US 20180245340A1

(19) **United States**

(12) **Patent Application Publication**

**VISKOVIC et al.**

(10) **Pub. No.: US 2018/0245340 A1**

(43) **Pub. Date: Aug. 30, 2018**

(54) **BUILDING SYSTEM WITH A LOAD-RESISTING FRAME MADE OF REINFORCED CONCRETE OR STEEL INTEGRATED WITH WOODEN INFILL PANELS**


(71) Applicant: **UNIVERSITÀ DEGLI STUDI "G. D'ANNUNZIO" CHIETI-PESCARA**, Chieti Scalo (IT)

(72) Inventors: **Alberto VISKOVIC**, Chieti Scalo (IT); **Donatella RADOGNA**, Chieti Scalo (IT); **M. Cristina FORLANI**, Chieti Scalo (IT); **Manuela ROMANO**, Chieti Scalo (IT)

(73) Assignee: **UNIVERSITÀ DEGLI STUDI "G. D'ANNUNZIO" CHIETI-PESCARA**, Chieti Scalo (IT)



(21) Appl. No.: **15/757,419**

(22) PCT Filed: **Sep. 9, 2016**

(86) PCT No.: **PCT/IT2016/000207**

§ 371 (c)(1),
(2) Date: **Mar. 5, 2018**

(30) **Foreign Application Priority Data**

Sep. 9, 2015 (IT) ........................ 102015000050080

**Publication Classification**

(51) **Int. Cl.**

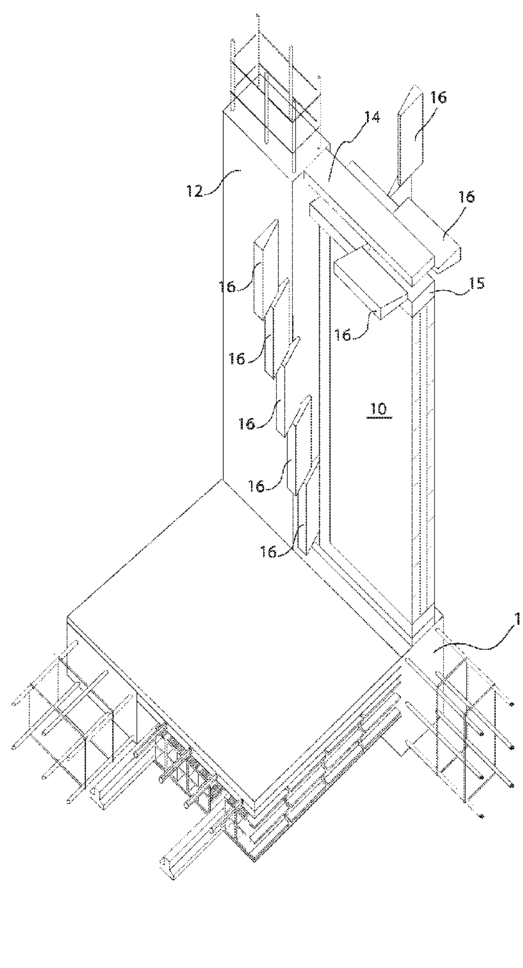
| | |
|---|---|
| ***E04B 2/56*** | (2006.01) |
| ***E04G 23/02*** | (2006.01) |
| ***E04H 9/02*** | (2006.01) |
| ***E04B 1/18*** | (2006.01) |
| ***E04B 1/24*** | (2006.01) |

(52) **U.S. Cl.**

CPC .......... ***E04B 2/562*** (2013.01); ***E04G 23/0218*** (2013.01); ***E04H 9/024*** (2013.01); *E04B 2001/2481* (2013.01); ***E04B 1/18*** (2013.01); ***E04B 1/24*** (2013.01); *E04B 2001/2496* (2013.01); ***E04H 9/025*** (2013.01)


(57) **ABSTRACT**


A construction system with a new or pre-existent supporting framework, made of reinforced concrete or steel, integrated with infill panels made of wood. The supporting framework is constituted by a frame of columns and beams. The infill panels are inserted and put under stress in one or more fields of the frame of the structure, forcedly and without play all along their perimeter.

