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(54) THE METHOD OF HYBRID STRUCTURAL CEILING STRAND PREFABRICATION

(57) The object of the invention is the method of hybrid structural ceiling strand prefabrication **characterized in that:**

a) in the first process, with the use of feeding conveyors elements in the form of flattened cuboids are delivered to the crosscut saw **7,** where the crosscuts are made in order to receive the upper straps **20** and the lower strap **21,**

b) in the second process with the use of CNC plotter **9** two identical rectangular webs **22** are cut, where each web has at least two straps, and in between, in the symmetry axis of each web is at least one technological hole **23,** next milling of the webs' surfaces is carried out,

c) next in the assembly area **1,** one by one, the following technological processes are carried out:

- the lower strap **21** is placed at its cradle **14** and stabilized,
- on the lower strap **21,** the rectangular support **24** and middle **25** posts are placed, and the lower surface of the supports adhering the lower strap is covered with layer of the glue,
- one upper strap **20** of the strand is placed on each of rotating side arms **19,**
- on each end of each upper strap **20** of the strand, one the rectangular support posts is placed, and the lower surface of the supports is covered with layer of the glue,
- on the side surface of each upper strap **20** and attached support posts **24,** after placing layer of the glue, webs **22** are placed,
- the cradle **14** together with the attached lower strap **21** of the strand is rotated by 90°,
- the milled surfaces of the web **22,** which are placed on the right side rotating arm **19,** are covered with glue,
- the right side arm **19** is rotated by 180° in such way, that attached right side wing almost overlaps the lower strap **21,**
- the right side wing is glued and stapled to the elements of the lower strap **21,**
- the right side rotating arm **19** returns to the initial position,
- the cradle **14** together with the attached lower strap **21** is rotated by 180°,
- the milled surfaces of the web **22,** which are placed on the left side rotating arm **19,** are covered with glue,
- the left side arm **19** is rotated by 180° in such way, that attached left side wing almost overlaps the lower strap **21,**
- the left side wing is glued and stapled to the elements of the lower strap **21,** which are placed on the cradle **14,**
- the left side rotating arm **19** returns to the initial position,
- the cradle **14** of the lower strap **21** of the strand returns to the initial position,
- the end **15** and side **16** pneumatic actuators are released,
- the ready hybrid strand is removed with the vacuum manipulator **11** and placed in the storage area **13.**

