insulation properties of these constructional joint, while not impede the vertical pre-tensioning reinforcing rods.

After assembling the skeleton made of said supporting pillars the assembling of external and internal cladding panels made of sheet material is carried out and between them is placed the appropriate filling material 50' being a thermo insulating and sound insulating material in a form of layers of mineral wool, basalt wool, Siopor-concrete, Polytech material and other

similar materials usually used for filling walls of commonly known skeleton-wall structure buildings.

Preferably, the insulating filling material used should have adequate stiffness that is it should maintain its own shape, for example, the shape of boards or other spatially-formed elements such as bricks, beams and similar, so as to not exert excessive pressure on the outer and inner layers of the cladding, such as cladding panels of internal or external walls. Examples of filling materials, which may be utilized in walls filling according to the invention also include: stitched basalt wool blankets, elements on the basis of expanded polystyrene, insulating fibrous materials, warming elements on the basis of perlite and other materials with similar characteristics. As the sheet wall cladding material may be used, in particular, veneer boards, OSB, MDF boards, DSP cladding boards, wainscot wood boards and composite wood or plastic, and also carpeting siding type and the type of materials with similar properties.

In one embodiment of the present invention in the wall constructions closed-section hollow beam elements defining inner central space as described earlier can be utilized, made by a continuous extruding method by means of a screw extruding device from a composition including particulate or comminuted wood material or another particulate material or fibrous material of natural origin, including plant origin, and a thermosetting resin. In this application, empty central spaces of hollow beam elements can be filled with insulating material, preferably in a form of bulk material, such as foamed polystyrene beads, granulated product, perlite, etc. Beam elements utilized as a filling of walls have, preferably, rectangular or square cross section. In said construction of walls said hollow beam elements can be arranged horizontally, perpendicularly to the supporting pillars, and placed in pile one on another. Said hollow beam elements can be also arranged in side by side configuration in parallel to said supporting pillars, and while utilizing such configuration of wall constructions the requirements related to finishing of walls both from inside and from outside are significantly lower, because in a case of such walls a high smoothness of wall surface at once is obtained. For example, for finishing external walls only gypsum-paperboard panels can be used of a very low strength, subsequently decrease in material cost and workload connected with finishing works can be ensured.

In case of using other fillings of walls for external and internal cladding the plate or sheet finishing elements of a higher strength, deformation resistant under the load exerted by the filling material, such as a veneer panels, OSB, MDF panels, DSP cladding and similar materials of sufficient mechanical strength are used.

Sample solutions of the wall design in the system according to the present invention are shown in Figure 5a-5c. Figure 5a shows an embodiment of the walls of the building of two stories height in the cross-section in which supporting pillars are utilized in the form of adequately shaped corner 1.b, serial 1.a and T-shaped 1.c hollow beam elements 1, in which the central empty spaces are filled with lightweight filling material 50 having thermo insulation properties, preferably bulk material. Similarly, interior spaces of walls are filled with thermo- and sound insulation material 50', which is coated on the outside with a cover in the form of plate or sheet cladding of the above mentioned kind. Fig. 5b shows an embodiment of the building wall in the system according to the invention for a building of four stores height, in a cross-section, using the supporting pillars in the form of adequately arranged beam elements 1 forming, respectively, a corner "1", serial "2" and T-type "3" constructional joint, in which the empty inner spaces of hollow beam elements 1 are filled with a heavy concrete 20, in which reinforcing skeleton 30 is embedded, and wherein internal spaces of walls, between supporting pillars, are filled with thermo- and sound insulating material 50', and a wall covering is provided with a cladding in the form of plate or sheet cladding elements of the above discussed kind. Additionally on external sides the areas of external walls adjacent to the positions of supporting pillars and their direct neighbourhood are covered with thermo-insulating material. Fig. 5c shows an embodiment of the wall part of the building in the system according to the invention adjacent to window and door openings, with mounted window opening, which said window opening is limited on both sides, looking at the longitudinal direction of the wall by an appropriately placed serial hollow beam elements having their empty central spaces filled with lightweight insulating material 50 of the aforesaid type, for ensuring good insulation properties in places of window settlement and simultaneous increased strength of the wall structure in those places. The similar solutions are applied in relation to door openings. After erection of walls, during which holes are provided to settle the windows and doors, the beam 15 reinforcing the bond is mounted on the contour of the wall on the top of wall, between cladding layers made of sheet elements (Fig. 4b). Ready outer wall structure has high technical parameters: thermal resistance $R > 3m\ ^0C/W$, fire resistance in terms of capacity, integrity and insulation is at least REI 50.

After the erection of said vertical walls to a given level the floor slabs are placed, in the embodiment according to the invention a store is made of reinforced-concrete monolithic ribbed slabs made in the technology of lost shuttering using "Sandwich" type panels as shown, for example, in a fragment in fig. 6a, b, c. "Sandwich" type panels or boards 21 are elements

of lost shuttering in the construction of monolithic reinforced-concrete ribbed floor slab (Fig. 7a, 7b), that said boards are supported on beams 15 reinforcing the bond. "Sandwich" type boards 21 can be manufactured using I-joists 25, for example, known in said Steico-system explained above, or other I-joists (I-beams) or having similar profile, for example, shown in Fig. 6d with a web made of hardboard or OSB board which combines two wooden flanges 25a, in the form of the chipboard element of solid section 25b, or from beams which are connected by the bent metal profile 25c, or from wood-polymer composite 25d such as "liquid wood", or from the bent metal profile 25e (fig. 6d). Thermal insulating and soundproof insulating material 23 is placed between the frame beams 25 of the "Sandwich" boards 21, for example, inserts from fibrous material, for example, Rockwool type of mineral wool, mineral wool mats, or stitched basalt wool blankets and similar materials, while from the top the "Sandwich" board 21 is covered with material in the form of fibreboard or cardboard sheets 22, whereas from the ceiling side it is fitted with a finishing cladding of the sheet or plate cladding material 24, for example of gypsum-cardboard boards, MDF boards and similar materials.