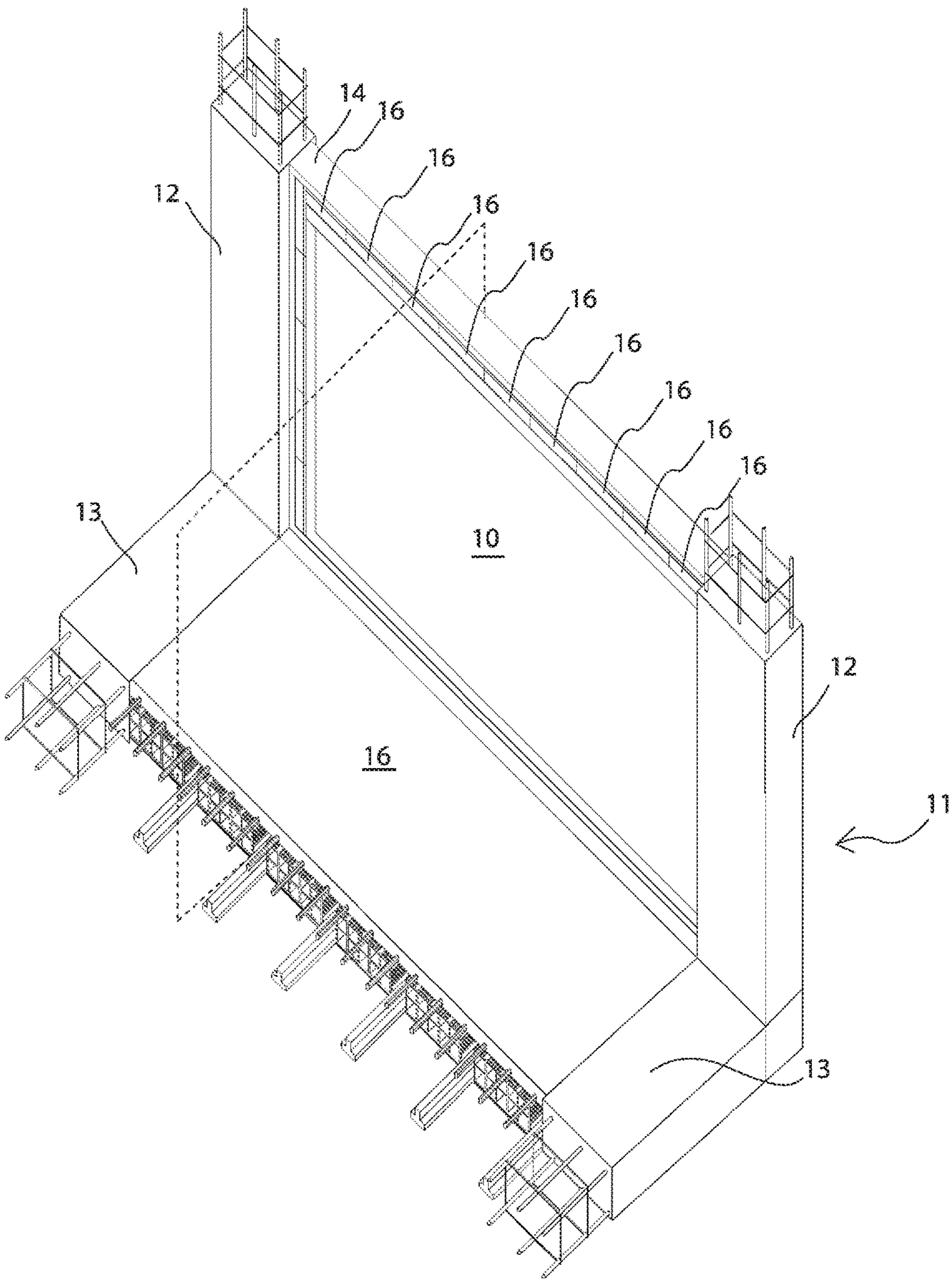



Fig. 1

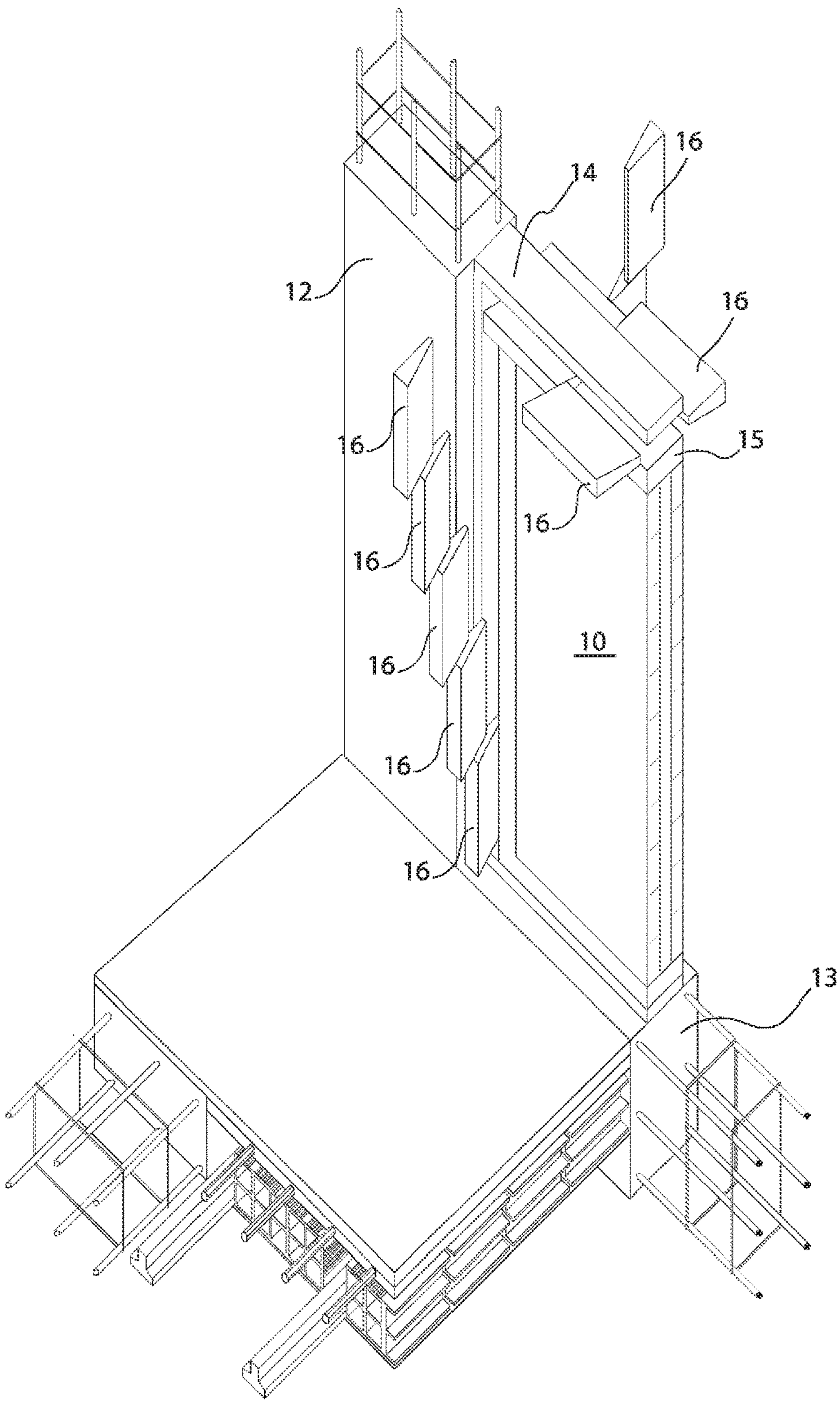



Fig. 2

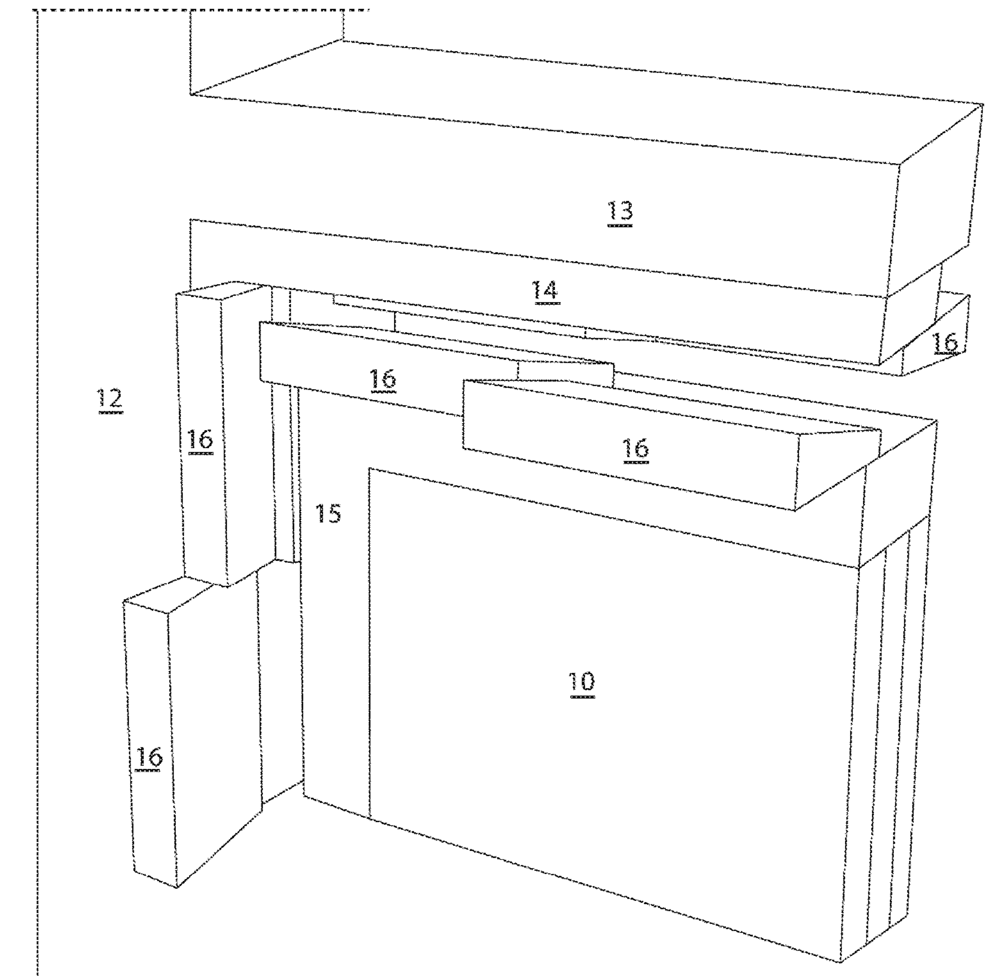



Fig. 3

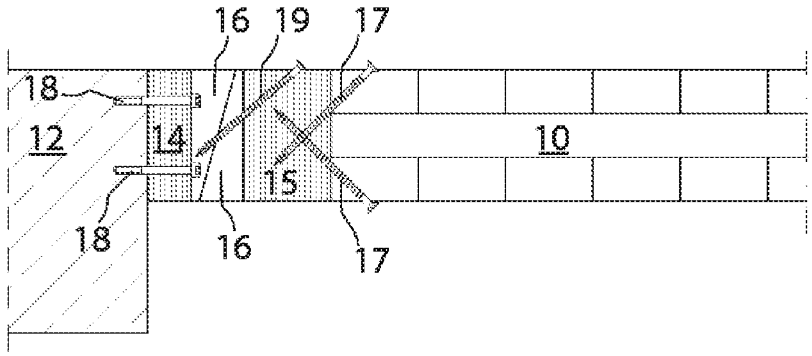



Fig. 4

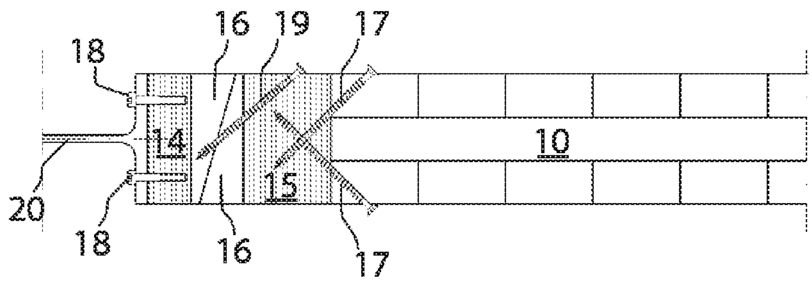



Fig. 5

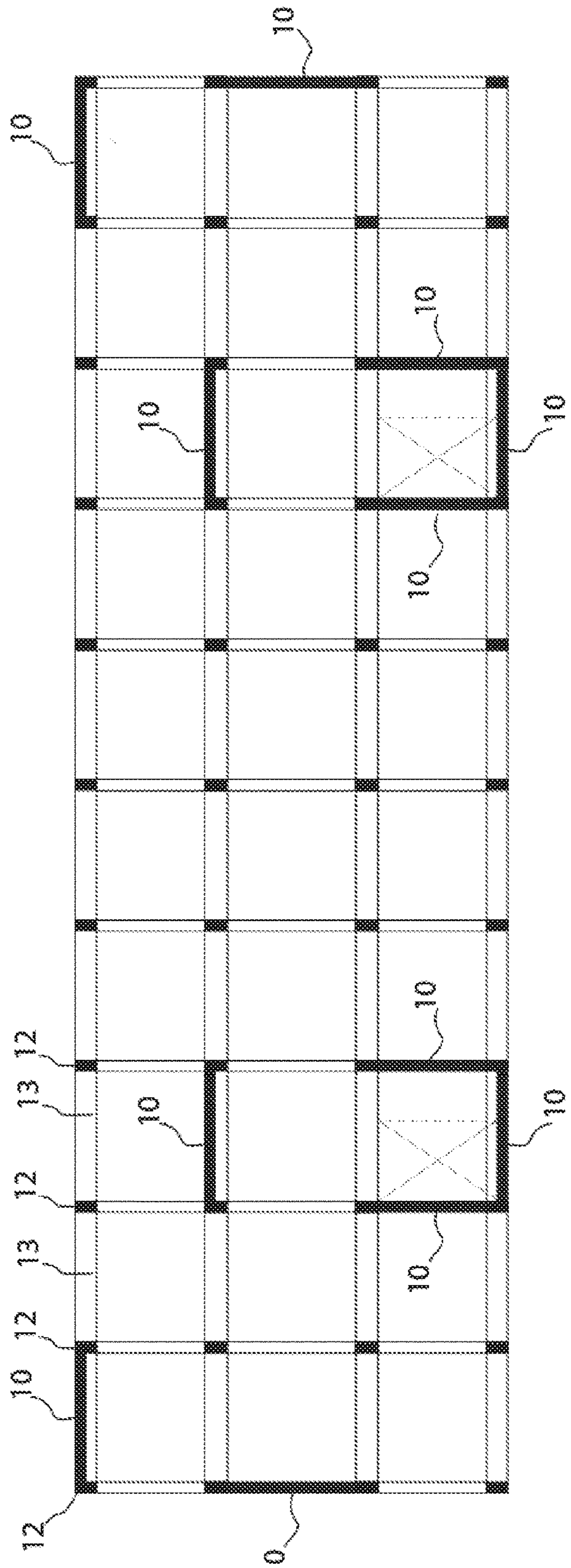



Fig. 6