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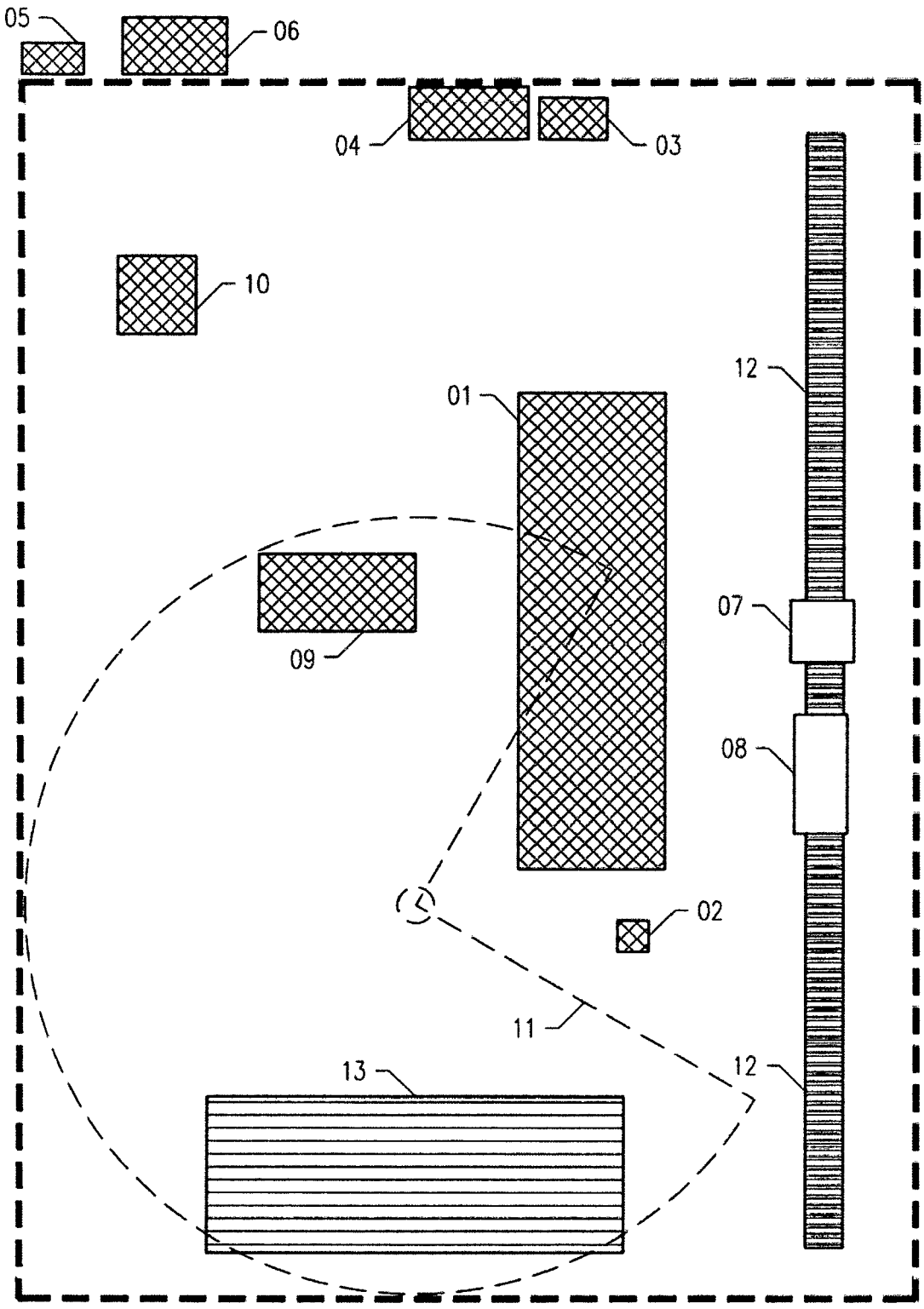

Fig. 1

Description

[0001] The object of the invention is the method of hybrid structural ceiling strand prefabrication being the construction element used for building the structural ceilings of construction objects, especially wooden frame house, including the one made of modular (panel) technology.

[0002] There are different types of ceiling strands, known from the state of the art, including the wooden and wood-based, as well as the methods of their manufacturing.

[0003] From the documentation of patent application of Polish invention P.319245, a wooden strand is known, which consists of glued cuboids, each made of two lamellas of prism shape with right-angle triangle base, made of radial sections of the trunk, where the cuboids are glued in such a way, that year-old wood grains are in standing position and basically spread towards the longitudinal direction of the strand.

[0004] The PL208514 patent description shows the method of reinforcing a wooden strand as well as wooden strand reinforced with fibre composites. The method of reinforcement consists of strengthening the wooden strand with fibre composites is characterised in that, two strands of fibre composites, preferably of carbon or fibreglass mats, are glued on both side surfaces of wooden strand, so that the strands cross on the lowers surface, in the middle of the strand span. Gluing of each band begins in the supporting area, in the upper corner of the side surface of the strand and runs diagonally towards the middle of the span of the strand through the lower surface to the other side of the side surface, then diagonally, and ends in the supporting area in upper corner of the other side surface of the strand.

[0005] The PL208513 patent description shows the method of reinforcing the wooden strand undercut at its support as well as wooden strand undercut at its support. The method of reinforcement of wooden strand undercut at the support is characterised in that, the band of fibre composites is glued on the surface of wooden strand in the supporting area, near the undercut, around the strand, so that the band makes a constant, closed clamp. Preferably carbon or fibreglass mats are used as the fibre composites.