During manufacturing of a monolithic ribbed floor slab of reinforced concrete between laid down Sandwich boards 21, in the spaces between adjacent boards the reinforced skeleton 28 is arranged (Figure 7a, 7b, 7c), and on the top at the upper side of the sandwich-type boards 21 reinforcing mesh 27 is arranged (Figure 7d) which can be combined with reinforcement element positioned at the junction of the horizontal floor slab and the structure of vertical supporting walls (Fig. 7e). After lying sandwich type boards 21 and prior to, or following installation of reinforcement elements of the floor slab, respective supports 26,26a of the floor are arranged from below in a form of beams and pillars of the reusable shuttering, whereby the individual slabs are supported on the respective beams and pillars of the reusable shuttering. The elements of the reinforcing skeleton 28 are further arranged between Sandwich type boards 21 (if they were not laid down earlier) (fig. 7c and d), preferably in a form of the skeleton of triangular cross section, and then both, an upper board and a space of gaps between Sandwich type boards 21 together with the reinforcement 28 arranged between them are filled with a poured concrete.

The elements of the reused shuttering 26,26a can be removed after hardening of the concrete filling, i.e. after about 7 days, starting from a time of pouring of the concrete. According to the invention, in the proposed construction system, next store of the building, and all subsequent stores and roof structure may be erected immediately after assembling the floor slab structure,

without waiting for setting of a poured concrete mortar and dismantling of the reusable shuttering, so that avoiding technological break, because proposed store construction is a self-supporting structure, and layers of the concrete mortar serve only for imparting the appropriate stiffness of the floor and damping of vibrations. The structure of the subsequent store of the building can be mounted in a way similar to above described first store, also in relation to a subsequent ceiling structure.

In Fig. 7e and f is presented an embodiment of the present invention relating to possible preferred solution of a structure of a junction of monolithic reinforced-concrete ribbed floor slab with the structure of the vertical wall, especially in the area of said supporting pillar in a form of hollow beam element 1 with the inner central space. In Figure 7e another embodiment is presented, in which a central inner space of said supporting pillar in a form of hollow beam element 1 is not filled with concrete filling material and it doesn't have a reinforcement, however, at an upper bearing side of a lower supporting pillar and at a lower bearing side of an upper supporting pillar, along a wall contour, between panels of the wall sheet cladding 12, a lower and upper beams 15 reinforcing the bond are arranged, which are mounted along a contour.

In addition, in the space of the ceiling between those reinforcing beams 15, a reinforcement is placed combined with reinforcing mesh 27 on the upper side of the reinforced-concrete floor slab 31. In Fig. 7f is shown another embodiment of the invention, according to which said empty central space of the supporting pillar consisting of beam elements 1 is flooded with concrete filling material and has the reinforcement 32 extending along full height of a lower pillar and upper pillar and a space between those pillars in the contour of monolithic reinforced concrete floor slab 31, which reinforcement is connected to a reinforcing mesh 27 on upper side of said reinforcing-concrete floor slab 31 and an entire structure constituted by said reinforced-concrete floor slab 31 and said inner central space of supporting pillars of the building structure, together with an area connecting said pillars in a contour of a floor slab is flooded with a concrete.

Said three-layered monolithic ribbed floor slab 31 made in a technology according to the invention has good technical parameters related to strength, stiffness, sound insulation, including sound suppression and fire resistance in the aspect of capacity, leak tightness and insulating power on a level at least 60 min, REI 60.

According to the invention, different roof structures can be applied for making roof coverings of buildings erected utilizing the construction system according to the present invention, for

example, it can be truss gratings of wooden boards and/or beams of various configuration, truss gratings of T-type beams of various configuration, truss, beam and structural constructions of thin walled bent metal profiles.

In one embodiment of the invention the roof construction made of thin walled metal profiles are shown (Fig. 4b). Structural, beam, truss roof structures are rested in the places of said supporting pillars defined empty central space, preferably cylindrical, a head part of which is reinforced in the rest part with a metal plate 9. Roof structures of thin walled metal profiles, that were used in the embodiment of the invention together with said supporting pillars and said floor slabs 31 form an uniform spatial construction system that ensures strength, stiffness and durability of the building consistent with acceptable standards, also in the most difficult geological and climate conditions, as well as reliability, proper thermal insulation, acoustic insulation and fire resistance, while the assembling of the finished building is simple and cost-effective in terms of workload and cost of materials.

It should be noted that the system of the present invention also provides ease of realization and assembling of all necessary installation in a building, such as the electrical, water supply, sewerage, heating and ventilation or air conditioning system, in the assembly of which empty central spaces of supporting pillars of the present invention can be used. A characteristic feature of the construction system of the present invention and its advantages, especially in the case of filling the central spaces of said hollow beam elements forming the supporting pillars with a lightweight concrete or heavy concrete is to obtain the particularly advantageous structure and strength of said concrete arranged within said pillar (i.e. concrete beams), since the binding of the poured concrete occurs in the confined space without moisture evaporation, absorption of water by the shuttering elements, without excessive heating and heat loss, so in the optimal conditions for proper binding of concrete.

In the case of natural disasters such as fires, in buildings erected using the construction system according to the present invention, even with substantial damages, it remains undamaged concrete or a building skeleton made of reinforced concrete, which can be re-covered with the relevant finishing and insulating materials which restore good utility condition for building without excessive costs and in a very short time.

Our case reference: 83P25394PL00

Claims

1. A construction system for building, particularly for construction in a fast assembling of skeleton type buildings for various applications, founded on a foundation part (11), comprising supporting skeleton pillars consisting of at least one or more closed-section hollow beam elements (1) each defining an inner central space, floor structure, wall structures and a roof structure, characterized in that at least one closed-section hollow beam element (1) or more closed-section hollow beam elements forming the supporting skeleton pillars are made of a composition comprising at least filling material consisting of particulate, ground or short-fibre material of natural origin, preferably a comminuted and/or broken-up wood material and at least one binding substance containing a thermosetting resin, which composition is extruded by a continuous extruding method using an extruding device, preferably such as a screw extruder.

2. The construction system according to claim 1, characterized in that the empty inner central space (1') defined by hollow beam elements (1) constituting the supporting pillars has a shape of longitudinal channel of a substantially circular cross section, a surface of which is provided with a continuous groove in a shape similar to the thread contour, extending along the screw line over entire length of the close-section beam element (1).

3. The construction system according to claim 1, characterized in that, the closed-section hollow beam element (1) has the cross sectional area of the internal channel of about half of the total transverse cross sectional area of said hollow beam element (1).