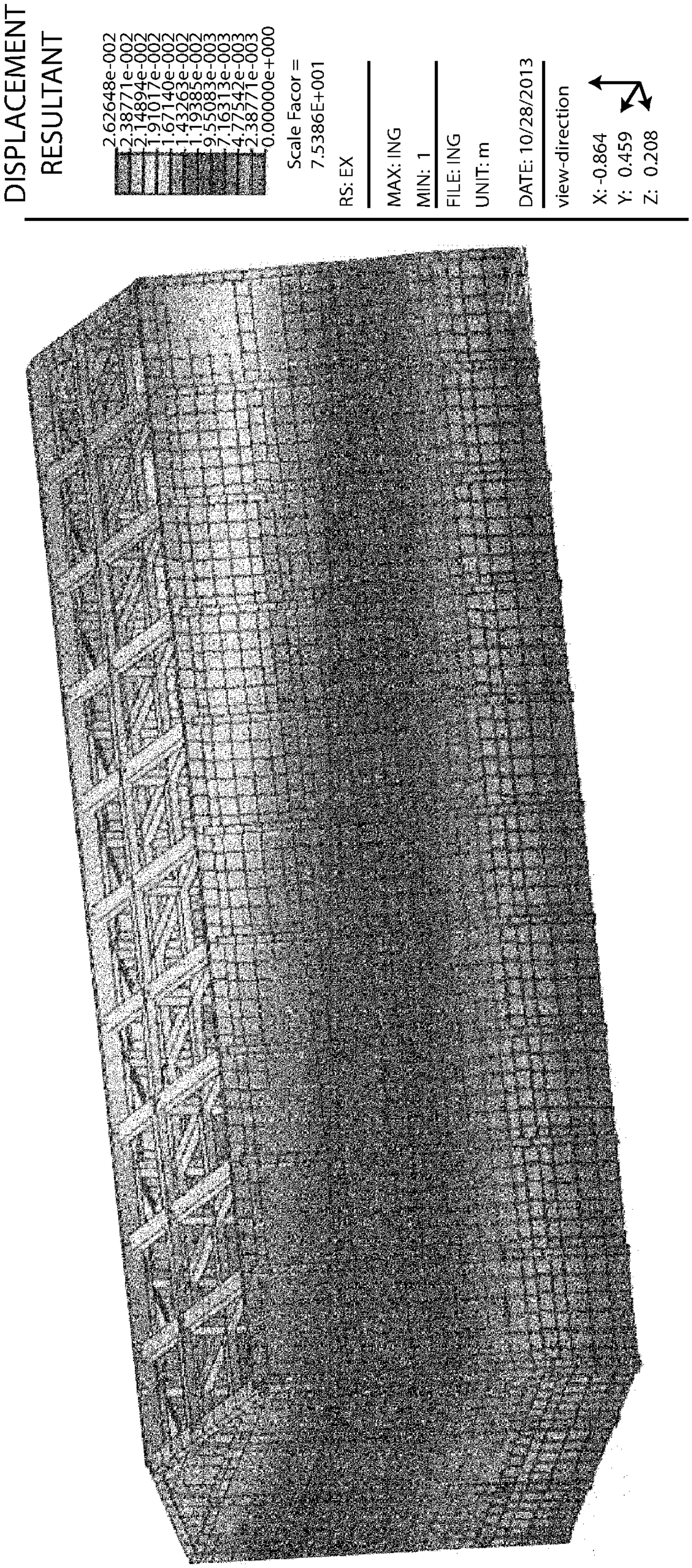

DISPLACEMENT
RESULTANT
2.62648e-002
2.38771e-002
2.14894e-002
1.91017e-002
1.67140e-002
1.43263e-002
1.19385e-002
9.55083e-003
7.16313e-003
4.77542e-003
2.38771e-003
0.00000e+000
Scale Facor =
7.5386E+001
RS: EX
MAX: ING
MIN: 1
FILE: ING
UNIT: m
DATE: 10/28/2013
view-direction
X: -0.864
Y: 0.459
Z: 0.208