[0006] The PL224876 patent description shows the method of the reinforced wooden strand, especially multi-layered one, used as a girder element in the construction. The reinforced strand consists of glued layers of wood and at least one synthetic reinforcement consisting of at least one continuous fibre connected with resin matrix. Each fibre along with the matrix is set in the certain position in the wooden strand, as well as in the wood layer thanks to straight cut in the wood layer. The synthetic reinforcement consists of at least one additional element, connecting the layers of wood with tongue-groove system, where the synthetic reinforcement is the tongue placed inside the wooden strand, that is invisible on the outside.

[0007] The P.402907 Polish application documentation of the invention shows the method of manufacturing the glued wooden strand characterised in that, at least two radial cuts are made inside of the core strand along the axe of the core, which do not reach the core and divide the core strand into the segments, next such cut core strand is dried in order to reach a required humidity, next it is radially cut through its core, and the cut segments, which in the cross-section are in the shape of a circle, are milled in the radial surfaces of the cuts until the remaining part of the core is cut and the required dimensional elements are gained, next these elements are glued with the known methods.

[0008] The state of the art knows ceiling structures in wooden frame construction manufactured either from single wooden strands or in the form of large prefabricated panel elements. In the first case it comes to making the structural ceiling at the construction site, having walls put up first from single wooden strands, on which structural ceiling lining is placed. This solution is laborious and requires a lot of skills from the workers. In the second case the strands or their fragments are prefabricated in the factory and next delivered to the construction site and placed with the use of a heavy equipment due to their weight.

[0009] The additional inconvenience of the known solutions is the long prefabrication time of these modular construction objects or their elements in the factory, as well as long and also difficult assembly of these objects on the construction site.

[0010] The solution of the above mentioned invention allows for relatively fast and easy prefabrication of the structural ceiling strands, which are used to make ceiling, which are manufactured on the hybrid ceiling strands production line, which then allows to make the structural ceiling without the use of heavy transport and assembly equipment.

[0011] The advantage of the invention is the possibility of manufacturing structural ceiling strands in advance and storing them until needed, what shortens the time from making the project to its assembly.

[0012] The aim of the mentioned invention was to develop semi-automatic method of hybrid structural ceiling strand prefabrication, being the construction element used for building the structural ceilings of construction objects especially wooden frame house, ensuring facilitation, optimization and high precision of the strands prefabrication process, as well as shortening the prefabrication time to its minimum.

[0013] The object of the invention is the method of hybrid structural ceiling strand prefabrication consisting of cuboid supporting and middle posts and elements in the form of flattened cuboids, i.e. two upper and one lower strap perpendicular to the vertical axis of symmetry of the strand as well as two discontinuous webs, parallel to vertical symmetry axis of the strand, connected so that in the vertical section, the ceiling strand is U-shaped,

where in the middle part it has a hole or holes partly restricted by the upper surface of the strap, lower surfaces of the two upper straps and side edges of the discontinuous webs, **characterized in that:**

a) in the first process, with the use of feeding conveyors elements in the form of flattened cuboids are delivered to the crosscut saw, where the crosscuts are made in order to receive the upper straps and the lower strap of the required lengths between 100 and 1000cm, preferably 800cm, wherein the upper straps, the lower strap and the elements of the cross-section in the form of rectangle, of which one side has the length of 3 to 9 cm, while the other has the length between 9,5 to 18,5 cm,
b) in the second, independently to the first one process with the use of vacuum manipulator, the plate of 12 to 25 mm thick, preferably 18 mm thick, is moved to the CNC plotter, to have two identical rectangular webs made in required length and width, where each web has at least two straps, and in between, in the symmetry axis of each web is at least one technological hole, wherein with strands of 600 cm the width of each web is 25-35 cm, preferably 30 cm, and the length of each web is less than the length of upper straps by 30-40 cm, preferably 35cm, whereas with strands of length above 600 cm the width of each web is 35-45cm, preferably 40cm and the length of each web is less than the length of upper straps by 65-75 cm, preferably 70cm, where the difference in webs' length and upper straps is the width of the technological hole/holes, next - with the CNC plotter-milling of the webs' surfaces is carried out, wherein one mill is done on each side of the web, and the distance of the mill from the edge of the web is equal to the width of the strand, which will be glued in the next stage,
c) next in the assembly area, using the control panel, semi-automatically, one by one, the following technological processes are carried out:

- the lower strap is placed at its cradle and stabilized with pneumatic side actuators,
- with the pneumatic end actuator, on the lower strap of the strand, perpendicularly to its wider side surface, the rectangular support and middle posts are placed, then pressed down mechanically and stabilized. Their width is equal to the longer side of the rectangle in the cross-section of the lower strap, and their height is equal to the web decreased by the amount equal to the shorter side of the rectangle in the cross-section of the lower strap, wherein one support post is placed on each end of the lower strap of the strand, and middle posts are placed symmetrically on the lower strap of the strand. Moreover, the lower surface of the supports adhering the lower strap is covered with layer of the glue, before placing them on the surface of the lower strap,
- one upper strap of the strand is placed on each of rotating side arms,
- using pneumatic actuators of side arms, on each end of each upper strap of the strand, perpendicularly to its wider side surface, one rectangular support post is positioned and mechanically pressed and stabilized, their width is equal to the longer side of the rectangle in the cross-section of the upper strap and their height is equal to the width of web decreased by the amount equal to the shorter side of the rectangle in the cross-section of the upper strap, moreover, the lower surface of the supports is covered with layer of the glue, before placing the straps on the surface of the upper strap,
- on the side surface of each upper strap and attached support posts, after placing layer of the glue, webs are placed, forming left and right side wings, wherein after placing the webs, it is preferable to stabilize them by tightening the screws or stapling (staples are used to stabilize web plates during the gluing process, because without staples there is a risk of misplacing them relatively to upper strap due to glue swelling),
- with the power unit the cradle together with the attached lower strap of the strand is rotated by 90°,
- the milled surfaces of the web, which are placed on the right side rotating arm, are covered with glue,
- the right side arm is rotated by 180° in such way, that attached right side wing almost overlaps the lower strap,
- the right side wing is glued and stapled to the elements of the lower strap, which are placed on the cradle of the lower strap of the strand,
- after releasing the pneumatic actuators of the right arm, the right side rotating arm returns to the initial position,
- with the power unit the cradle together with the attached lower strap of the strand is rotated by 180°,
- the milled surfaces of the web, which are placed on the left side rotating arm, are covered with glue,
- the left side arm is rotated by 180° in such way, that attached left side wing almost overlaps the lower strap,
- the left side wing is glued and stapled to the elements of the lower strap, which are placed on the cradle of the lower strap of the strand,
- after releasing the pneumatic rotating actuators of the rotating left side arm, the left side rotating arm returns to the initial position,
- with the use of the power unit the cradle of the lower strap of the strand returns to the initial

position,

- the end and side pneumatic actuators are released,
- the ready hybrid strand is removed with the vacuum manipulator and placed in the storage area.

[0014] Preferably, the elements consisting of upper and lower straps are the elements made of wood-based materials, plastic or composite materials yet preferably made of wood.

[0015] Preferably, the upper straps are the elements of rectangle shape in cross-section, where one side is 4cm and the other 16cm long.

[0016] Preferably, the lower strap is the element of rectangle shape in cross-section, where one side is 6cm and the other 16cm long.

[0017] Preferably, after cutting the strands with the crosscut saw all along, being the lower strap, at least two grooves are milled, which are placed symmetrically on the wider side of the lower strap, afterwards the composite rods are glued, preferably basalt ones, with the length equal to the one of the lower strap.

[0018] Preferably, the composite rods are cut to the length equal to the one of the lower strap, with the device used for scrolling and cutting rods.

[0019] Preferably, the composite rods are glued into the lower strap grooves with the composite glue, preferably epoxy one.

[0020] Preferably, rods with diameter of 8 to 12 mm, preferably 10mm, with round section are used, and the shape and diameter of the milled grooves in the lower strap is suitable to precise insertion of the rods.

[0021] Preferably, the plates which are used to cut webs are made of plastic, composite or wood-based materials, including wood-based board, preferably of OSB/3 oriented strand board.

[0022] Preferably, the glued surfaces are moistened with water, before placing the glue.