4. The construction system according to claim 1, characterized in that as a binding substance in the closed-section beam element (1) at least one thermosetting resin selected from the group consisting of urea-formaldehyde resins, phenol formaldehyde resins, formaldehyde-melamine resins and/or urea-melamine-formaldehyde resins in a total amount from 4% to 30% by weight is used.

5. The construction system according to claim 1, characterized in that the filling material used in the composition for manufacture of closed-section beam elements comprises wood particulates or pieces and/or short fibre bulk materials of plant origin, preferably cellulose fibres and/or fibres obtained from natural minerals, preferably basalt or glass fibres.

6. The construction system according to one of claims 1-5, characterized in that the supporting pillars comprising at least one or more closed-section hollow beam elements, each

defining an inner central space, have an external shape of miscellaneous shaped cross sections, which shape is adapted to the construction of series (1.a), corner (1.b), T-type (1.c) and/or cruciform (1.d) constructional joint, while the inner central space (1') defined within closed-section hollow beam elements of the pillars is provided with a filling comprising at least one material selected from the group consisting of: insulating material, concrete, reinforced concrete and/or a high quality pre-tensioned reinforcement, preferably tensioning member (40), which filing (10) facilitate the erection of building structures up to 4 stories high in normal geological conditions, as well as in difficult geological conditions, for example in ground settlements, mining damages, seismic hazards, landslide areas and in areas of hurricanes occurrence.

7. The construction system according to one of claims 1-6, characterized in that, the walls are made of cladding panels (12) and are constructed of a cladding in a form of sheet cladding particleboards fastened on opposite sides to the supporting skeleton pillars constituted by one or more closed-section beam elements (1), wherein the wall space defined between cladding panels is filled with efficient insulating material (50'), the distance between cladding panels is defined on the basis of heat calculation while ensuring the wall thermal resistance of at least R= 3,0 m^0C/W or more and the fire resistance of at least REI 50, wherein variety of filling materials are used that are arranged between cladding panels, as well as are used as a filling of the inner central space of the closed-section hollow beam elements (1), for example, such as selected from a group consisting of mineral wool, basalt wool, foamed polystyrene panels and/or insulating bulk material and similar materials of thermo-insulating and soundproof properties.

8. The construction system according to one of claims 1-6, characterized in that, the wall structures are made of closed-section hollow beam elements (1) each defining a central inner space that are arranged between supporting skeleton pillars, forming a filling (50') of walls, wherein said hollow beam elements can be stacked in a pile in perpendicular direction with regards to said skeleton pillars and/or they can be arranged in side by side configuration parallel to said skeleton pillars.

9. The construction system according to one of claim 8, characterized in that closed-section hollow beam elements, each defining a hollow inner space arranged to form wall structures, preferably have said central inner space filled with insulating material, for example such as selected from a group consisting of mineral wool, basalt wool, perlite, foamed

polystyrene, as well as other insulating bulk and/or granulated material exhibiting thermo-insulating and soundproof properties.

10. The construction system according to one of claims 1-9, characterized in that, the floor structure comprises monolithic, reinforced-concrete, ribbed slabs (31) made utilizing a lost shuttering method, wherein the lost shuttering is made in the form of "sandwich" plates (21) in which I-joists beams are utilized that are provided with a clean ceiling lining (24) of sheet materials boards, and wherein internal space defined between opposite boards is filled with an efficient, soundproof and thermo insulating filling material, while thickness of the "sandwich" type panels (21) and the distance between opposite boards facilitate to obtain T-type cross section of reinforced concrete beam adjusted to the required loads and span of said slabs up to max. 9 metres, ensuring simultaneously required standards for bending strength and the tensile strength, as well as stiffness, soundproof, thermal insulation properties and a fire resistance of the structure exceeding at least of REI 60.

11. The construction system according to claims 1-10, characterized in that it includes a roof structure made of metal profiles in a form of trusses (8), preferably of bent thin walled galvanized metal profiles.

12. The construction system according to one of claims 1-11, characterized in that the roof structure is made in the form of truss (8) of different configurations of bent metal thin walled galvanized profiles, wherein in a supporting part of a truss structure (8) a metal plate (9) is provided with an opening for passing through of the reinforcement, preferably a tension member (40) and its attachment to a building structure, wherein the tension member passes through said inner empty central space of a closed-section hollow beam element (1) of a supporting pillar and is fastened to a foundation part (11) of the building.

13. The construction system according to one of claims 1-12, characterized in that, between said skeleton structure vertical supporting pillars comprising one or more closed-section hollow beam elements (1) defining inner central space any possible spacing can be used, depending on an architectonic design of the building, but not exceeding 9 metres distance, while maintaining the condition that in a transverse cross-section of the building said supporting pillars, said reinforced concrete ceiling beams, provided between said lost shuttering of "sandwich" type plates (21) and said trusses (8) of thin walled galvanized metal profiles of a roof structure are arranged in one plane.

AMENDED CLAIMS
received by the International Bureau on 05 August 2011 (05.08.2011)

1. (amended) A construction system for building, particularly for construction in a fast assembling of skeleton type buildings for various applications, which can be founded on a foundation part (11), comprising main structural elements that are joined together for obtaining a compact and durable construction of buildings, said main structural elements include: supporting skeleton pillars of the skeleton consisting of at least one or more closed-section hollow beam elements (1) each defining a hollow central space; monolithic reinforced-concrete ribbed floor slabs (31) made utilizing a lost shuttering method, walls made of cladding panels (12) with a filling of spaces between the panels with a thermo insulating filling material and a roof structure, characterized in that at least one closed-section hollow beam element (1) or more closed-section hollow beam elements forming the supporting skeleton pillars are produced by continuous extrusion method using a screw extrusion device from a composition comprising at least filling material consisting of particulate, ground or short-fibre material of natural origin, preferably a comminuted and/or broken-up wood material and at least a binder substance, such us a thermosetting resin, selected from the group consisting of urea-formaldehyde resins, phenol formaldehyde resins, formaldehyde-melamine resins and/or urea-melamine-formaldehyde resins, which resign while heating pass irreversibly to the solid state, and wherein the empty central space (1') defined by closed-section hollow beam elements (1) constituting the supporting pillars has a shape of longitudinal channel of a circular cross section, a surface of which is provided with a continuous groove in a shape similar to the thread contour, extending along the screw line over entire length of the close-section beam element (1).