Fig. 7

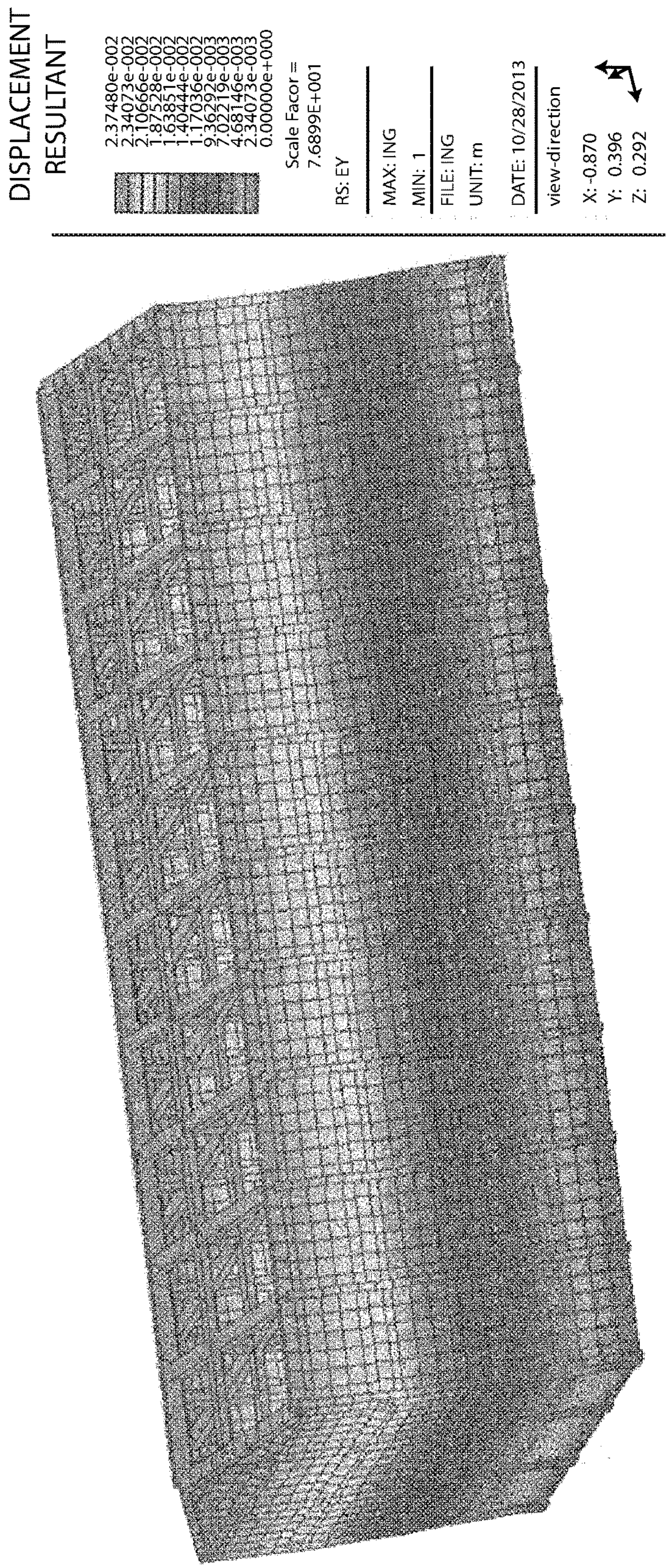

DISPLACEMENT
RESULTANT
2.37480e-002
2.34073e-002
2.10666e-002
1.87528e-002
1.63851e-002
1.40444e-002
1.17036e-002
9.36292e-003
7.02219e-003
4.68146e-003
2.34073e-003
0.00000e+000
Scale Facor =
7.6899E+001
RS: EY
MAX: ING
MIN: 1
FILE: ING
UNIT: m
DATE: 10/28/2013
view-direction
X: -0.870
Y: 0.396
Z: 0.292

Fig. 8

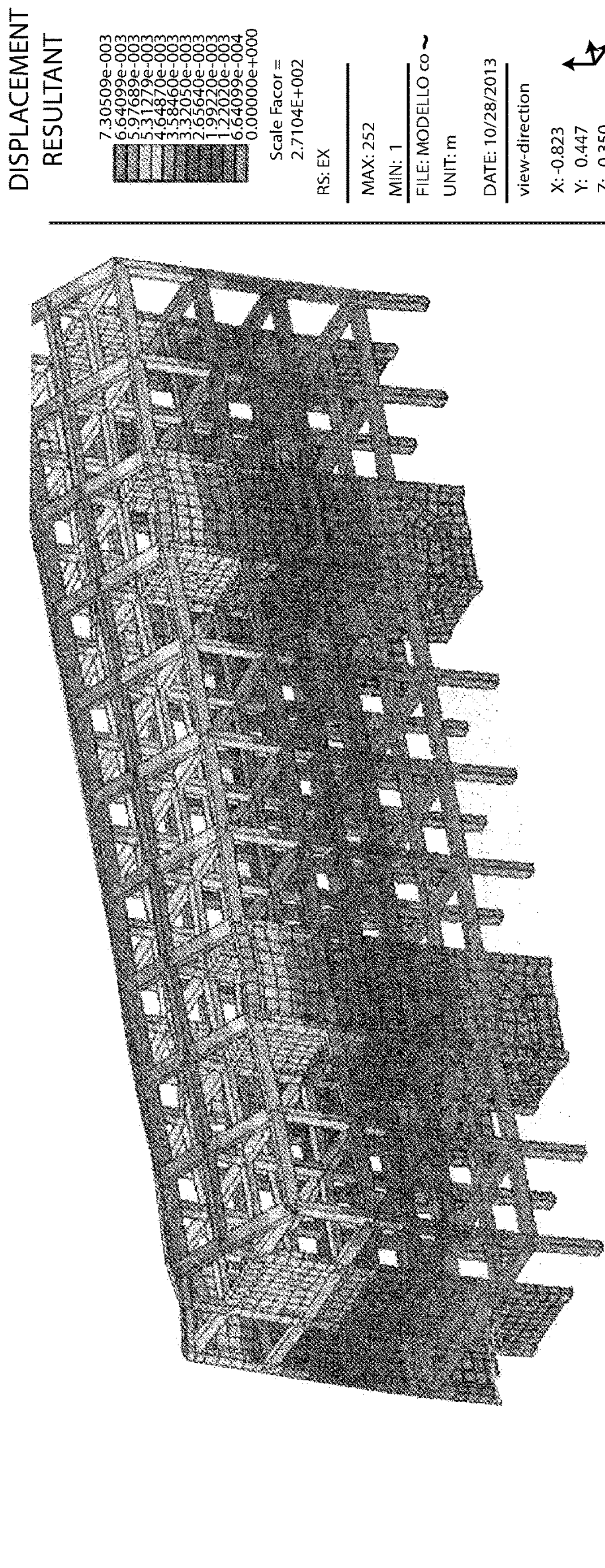

DISPLACEMENT
RESULTANT
7.30509e-003
6.64099e-003
5.97689e-003
5.31279e-003
4.64870e-003
3.58460e-003
3.32050e-003
2.65640e-003
1.99220e-003
1.22020e-003
6.64099e-004
0.00000e+000
Scale Facor =
2.7104E+002
RS: EX
MAX: 252
MIN: 1
FILE: MODELLO co
UNIT: m
DATE: 10/28/2013
view-direction
X: -0.823
Y: 0.447
Z: 0.350