[0023] Preferably, layers of the glue are placed with the special device.

[0024] Preferably, essential compressed air to carry out all pneumatic technological processes is supplied form the central compressor.

[0025] Preferably, while carrying out individual technological processes with the central sawdust extraction, sawdust is removed from the crosscut saw and mill as well as the CNC plotter.

[0026] According to the invention, the method of hybrid structural ceiling strand prefabrication, is carried out with the use of semi-automatic production line of the hybrid structural ceiling strand, presented in fig. 1, which includes: assembly area, control panel for controlling semi-automatic technological processes of the assembly area, at least one device to apply the glue, at least one stapling device, central compressor to supply compressed air required to carry out technological processes on production line devices, central sawdust vacuum to remove sawdust form crosscut saw, mills and CNC plotter, crosscut saw, mill do make grooves built-in on production line between the feeding conveyors, CNC plotter, a device used for scrolling and cutting composite rods, vacuum manipulator, feeding conveyors, storage area do store ready products.

Whereas, assembly area, consists of: lower strand cradle, pneumatic end actuators, pneumatic side actuators, pneumatic actuators of the side arms, power unit to turn the cradle of the lower strap, rotating side arms.

[0027] The basic advantages of such solution are:

- possibility of manufacturing structural ceiling strands and flat-roofs of wood or wood-based materials with span up to 10 meters.;
- possibility of manufacturing and dimension supervising hybrid structural ceiling strands;
- ensuring high precision of gaining the dimensions of hybrid structural ceiling strands, as well as repeatability of: the length, width, and angles;
- compactness of the solution - a relatively small production area is required, about 400 m^2;
- relatively easy operating and small number of workers are required to operate the technological line, which with the lowest efficiency can be operated by two people;
- relatively low power consumption - about 30 kWh;
- lack of necessity employing automation specialists to operate production line;
- relatively short amount of time to manufacture hybrid ceiling strands;
- easier storage of and transport of constructional and dimensional repeatable hybrid structural ceiling strands manufactured on the production line;
- thanks to the precision and completeness of making certain elements there is no need to carry out additional processing on construction site;
- Such prepared strands and flat-roofs on the production line of hybrid strands are easy to assemble, thanks to the quality and repeatability of the hybrid strands;
- The time period of the installation is much better than traditional construction of frame ceiling strands and wooden ones, and received toughness is also much better than ceilings used so far in the frame building.

[0028] The subject of the invention is presented in the drawing, where fig. 1 shows the layout of the given elements of the production line to prefabricate hybrid ceiling strand in accordance to the invention, fig. 2 assembly area from upper view, fig. 3 - installed ceiling in axonometric section, fig. 4 - installed ceiling strand in axonometric section, fig. 5 - structural ceiling strand in vertical section along the shorter side.

Example 1

[0029] The example of prefabrication process of the

hybrid structural ceiling strand invention is carried out with the use of semi-automatic production line of the hybrid structural ceiling strands, presented in fig. 1, -consisting of: assembly area **1,** control panel **2** for semi-automatic operation of assembly area **1**technological processes, glue applying device **3,** two staplers **4,** central compressor **5,** saw dust central extraction **6,** cross-cut saw **7,** mill **8** for groove milling built in the technological line between feeding conveyors **12,** CNC plotter **9,** device **10** used for scrolling and cutting composite rods, vacuum manipulator **11,** feeding conveyors **12,** storage area **13** to storage ready made products.

[0030] Whereas the assembly area consists of: cradle of lower strap of strand **14,** pneumatic end actuators **15,** pneumatic side actuators **16,** pneumatic arms actuator **17,** power unit **18** that rotates the cradle **14** of the lower strap, rotating side arms **19.**