2. (deleted)

3. (unchanged) The construction system according to claim 1, **characterized in that**, the closed-section beam element (1) has the cross sectional area of the internal channel of about half of the total transverse cross sectional area of said profiled beam element (1).

4. (amended) The construction system according to claim 1, **characterized in that** in the closed- section beam element (1) at least one thermosetting resin is contained in a total amount from 4% to 30% by weight, which is used as a binding substance.

5. (unchanged) The construction system according to claim 1, **characterized in that** the filling material used in the composition for manufacture of closed-section beam elements comprises wood particulates or pieces and/or short fibre bulk materials of plant origin, preferably cellulose fibres and/or fibres obtained from natural minerals, preferably basalt or glass fibres.

6. (unchanged) The construction system according to one of claims 1-5, **characterized in that** the supporting pillars comprising at least one or more closed section longitudinal profiled elements with a hollow central space have an external shape of miscellaneous shaped cross sections, which shape is adapted to the construction of series (1.a), corner (1.b), T-type (1.c) and/or cruciform (1.d) constructional joint, while the inner central space (1') defined within closed-section hollow beam elements of the pillars is provided with a filling comprising at least one material selected from the group consisting of: insulating material, concrete, reinforced concrete and/or a high quality pre-tensioned reinforcement, preferably tensioning member (40), which filing (10) facilitate the erection of building structures up to 4 stories high in normal geological conditions, as well as in difficult geological conditions, for example in ground settlements, mining damages, seismic hazards, landslide areas and in areas of hurricanes occurrence.

7. (unchanged) The construction system according to one of claims 1-6, **characterized in that** the walls made of cladding panels (12) are constructed of a cladding in a form of sheet cladding particleboards fastened on opposite sides to the supporting skeleton pillars constituted by one or more close-section beam elements (1), and the space defined between cladding panels is filled with efficient insulating material (50'), the distance between cladding panels is defined on the basis of heat calculation while ensuring the wall thermal resistance of at least R= 3,0 m^0C/W or more and the fire resistance of at least REI 50, wherein variety of filling materials are used that are arranged between cladding panels, and as a filling of the hollow central space of the close-section beam elements (1), for example such as selected from a group consisting of mineral wool, basalt wool, foamed polystyrene panels, as well as insulating bulk material and similar materials of thermo insulating and soundproof properties.

8.(unchanged) The construction system according to one of claims 1-6, **characterized in that** the walls structures are made of one or more closed-section beam elements (1) each defining a hollow inner space, that are arranged between supporting skeleton pillars, forming

a filing (50') of walls, wherein said hollow beam elements can be stacked in a pile in perpendicular direction with regards to skeleton pillars and/or they can be arranged in side by side configuration parallel to the skeleton pillars.

9. (unchanged) The construction system according to one of claim 8, **characterized in that** closed-section beam elements, each defining a hollow inner space arranged to form wall structures, preferably have said central inner space filled with insulating material, for example such as selected from a group consisting of mineral wool, basalt wool, perlite, foamed polystyrene, as well as other insulating bulk and/or granulated material exhibiting thermo-insulating and soundproof properties.

10. (unchanged) The construction system according to one of claims 1-9, **characterized in that** the floor structure comprises monolithic, reinforced concrete, ribbed slabs (31) made utilizing a lost shuttering method, wherein the lost shuttering is made in the form of "sandwich" plates (21) in which I-joists beams are utilized that are provided with a clean ceiling lining (24) of sheet materials boards, and wherein internal space defined between opposite boards is filled with an efficient, soundproof and thermo insulating filling material, while thickness of the "sandwich" type panels (21) and the distance between opposite boards facilitate to obtain T-type cross section of reinforced concrete beam adjusted to the required loads and span of said slabs up to max. 0,9 metres, ensuring simultaneously required standards for bending strength and the tensile strength, as well as stiffness, soundproof, thermal insulation properties and a fire resistance of the structure exceeding at least of REI 60.

11. (unchanged) The construction system according to claims 1-10, **characterized in that** it includes a roof structure made of metal profiles in a form of trusses (8), preferably of bent thin walled galvanized metal profiles.

12. (unchanged) The construction system according to one of claims 1-11, **characterized in that** the roof structure is made in the form of truss (8) of different configurations of bent metal thin walled galvanized profiles, wherein in a supporting part of a truss structure (8) a metal plate (9) is provided with an opening for passing through of the reinforcement, preferably a tension member (40) and its attachment to a building structure, wherein the tension member passes through said inner empty central space of a closed-section hollow beam element (1) of a supporting pillar and is fastened to a foundation part (11) of the building.

13. (unchanged) The construction system according to one of claims 1-12, **characterized in that** between the skeleton structure vertical supporting pillars comprising one or more closed-section hollow beam elements (1) defining inner central space any possible spacing can be used, depending on an architectonic design of the building, but not exceeding 9 metres distance, while maintaining the condition that in a transverse cross-section of the building said supporting pillars, said reinforced concrete ceiling beams, provided between said lost shuttering of "sandwich" type plates (21) and said trusses (8) of thin walled galvanized metal profiles of a roof structure are arranged in one plane.