Fig. 9

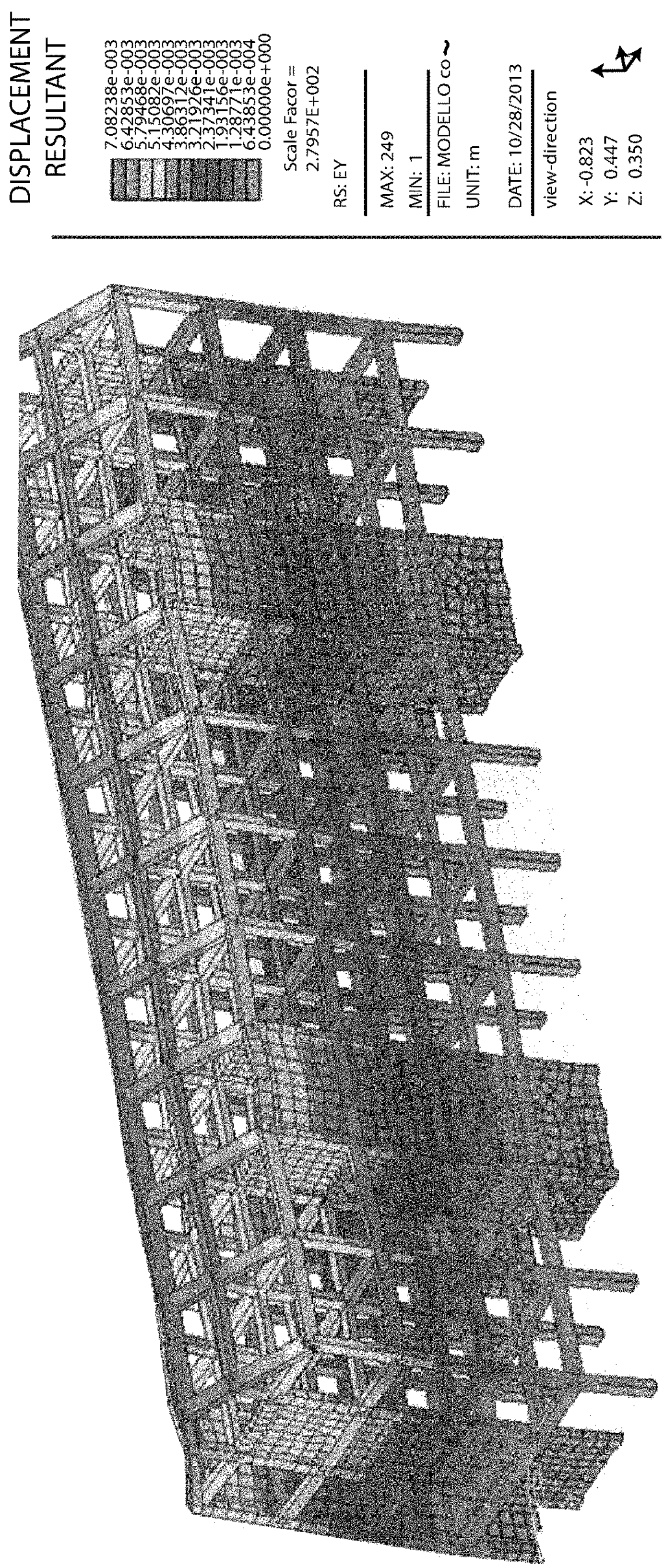
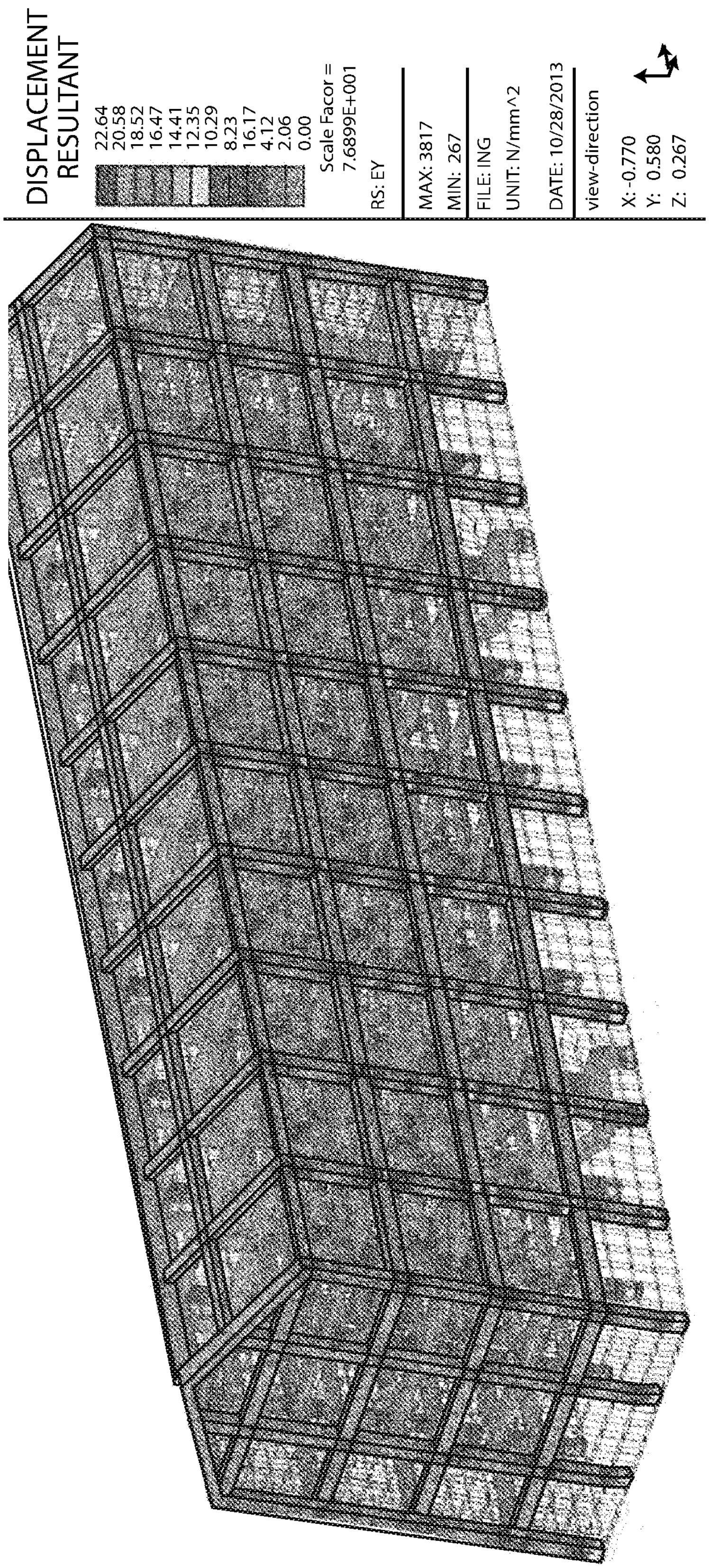

DISPLACEMENT
RESULTANT
7.08238e-003
6.42853e-003
5.79468e-003
5.15082e-003
4.30697e-003
3.86312e-003
3.21926e-003
2.37341e-003
1.93156e-003
1.28771e-003
6.43853e-004
0.00000e+000
Scale Facor =
2.7957E+002
RS: EY
MAX: 249
MIN: 1
FILE: MODELLO co~
UNIT: m
DATE: 10/28/2013
view-direction
X: -0.823
Y: 0.447
Z: 0.350

Fig. 10


DISPLACEMENT
RESULTANT
22.64
20.58
18.52
16.47
14.41
12.35
10.29
8.23
16.17
4.12
2.06
0.00
Scale Facor =
7.6899E+001
RS: EY
MAX: 3817
MIN: 267
FILE: ING
UNIT: N/mm^2
DATE: 10/28/2013
view-direction
X: -0.770
Y: 0.580
Z: 0.267