[0031] According to the present example the method of hybrid structural ceiling strand prefabrication consisting of cuboid supporting **24** and middle **25** posts and elements in the form of flattened cuboids, i.e. two upper **20** and one lower strap **21** perpendicular to vertical axis of symmetry of the strand as well as two discontinuous webs **22,** parallel to vertical axis of symmetry of the strand, connected so that in the vertical section the ceiling strand is U-shaped, wherein in the middle part it has holes or partly restricted by the upper surface of the strap holes, lower surfaces of the two upper straps and side edges of the discontinuous webs, characterized in that:

a) in the first process, with the use of feeding conveyors **12** elements in the form of flattened cuboids are delivered to the crosscut saw **7,** where the cross-cuts are made in order to receive the upper straps **20** and the lower strap **21** of the lengths 800cm, wherein the upper straps and the lower strap are elements with cross-section in the form of rectangle, of which one side has the length of 4 cm - upper strap, and 6 cm - lower strap, while the other side is 16 cm long - the upper and lower straps.

b) in the second, independently to the first one, process with the use of vacuum manipulator **11,** the wood-based board, preferably of OSB/3, is moved to have webs of **18** mm thick made, to the CNC plotter **9,** where two identical rectangular webs **22** are made in required length and width, where each web consists of least two straps, and in between, in the symmetry axis of each web is at least one technological hole **23,** wherein the width of each web is 40 cm, and the length of each web is shorter than the length of the upper straps by 70 cm, where the difference in webs' length and upper straps is the width of the technological holes **23,** next - with the CNC plotter **9-** milling of the webs' surfaces is carried out, wherein one mill is done on each side of the web, and the distance of the mill from the edge of the web is equal to the width of the strand, which will be glued in the next stage,

c) next in the assembly area **1,** using the control panel **2,** semi-automatically, one by one, the following technological processes are carried out:

- the lower strap **21** is placed at its cradle **14** and stabilized with pneumatic side actuators **16,**
- with the pneumatic end actuator **15,** on the lower strap of the strand **21,** perpendicularly to its wider side surface, the rectangular support **24** and middle **25** posts are placed of 16 cm wide and 34cm high, where one support post **24** is placed on each end of the lower strap of the strand **21,** and middle posts **25** are placed symmetrically on the lower strap of the strand **21.** Moreover, the lower surface of the supports adhering the lower strap is covered with layer of the glue, before placing them on the surface of the lower strap,
- one upper strap of the strand **20** is placed on each of rotating side arms **19,**
- using pneumatic actuators **17** of rotating side arms **19,** on each end of each upper strap **20** of the strand, perpendicularly to its wider side surface, the rectangular support post **24** of 16 cm wide and 34cm high, is placed, then pressed down mechanically and stabilized. Moreover, the lower surface of the support is covered with layer of the glue, before placing the straps on the surface of the upper strap,
- on the side surface of each upper strap **20** and attached support posts **24,** after placing layer of the glue, webs **22** are placed, forming left and right side wings, wherein after placing the webs, it is preferable to stabilize them by tightening the screws or stapling with the stapler **4,**
- with the power unit **18** the cradle **14** together with the attached lower strap of the strand **21** is rotated by 90°,
- the milled surfaces of the web **22,** which are placed on the right side rotating arm **19,** are covered with glue,
- the right side arm **19** is rotated by 180° in such way, that right side wing mounted on it overlaps the elements of the lower strap **21,**
- the right side wing is glued and stapled to the elements of the lower strap **21,** which are placed on the cradle **14** of the lower strap of the strand,
- after releasing the pneumatic actuators **17** of the right arm, the right side rotating arm **19** returns to the initial position,
- with the power unit **18** the cradle **14** together with the attached lower strap of the strand **21** is rotated by 180°,
- the milled surfaces of the web **22,** which are placed on the left side rotating arm **19,** are covered with glue,
- the left side arm **19** is rotated by 180° in such way, that attached left side wing mounted on it

overlaps the elements of the lower strap **21,**

- the left side wing is glued and stapled to the elements of the lower strap **21,** which are placed on the cradle **14,**
- after releasing the pneumatic actuators **17** of the rotating left arm, the left side rotating arm **19** returns to the initial position,
- with the use of the power unit **18** the cradle **14** of the lower strap of the strand returns to the initial position,
- the end **15** and side **16** pneumatic actuators are released,
- the ready hybrid strand is removed with the vacuum manipulator **11** and placed in the storage area **13.**

[0032] The elements constituting of upper **20** and lower straps **21** are the elements made of wood.