WO 2011/152741 PCT/PL2010/000046

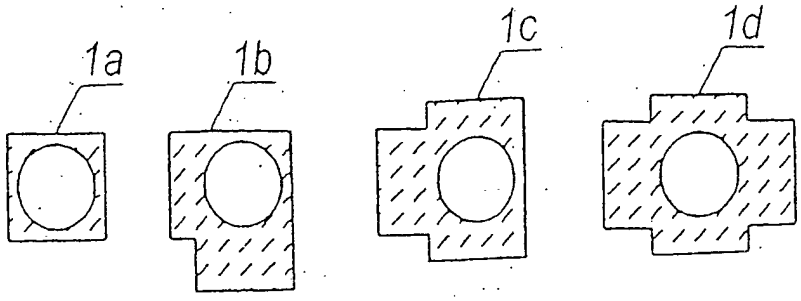

fig. 1

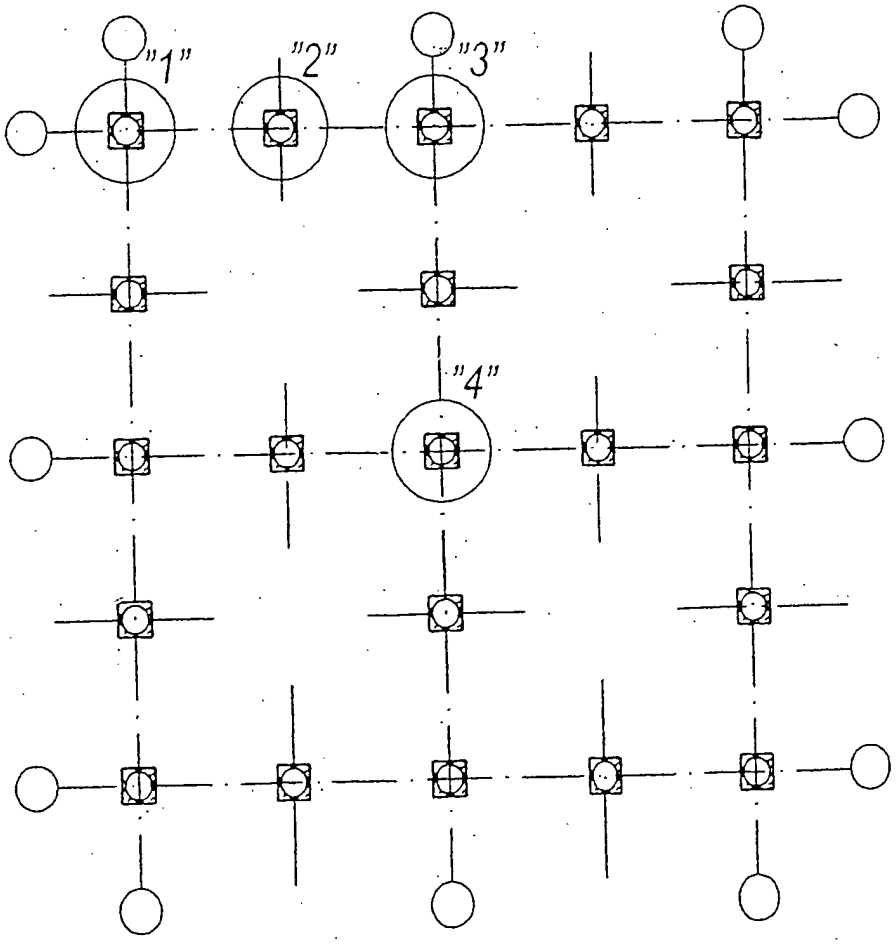

fig. 2

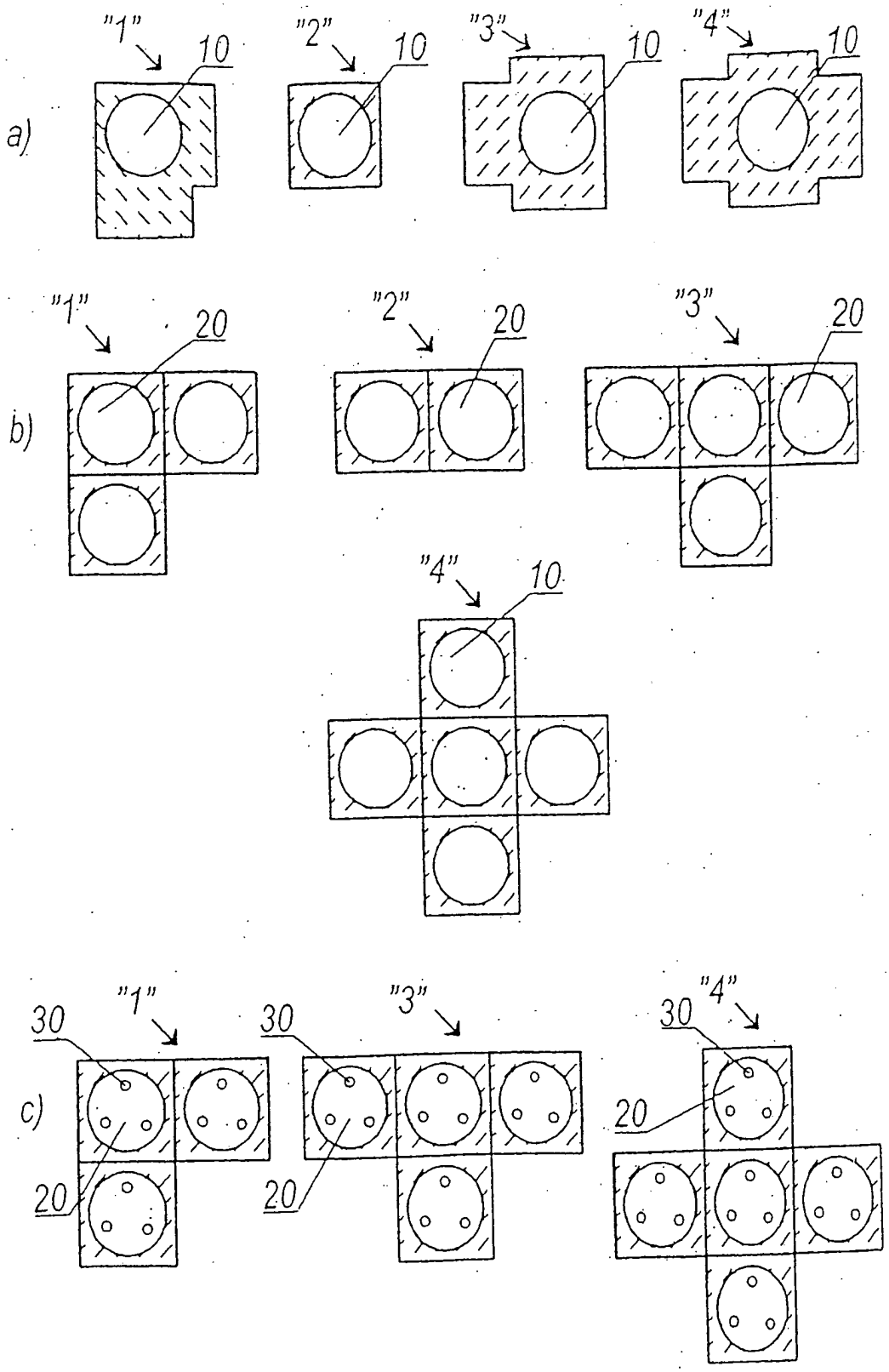

fig. 3

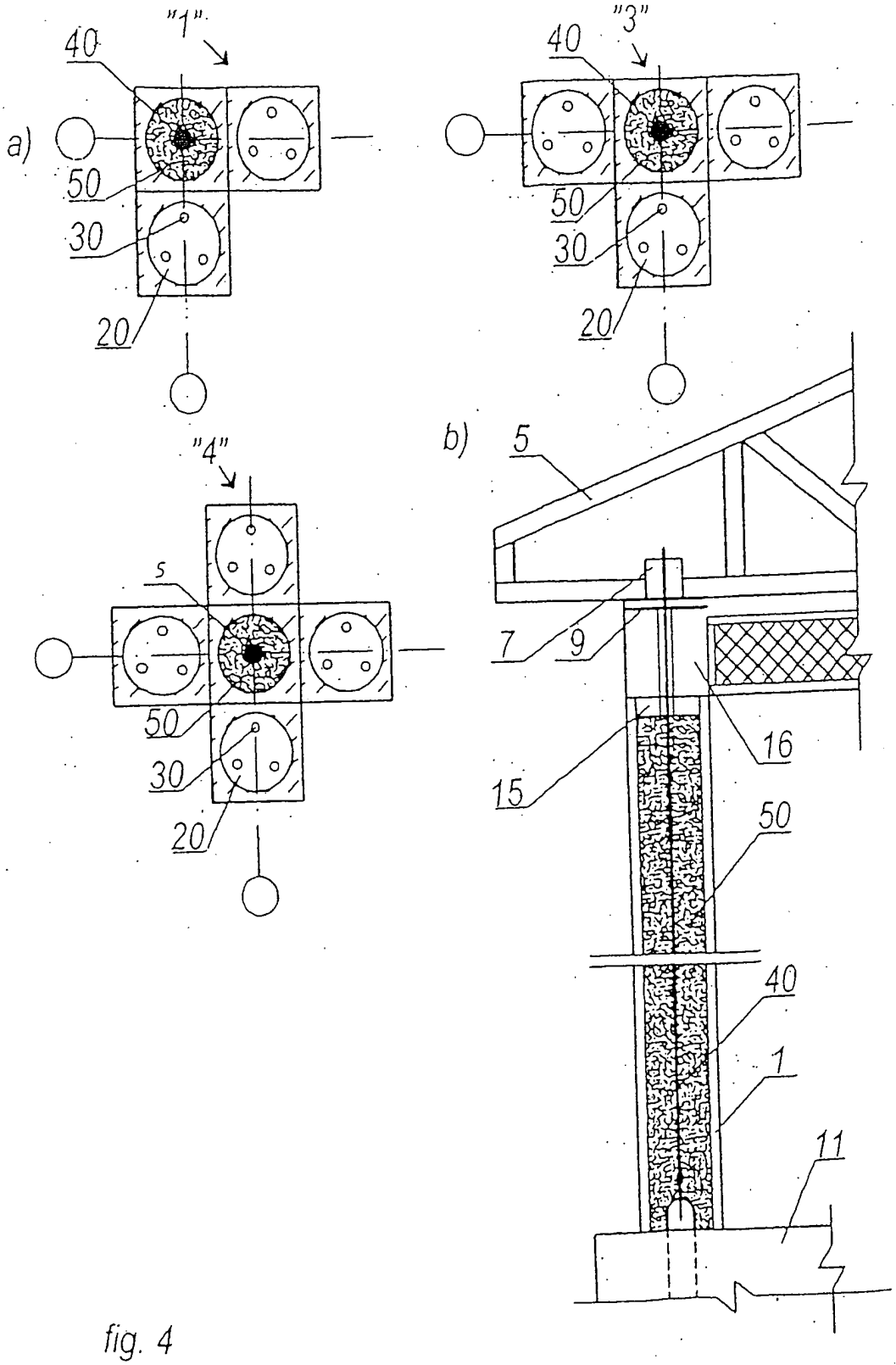

fig. 4

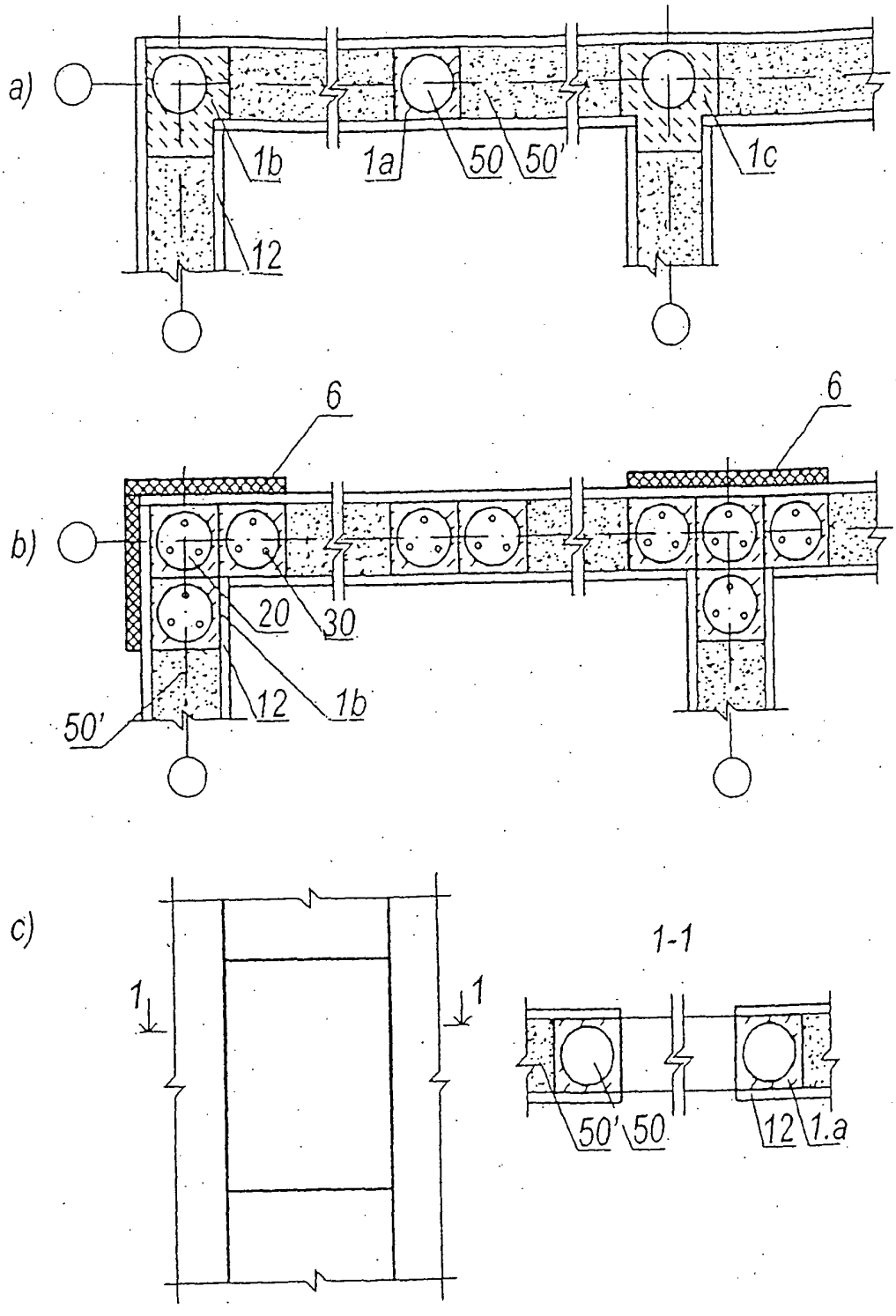

fig. 5

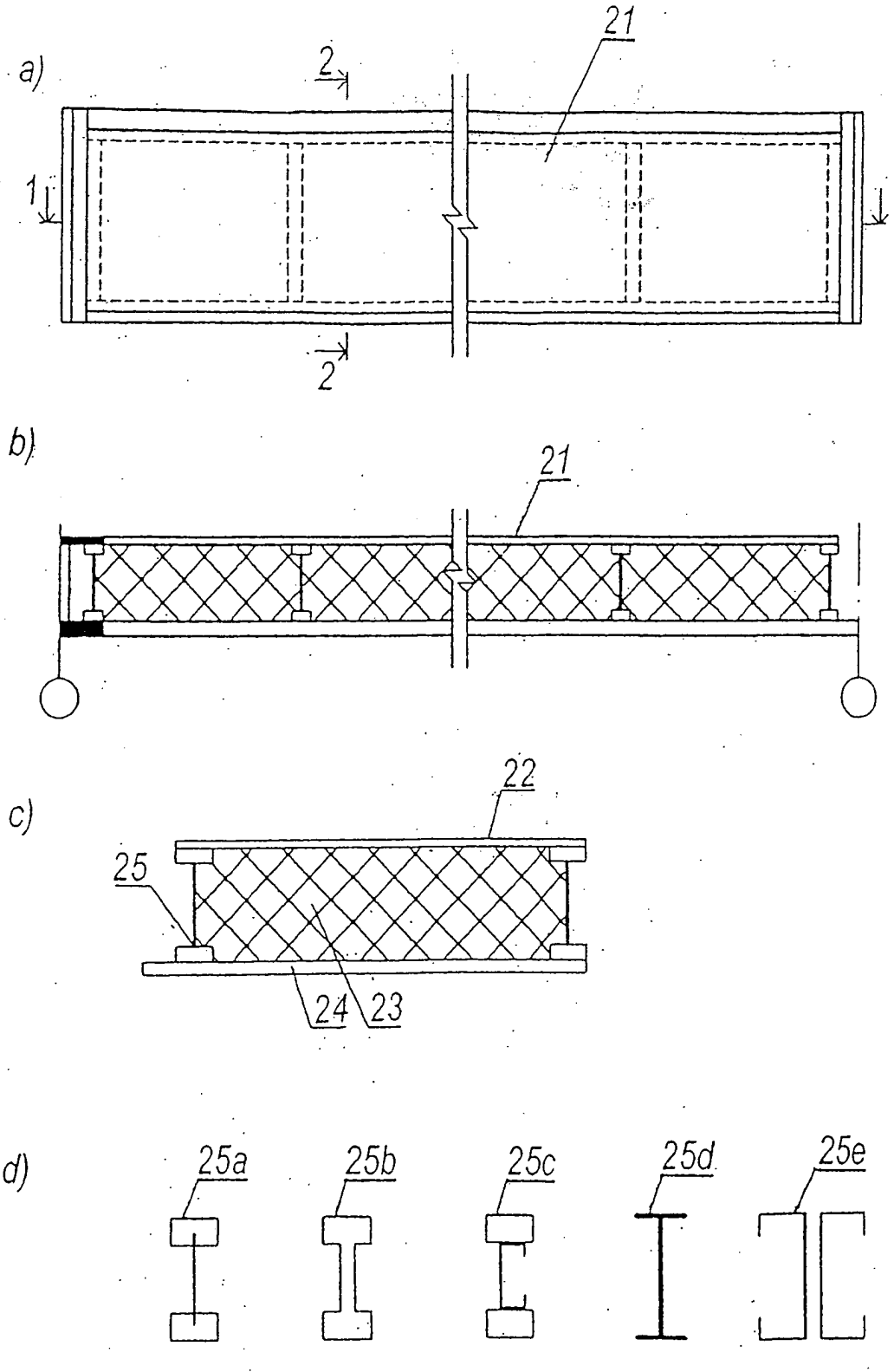

fig. 6

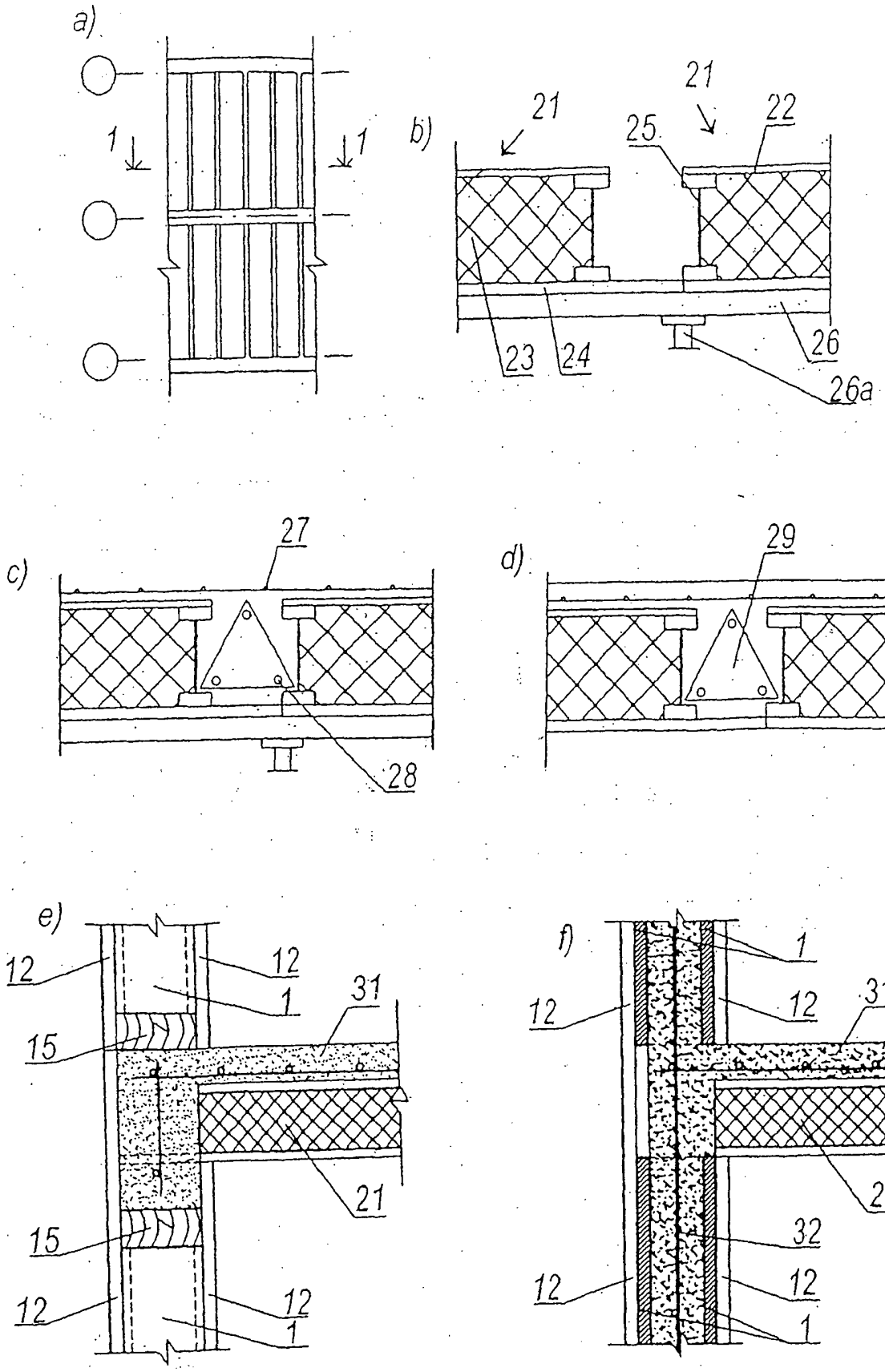
a)
1
1
b)
21
21
22
25
23
24
26
26a
c)
27
28
d)
29
e)
12
12
1
31
15
21
15
12
12
1
f)
1
12
12
31
21
32
12
12
1

fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2010/000046

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B1/16 E04B1/28 E04B1/30 E04C3/36
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/048055 A1 (BRANCA ALFONSO [IT]) 11 March 2004 (2004-03-11) abstract paragraphs [0003], [0015] - [0028] figures 1-7	1,4,5
X	GB 1 393 577 A (KURODA S) 7 May 1975 (1975-05-07) page 2, line 4 - page 2, line 123 figures 1-10	1