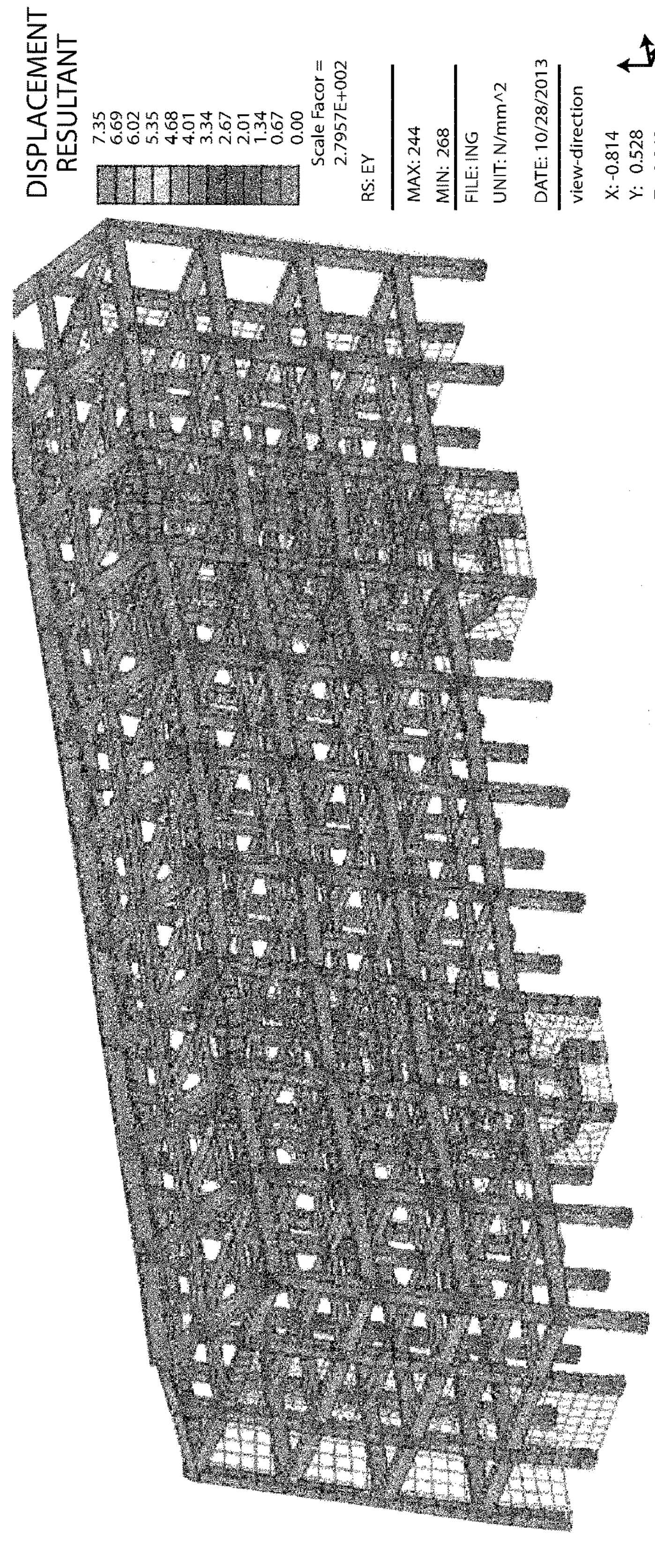

DISPLACEMENT
RESULTANT
7.35
6.69
6.02
5.35
4.68
4.01
3.34
2.67
2.01
1.34
0.67
0.00
Scale Facor =
2.7957E+002
RS: EY
MAX: 244
MIN: 268
FILE: ING
UNIT: N/mm^2
DATE: 10/28/2013
view-direction
X: -0.814
Y: 0.528
Z: 0.242

Fig. 12

# BUILDING SYSTEM WITH A LOAD-RESISTING FRAME MADE OF REINFORCED CONCRETE OR STEEL INTEGRATED WITH WOODEN INFILL PANELS

**[0001]** The present invention concerns un construction system with a supporting framework made of reinforced concrete or steel, integrated with infill panels made of wood.

**[0002]** The invention regards the field of buildings and in particular defines a technical sector shared between that of non-structural infills for framed buildings (made of reinforced concrete or steel) and the field of supporting panels made of cross-laminated wood.

**[0003]** More in particular, the invention concerns the performance improvement of the systems with supporting frame made of reinforced concrete and steel, new or pre-existent, through the use of dry-layered infills (in the specific case, made of cross-laminated wood with additionally possible layers of external and internal finishing, possible insulation layers, vapor barrier, etc.). Such an improvement makes reference to the classes of needs of structural safety, management, wellness, usability, usability, ability to be integrated, appearance and environmental safeguard and is intended for interventions both of restoration of an existing building and of a new building.

**[0004]** It is known that the building structures made of reinforced concrete or steel are provided with external and internal infills (the expression internal infills designates the infills of the stairwells and the partition walls between different properties) made of masonry of hollow blocks made of bricks or concrete. In the same structures, the internal partitions and sometime the internal linings of the external infills, are made by hollow blocks of bricks or by chalk blocks.

**[0005]** The use of blocks made of hollow bricks forato or concrete or chalk, leads to an elastic-fragile behavior of the partitions and infills.

**[0006]** It follows that, in case of earthquakes, the structures are rendered unusable by the rupture of infills and partitions, with the risk of local collapses of damaged elements, even when the main structure has not suffered significant structural damages.

**[0007]** Sometimes, in the case of structures made of reinforced concrete, if the infills are not particularly weak in relation to the resistances of the main frame, or the infills are for some reason stronger than the average, the risk of serious structural damage to the main frame emerges and in particular the risk of shear breakage of the columns emerges, caused by the same infills. In fact, the horizontal actions trigger a tilted strut resistance mechanism in the infill, which concentrates the shear stresses at the ends of the columns, in the area of connection with the beams.

**[0008]** In the case of buildings with structure made of steel realized or to be realised in steel realized or to be realized in a seismic zone, one can observe that, in the last decade or so, the practice not to insert rigid vertical bracing (ie with perfectly triangular meshes), but rather braces with elastic-plastic deformation capacity, in bearing horizontal actions. This is to ensure a proper seismic energy dissipation. These braces are made taking appropriate geometries and/or by inserting suitable elastic-plastic devices. Consequently, in case of strong seismic actions, some elements of these braces are "damaged" to ensure the necessary "plastic deformations" and must be replaced.

**[0009]** In addition, the type of infill commonly employed, with the above-mentioned structural types, imply more or less serious performance deficiencies, especially in terms of environmental comfort and energy consumption (high values of thermal transmittances), as well as usability of the spaces (inability to change distributive systems except with costly demolition works).

**[0010]** As regards new buildings with load-bearing structure entirely in panels of cross-laminated wood, the flexural strength (and hence the tensile strength) and the cutting strength of a vertical wall which is formed by overlapping panels, has its own weaknesses in the joints between these panels. In particular, the tensile stresses are transmitted through connections that employ steel plates riveted or bolted or simply screwed to the wood panels, with consequent concentration of efforts and damage in case of seismic actions.

**[0011]** In this context lies the present invention, which aims to achieve two objectives, structural and environmental: improving the seismic and energy behavior of buildings (made of reinforced concrete or steel or wood), new or pre-existing, intervening on the construction technique and on the material of the vertical paneling/infills, thereby determining performance improvements also in respect of other classes of needs that, together with the structural safety and wellness/comfort temperature and humidity, can implement the possibilities and the qualities of use of buildings.

**[0012]** These and other results are obtained according to the present invention proposing a construction system with a supporting framework made of reinforced concrete and steel integrated with infill panels made of wood, so to act on the following specific issues:

**[0013]** improving the capacity of bracing in the vertical planes of the infills;

**[0014]** removing the brittle fracture behavior of the infills in brick or chalk or concrete;

**[0015]** increasing the ability of the infills to dissipate energy;

**[0016]** reducing the possibility of damage to the columns in reinforced concrete, because of the infills;

**[0017]** removing the dissipative elements of sacrifice from the structures in steel;

**[0018]** improving the dissipation of seismic energy in buildings in steel;

**[0019]** reducing local damage, improving the behavior under flection-tensile strength in new buildings in load-bearing panels made of cross-laminated wood.

**[0020]** Improving the energy behavior (of the building and ambient envelope and the built) is achieved by improving the following specific aspects:

**[0021]** obtaining transmittance values far below regulatory limits;

**[0022]** improving the thermal capacity of the infill in the winter seasons;

**[0023]** improving the phase shift and attenuation values of heat wave in the summer months;

**[0024]** improving the perspiration and heat insulation, saving energy for the heating and the cooling of the building;

**[0025]** reducing the conductivity and increasing the thermal inertia;

**[0026]** improving the healthiness of the building (and of the built environment);

**[0027]** reducing the environmental impact, thanks to the reduced carbon footprint of wood.

[0028] The use of a “dry” implementation also leads to a reduction of construction costs and times, of management and maintenance.