[0033] After cutting along the strands with the crosscut saw **7,** which is the lower strap **21,** at least two grooves are milled, with the use of mill **8,** which are placed symmetrically on the wider side of the lower strap **21,** afterwards the composite rods are glued, basalt ones, with the length equal to the one of the lower strap, wherein the composite rods are previously cut to the length equal to the one of the lower strap, with the device **10** used for scrolling and cutting rods, and next glued into the lower strap **21** grooves with the composite epoxy glue.

[0034] Rods with diameter of 10mm, with round section are used, and the shape and diameter of the milled grooves in the lower strap is suitable to precise insertion of the rods.

[0035] The glued surfaces are moistened with water before placing the glue with the suitable device **3.**

[0036] Essential compressed air to carry out all pneumatic technological processes is supplied form the central compressor **5.**

[0037] While carrying out individual technological processes with the central sawdust extraction **6,** sawdust are removed from the crosscut saw **7** and mill **8** well as the CNC plotter **9.**

Claims

1. The method of hybrid structural ceiling strand prefabrication consisting of cuboid supporting and middle posts and elements in the form of flattened cuboids, i.e. two upper and one lower strap perpendicular to the vertical axis of symmetry of the strand as well as two discontinuous webs, parallel to vertical symmetry axis of the strand, connected so that in the vertical section, the ceiling strand is U-shaped, where in the middle part it has a hole or holes partly restricted by the upper surface of the strap, lower surfaces of the two upper straps and side edges of the discontinuous webs, **characterized in that:**

a) in the first process, with the use of feeding conveyors **12** elements in the form of flattened cuboids are delivered to the crosscut saw **7,** where the crosscuts are made in order to receive the upper straps **20** and the lower strap **21** of the required lengths between 100 and 1000cm, preferably 800cm, wherein the upper straps, the lower strap and the elements of the cross-section in the form of rectangle, of which one side has the length of 3 to 9 cm, while the other has the length between 9,5 to 18,5 cm,

b) in the second, independently to the first one process, with the use of vacuum manipulator **11,** the plate of 12 to 25 mm thick, preferably 18 mm thick, is moved to the CNC plotter **9,** to have two identical rectangular webs **22** made in required length and width, where each web has at least two straps, and in between, in the symmetry axis of each web is at least one technological hole **23,** wherein with strands of 600 cm the width of each web is 25-35 cm, preferably 30 cm, and the length of each web is less than the length of upper straps **20** by 30-40 cm, preferably 35cm, whereas with strands of length above 600 cm the width of each web is 35-45cm, preferably 40cm and the length of each web is less than the length of upper straps **20** by 65-75 cm, preferably 70cm, where the difference in webs' length and upper straps is the width of the technological hole/holes **23,** next - with the CNC plotter **9** - milling of the webs' surfaces is carried out, wherein one mill is done on each side of the web, and the distance of the mill from the edge of the web is equal to the width of the strand, which will be glued in the next stage,

c) next in the assembly area **1,** using the control panel **2,** semi-automatically, one by one, the following technological processes are carried out:

- the lower strap **21** is placed at its cradle **14** and stabilized with pneumatic side actuators **16,**
- with the pneumatic end actuator **15,** on the lower strap **21** of the strand, perpendicularly to its wider side surface, the rectangular support **24** and middle **25** posts are placed, then pressed down mechanically and stabilized, wherein their width is equal to the longer side of the rectangle in the cross-section of the lower strap, and their height is equal to the web decreased by the amount equal to the shorter side of the rectangle in the cross-section of the lower strap, wherein one support post **24** is placed on each end of the lower strap **21** of the strand, and middle posts **25** are placed symmetrically on the lower strap of the strand, moreover, the