A	WO 95/02097 A1 (LEFTMINSTER PTY LTD [AU]; GROMAT JOHANNES [AU]) 19 January 1995 (1995-01-19) cited in the application the whole document	1

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 2011	06/06/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Beucher, Stefan

3

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/PL2010/000046

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

see additional sheet(s)

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2010/000046

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 289 665 A (HIGGINS GREGORY J [US]) 1 March 1994 (1994-03-01) cited in the application the whole document -----	1
A	US 5 537 786 A (LOZIER JAMES P [US] ET AL) 23 July 1996 (1996-07-23) cited in the application the whole document -----	1

3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/PL2010/000046

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004048055 A1	11-03-2004	US 2007237940 A1	11-10-2007
GB 1393577 A	07-05-1975	NONE	
WO 9502097 A1	19-01-1995	AT 214447 T	15-03-2002
		BR 9407011 A	06-08-1996
		CA 2166791 A1	19-01-1995
		CN 1127022 A	17-07-1996
		CZ 9600025 A3	11-09-1996
		DE 69430122 D1	18-04-2002
		DE 69430122 T2	31-10-2002
		EP 0710310 A1	08-05-1996
		ES 2176247 T3	01-12-2002
		HU 74159 A2	28-11-1996
		JP 8512110 T	17-12-1996
		NZ 267562 A	27-05-1998
		PL 312437 A1	29-04-1996
		US 5950374 A	14-09-1999
US 5289665 A	01-03-1994	AU 6548394 A	08-08-1995
US 5537786 A	23-07-1996	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6

   A construction system comprising pillars that consist of extruded hollow beam elements made of a composite material (fibers, preferably wood fibers, and resin), a floor structure, a wall structure, and a roof structure; wherein said hollow beam elements are further defined

   ---

2. claims: 1, 7-9

   A construction system comprising pillars that consist of extruded hollow beam elements made of a composite material (fibers, preferably wood fibers, and resin), a floor structure, a wall structure, and a roof structure; wherein said wall structure is further defined

   ---

3. claims: 1, 10, 13

   A construction system comprising pillars that consist of extruded hollow beam elements made of a composite material (fibers, preferably wood fibers, and resin), a floor structure, a wall structure, and a roof structure; wherein said floor structure is further defined

   ---

4. claims: 1, 11-13

   A construction system comprising pillars that consist of extruded hollow beam elements made of a composite material (fibers, preferably wood fibers, and resin), a floor structure, a wall structure, and a roof structure; wherein said roof structure is further defined

   ---