[0029] The dry implementation, together with the use of the wood material, allows, moreover, an optimization of the possibilities of use and re-use (recycling of the material, reuse of the construction system, adaptability to requirements of use of the constructed system).

[0030] Purpose of the present invention is therefore to provide a construction system with a supporting framework in reinforced concrete and in steel integrated with infill panels made of wood which overcomes the limits of the construction system with a supporting framework in reinforced concrete and in steel according to the prior art and to obtain the technical results previously described.

[0031] Another aim of the invention is that said construction system can be made with substantially limited costs, both as regards production costs and as regards the management costs.

[0032] Another object of the invention is to propose a construction system with a supporting framework in reinforced concrete and steel integrated with infill panels made of wood that is simple, safe and reliable.

[0033] It is therefore a specific object of the present invention a construction system with a new or pre-existing supporting framework made of reinforced concrete or steel, integrated with infill panels made of wood, wherein said supporting framework is constituted by a frame of columns and beams, and in which said infill panels are inserted in one or more fields of the frame of the structure, forcedly and without play all along their perimeter.

[0034] In the context of the present invention, with the expression “forcedly” it is intended to define the fact that the panels are forced to inside said fields of the frame, and with the expression “without play” is intended to define the fact that no relative movement between the frame and panels is possible.

[0035] Preferably, according to the invention, said infill panels are made of laminated wood.

[0036] More preferably, according to the invention, said infill panels are made of cross-laminated wood.

[0037] Furthermore, according to the present invention, said infill panels can be integrated in a frame.

[0038] It is evident the effectiveness of the construction system with a supporting framework in reinforced concrete and in steel integrated with infill panels made of wood of the present invention, that, as regards the framed structures (made of reinforced concrete or steel), and in virtue of the use of panels in cross-laminated wood, have a higher tensile strength and a higher ductility under compression compared to brick masonry panels (or panels made of blocks of concrete or chalk). Ductile breaks follow, not hazardous to the safety of people and things. In addition, the ductile breakage allow a greater dissipation of energy; it follows that, with suitable dimensioning of the thickness of the wooden panels, it is possible to increase both the resistance to horizontal actions and the ability to dissipate the seismic energy, with an improvement in structural performance as a whole.

[0039] The increased local ductility of the wood, compared to conventional infills materials, also allows a better distribution of pressure on the columns, thus avoiding dangerous concentrations of shear stresses at the ends of the same.

[0040] This allows, in the case of structures made of reinforced concrete, to increase the resistance of the infills without risking to cause premature failure of the columns.

[0041] In the case of buildings made of steel, the use of panels made of cross-laminated wood allows to replace both the opaque “non-structural” infills, traditionally made of fragile material, and the bracing elements made of steel. Moreover, making all opaque infills “bracing”, it is easier to get an increase of the resistance to horizontal actions, as well as an increase in capacity to dissipate energy (greatly increasing the volume of material relevant to the plastic deformation); or reduction is possible to make the damages non significant, for the same deformation—dissipation.

[0042] As regards new buildings, compared to a structure totally in load-bearing wooden panels, the insertion of wooden panels inside made of steel or reinforced concrete frames eliminates the problem of the tensile strength in the joints and allows a better exploitation of the resistance to compression and to shear of such panels.

[0043] In the case of structures of new construction it is also possible to think of a reversal of the structural-functional relationship, between panels and frames: one can assign to the panels the function of main load-bearing structures (both for the vertical loads and for the horizontal actions) while the frames (with suitably reduced sections of the elements) may limit to make the function of “confining” the individual panels and connecting the panels to each other, ensuring the tensile strength.

[0044] The physical and biological characteristics of the wood, put the material as best resource to create environments that are healthy and comfortable to man, allowing to realize energy efficient casings and to reach standards of “passive building” employing multilayer walls solutions with very limited thicknesses.

[0045] In fact, the wooden constructional packages allow to obtain, with a considerably reduced thickness, a good winter thermal insulation; the transmittance values are in fact far below regulatory limits and the average values of structures built with other materials. In addition, the phase shift values and thermal wave attenuation values in summer months, although not reaching the 16 hours of phase shift and 20 Fa of the brick wall, stood at around 11 hours and 23 Fa, returning in optimal intervals prescribed by the regulations and then allowing to sufficiently dampen the incoming energy.

[0046] Moreover, given the increasingly urgent issues concerning the protection of the environment and climate, it is not possible to ignore the ecological quality of the material that, with a small footprint of $CO_2$, can be considered as an unbeatable material/natural resource in the field of buildings.

[0047] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiment, with particular reference to the figures of the accompanying drawings, in which:

[0048] FIG. **1** shows a perspective view of an infill panel inserted in a frame of reinforced concrete according to the present invention,

[0049] FIG. **2** shows a perspective view of a detail of the panel and the frame of FIG. **1**, during assembly,

[0050] FIG. **3** shows a perspective view of a further detail of the panel and the frame of FIG. **1**, during assembly,

[0051] FIG. **4** shows a plan sectional view of a detail of the panel and the frame of FIG. **1**, assembled,

[0052] FIG. **5** shows a plan sectional view of a covering panel inserted in a frame made of steel according to the present invention, assembled,

[0053] FIG. **6** shows a plan view of the load-bearing structure of a building, in which some wooden infill panels are inserted, according to the present invention,

[0054] FIG. **7** shows a representative model of the displacements in the horizontal direction of the elements of the frame made of reinforced concrete of a building, with brick panels as infills, for comparative purposes,

[0055] FIG. **8** shows a representative model of the displacements in the vertical direction of the elements of the frame made of reinforced concrete of a building, with brick panels as infill, for comparative purposes,

[0056] FIG. **9** shows a representative model of the displacement in the horizontal direction of the elements of the frame made of reinforced concrete of a building, with cross-laminated wood panels as infill, according to the present invention,

[0057] FIG. **10** shows a representative model of the displacements in the vertical direction of the elements of the frame made of reinforced concrete of a building, with cross-laminated wood panels as infill, according to the present invention,

[0058] FIG. **11** shows a representative model of the stress state of the reinforced concrete columns of the frame of a building, with brick panels as infill, for comparative purposes, and

[0059] FIG. **12** shows a representative model of the stress state of the frame-reinforced concrete columns of a building, with cross-laminated wood panels as infill, according to the present invention.

[0060] The present invention is essentially based on the replacement of infill elements made of bricks with infill elements made of wood; the elements having sometimes structural reinforcement function, as in the case of the bracing elements, made of laminated wood panels and preferably of laminated wood with glued crossed lamellas, such as the panel marketed by KLH with the name X-Lam; and sometimes with perimeter infill function and partition walls, as in the case of elements of external and internal vertical closing.

[0061] The bracing elements, within the load-bearing skeleton of a building, are configured as special constraints that prevent the structure to carry out a displacement or a rotation due to a horizontal force induced by seismic events of average and high intensity.

[0062] The higher tensile strength and higher ductility of the wooden panels compared to masonry panels made of brick, allows to avoid the elastic-fragile behavior of the infills and to improve the distribution of pressing loads on the columns. This results in a substantial increase in the ability to dissipate energy, such as to increase the load bearing capacity of the structure, thus allowing a global seismic upgrading of buildings.

[0063] As regards the elements of internal and external vertical closing, the use of dry-layered infills allows easy redistribution of the environments, improving the flexibility of the plant and allowing to adapt the system to the different possibilities of use, while the inclusion of perimeter wooden infills contributes to improving the energy performance of the building envelope.

[0064] In accordance with the requirements dictated by law and by the rules of proper design, the earthquake resistant infills made of laminated wood with crossed lamellae have to be positioned symmetrically and uniformly distributed both in plan and elevation, so as to counter the torsional motions of the building in case of side actions.

[0065] To ensure the effectiveness of the proposed solution, it is essential the correct execution of the details concerning the connections between the wooden bracing infills and the frames made of reinforced concrete or steel. In fact, to have an adequate effectiveness of the bracing effect of the infills made of cross-laminated wood, the last must be appropriately "forced" in their respective fields of the frames, in order to eliminate any possible "play" and thus make the bracing active since the first occurrence of a horizontal action (wind or earthquake).

[0066] So, for the purposes of the present invention, the wooden panels made of cross laminated wood must be forcedly placed along the entire perimeter inside frames made of reinforced concrete or steel of buildings already existing or to be realized.

[0067] The way in which this is achieved is not important, different assembling alternatives are apparent to experts in the field on the basis of the teachings of the present invention.

[0068] In other words, to be structurally efficient, the wooden panels, preferably made of laminated wood and more preferably made of cross-laminated wood, must be, regardless the adopted method of laying in work, inserted forcedly and without play, all along their perimeter, within the field of the frame (made of reinforced concrete or steel) in which they are inserted.

[0069] Referring to FIGS. **1-4**, it is shown, for purposes of example only and not of limitation, a simple embodiment of the present invention, in which a wooden panel, indicated by the reference number **10**, is laid in place and forcedly put all around its perimeter in a frame **11** made of reinforced concrete, consisting of columns **12** and beams **13**, according to a very simple and generic method, used by way of example but not of limitation of the present invention, by means of a wooden counter-frame **14**. In the figures, the panel **10** is in turn integrated in a frame **15**, also made of wood. Again with reference to FIGS. **1-4**, the forced insertion of the panel **10** is obtained, by way of example and not of limitation, by inserting between the panel **10**, or better between the frame **15** of the panel **10** and the counter-frame **14**, a plurality of wedges **16**. In particular, FIG. **1** and FIG. **4** show the constituent elements of the construction system according to the present invention subsequently to the forced insertion, with wedges **16** tightly packed between the counter-frame **14** of the building structure and the frame **15** of the panel **10**, and FIG. **2** and FIG. **3** show the same items before forced insertion.

[0070] This particular embodiment of the present invention is very similar to that of installation of the doors, with the difference in that, while between the frames and the counter-frames it is sufficient to put four wedges, two for each vertical upright, according to the present invention putting into force must be made all along the perimeter of the panel **10**, with the exception of the base (automatically forced by putting into force the upper side **10** of the same panel), through a suitable number of wedges **16**.

[0071] If desired, in the case of columns **12** made of steel or reinforced concrete with perfectly vertical faces, it could also be possible to put into force only one of the vertical sides of the panel **10**.

**[0072]** In particular, FIG. **4** shows how the panel **10** is made integral with the frame **15** due to the action of coupling effected by screws **17**, which preferably may be double thread screws **17**. By contrast, the counter-frame **14** also is made integral with the column **12** made of reinforced concrete due to the effect of the coupling action operated by respective screws **18**. In FIG. **4** is also shown a further screw **19**, which preferably may be a double thread screw **19**, by which the panel **10**, by means of its frame **15**, the counter-frame **14** and the wedges **16** are rendered integral with each other, after the putting into force of the system.

**[0073]** FIG. **5**, very similar to FIG. **4**, presents the difference that the supporting skeleton of the building is made of steel, so that, instead of the column **12** made of reinforced concrete shown in FIG. **4**, in FIG. **5** a column **20** of steel with double-T type profile is shown.

EXAMPLE

**[0074]** The study of the applicability of the construction system according to the present invention analyzed the general problems of public housing built in Italy in the first half of the XX century and has addressed, in line with the emerging policies of environmental sustainability and reduction of energy consumption, the theme of sustainable restoration of existing buildings by intervening on the particular case study of Preturo ATER district; a small residential settlement located on the outskirts of L'Aquila and characterised by a low level of livability, made worse by the withdrawal as a result of the serious damage caused by the earthquake of April 2009.

**[0075]** The study allowed to evaluate the applicability of the technology in dry conditions according to the present invention, in the building restoration, verifying how this system is particularly suitable for the improvement of seismic behavior of structures and of the energy behavior of the envelope.

**[0076]** The restoration project was an important case study on which it was possible to analytically verify the effective functioning of the proposed solution, verifying how with this intervention it is possible to achieve a substantial improvement in the overall seismic behavior of the structure.

**[0077]** The area forming object of study consists of six buildings arranged as a court and having 3 and 4 floors above ground.

**[0078]** The six buildings have same construction-structural characteristics: rectangular plan with a size of 39.3 m in the X direction and 12 m in the Y direction and an elevation above ground of 3 and 4 floors with a height of 11.3 m and 14.1 m.

**[0079]** The load bearing structure, made of reinforced concrete frame, is made up of columns with a size of 30×60 cm and beams which can be divided into emerging beams 30×50 cm and beams with 60×30 cm thickness.

**[0080]** The typical deck is made with floors in brick-concrete, consisting of rows of perforated brick blocks and reinforced concrete joists with overhanging cooperative slab and transverse warp at the lower side of the building. The infills instead are made in hollow brick and chalk blocks.

**[0081]** In compliance with the requirements dictated by the regulations in force and of the rules of proper design, as shown in FIG. **6**, in which there is shown a plan view of the load-bearing structure of one of the buildings, the panels **10**, constituting bracing walls, realized in cross-laminated wood X-Lam, were arranged symmetrically and uniformly distributed in plan and in elevation, thereby reducing the tendency of the structure to twist due to side actions induced by an earthquake.

**[0082]** The evaluation of structural type has allowed to observe the different dynamic behavior of the structure stressed by seismic action and evaluate the aspects that cross-laminated wood X-Lam technology can offer in restoring infill framed structures.

**[0083]** The analysis made was of the dynamic linear type with acceleration spectrum response. Through the analysis it was possible to evaluate, in terms of deformation and even better in terms of participants masses, the substantial differences in the behavior of the frames of reinforced concrete infilled with brick panels (referred to in the FIGS. **7** and **8**, respectively, as about the displacement in the X direction and the displacement in the Y direction) and of reinforced concrete frames infilled with panel of cross-laminated wood X-Lam (referred to in FIGS. **9** and **10**, respectively, with respect to the displacement in the X direction and the displacement in Y direction).

**[0084]** From the evaluation of the structural weight of the two modeling the improving contributions in terms of reduction of the masses were observed, which of course become part in the dynamic analysis.

**[0085]** In the model studied with X-Lam panels a drastic reduction of the structural weight was observed, which implied a significant reduction of seismic shear on the building (the latter being nothing more than a cutting action to the base, proportional to the mass of the building and the design spectrum referred to the first return period) and then in an equally significant reduction (up to 20 times) of the etched displacements.

**[0086]** In the same models the different stress state of columns with different type of panels was then rated (referred to in the FIGS. **11** and **12**, respectively, with regard to infills with brick panels and with regard to infills with cross-laminated wood panels X-Lam), noting that the inclusion, in one or more fields of the frame of the structure, of panels made of cross-laminated wood, forcedly and without play all along their perimeter, according to the present invention, give to the structure evident improvements in terms of reduction of tensions.

**[0087]** In particolar, in the tensional state "stress beam earthquake bending y=bending by torsion", it was recorded a reduction of approximately 75% of the stress state of the columns, in the case of the model with infill of cross-laminated wood X-Lam panels (for which a maximum stress has been calculated to be 4.01 N/mm2), compared to the case of the model with brick infill (for which a maximum stress equal to 16.47 N/mm2) was calculated.

**[0088]** The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that variations and/or modifications can be made by those skilled in the art without departing from the relevant scope of protection, as defined by the enclosed claims.

**1-4**. (canceled)

**5**. A construction system with a supporting framework, new or pre-existent, made of reinforced concrete or steel, integrated with infill panels made of wood, wherein said supporting framework is constituted by a frame of columns and beams, wherein said infill panels are inserted and put under stress in one or more fields of the frame of the structure, forcedly and without play all along their perimeter.

**6**. The construction system according to claim **5**, wherein said infill panels are made of laminated wood.

**7**. The construction system according to claim **6**, wherein said infill panels are made of cross-laminated wood.

**8**. The construction system according to claim **5**, wherein said infill panels are integrated in a frame.

* * * * *