lower surface of the supports adhering the lower strap is covered with layer of the glue, before placing them on the surface of the lower strap,
- one upper strap **20** of the strand is placed on each of rotating side arms **19,**
- using pneumatic actuators **17** of side arms **19,** on each end of each upper strap **20** of the strand, perpendicularly to its wider side surface, one rectangular support post **24** is positioned and mechanically pressed and stabilized, their width is equal to the longer side of the rectangle in the cross-section of the upper strap **20** and their height is equal to the width of web **22** decreased by the amount equal to the shorter side of the rectangle in the cross-section of the upper strap **20,** moreover, the lower surface of the supports is covered with layer of the glue, before placing the straps on the surface of the upper strap,
- on the side surface of each upper strap **20** and attached support posts **24,** after placing layer of the glue, webs **22** are placed, forming left and right side wings, wherein after placing the webs, it is preferable to stabilize them by tightening **4** the screws or stapling,
- with the power unit **18** the cradle **14** together with the attached lower strap **21** of the strand is rotated by 90°,
- the milled surfaces of the web **22,** which are placed on the right side rotating arm **19,** are covered with glue,
- the right side arm **19** is rotated by 180° in such way, that attached right side wing almost overlaps the lower strap **21,**
- the right side wing is glued and stapled to the elements of the lower strap **21,** which are placed on the cradle **14** of the lower strap of the strand,
- after releasing the pneumatic actuators **17** of the right arm, the right side rotating arm **19** returns to the initial position,
- with the power unit **18** the cradle **14** together with the attached lower strap **21** of the strand is rotated by 180°,
- the milled surfaces of the web **22,** which are placed on the left side rotating arm **19,** are covered with glue,
- the left side arm **19** is rotated by 180° in such way, that attached left side wing almost overlaps the lower strap **21,**
- the left side wing is glued and stapled to the elements of the lower strap **21,** which are placed on the cradle **14** of the lower strap of the strand,
- after releasing the pneumatic rotating actuators **17** of the rotating left side arm, the left side rotating arm **19** returns to the initial position,
- with the use of the power unit **18** the cradle **14** of the lower strap **21** of the strand returns to the initial position,
- the end **15** and side **16** pneumatic actuators are released,
- the ready hybrid strand is removed with the vacuum manipulator **11** and placed in the storage area **13.**

2. The method in accordance with claim 1, **characterized in that** the elements consisting of upper **20** and lower **21** straps are the elements made of wood-based materials, plastic or composite materials yet preferably made of wood.

3. The method in accordance with claim 1, **characterized in that** the upper straps **20** are the elements of rectangle shape in cross-section, where one side is 4cm and the other 16cm long.

4. The method in accordance with claim 1, **characterized in that** the lower strap **21** is the element of rectangle shape in cross-section, where one side is 6cm and the other 16cm long.

5. The method in accordance with claim 1, **characterized in that** after cutting the strands with the crosscut saw **7** all along, being the lower strap **21,** at least two grooves are milled, which are placed symmetrically on the wider side of the lower strap, afterwards the composite rods are glued, preferably basalt ones, with the length equal to the one of the lower strap.

6. The method in accordance with claim 1, **characterized in that** the composite rods are cut to the length equal to the one of the lower strap, with the device **10** used for scrolling and cutting rods.

7. The method in accordance with claim 1, **characterized in that** the composite rods are glued into the lower strap grooves with the composite glue, preferably epoxy one.

8. The method in accordance with claim 1, **characterized in that** rods with diameter of 8 to 12 mm, preferably 10mm, with round section are used, and the shape and diameter of the milled grooves in the lower strap is suitable to precise insertion of the rods.

9. The method in accordance with claim 1, **characterized in that** the plates which are used to cut webs **22** are made of plastic, composite or wood-based materials, including wood-based board, preferably of OSB/3 oriented strand board.

10. The method in accordance with claim 1, **characterized in that** the glued surfaces are moistened with water, before placing the glue.

11. The method in accordance with claim 1, **characterized in that** the layers of the glue are placed with the special device **3.**

12. The method in accordance with claim 1, **characterized in that** essential compressed air to carry out all pneumatic technological processes is supplied form the central compressor **5.**

13. The method in accordance with claim 1, **characterized in that** while carrying out individual technological processes with the central sawdust extraction **6,** sawdust is removed from the crosscut saw **7** and mill **8** as well as the CNC plotter **9.**

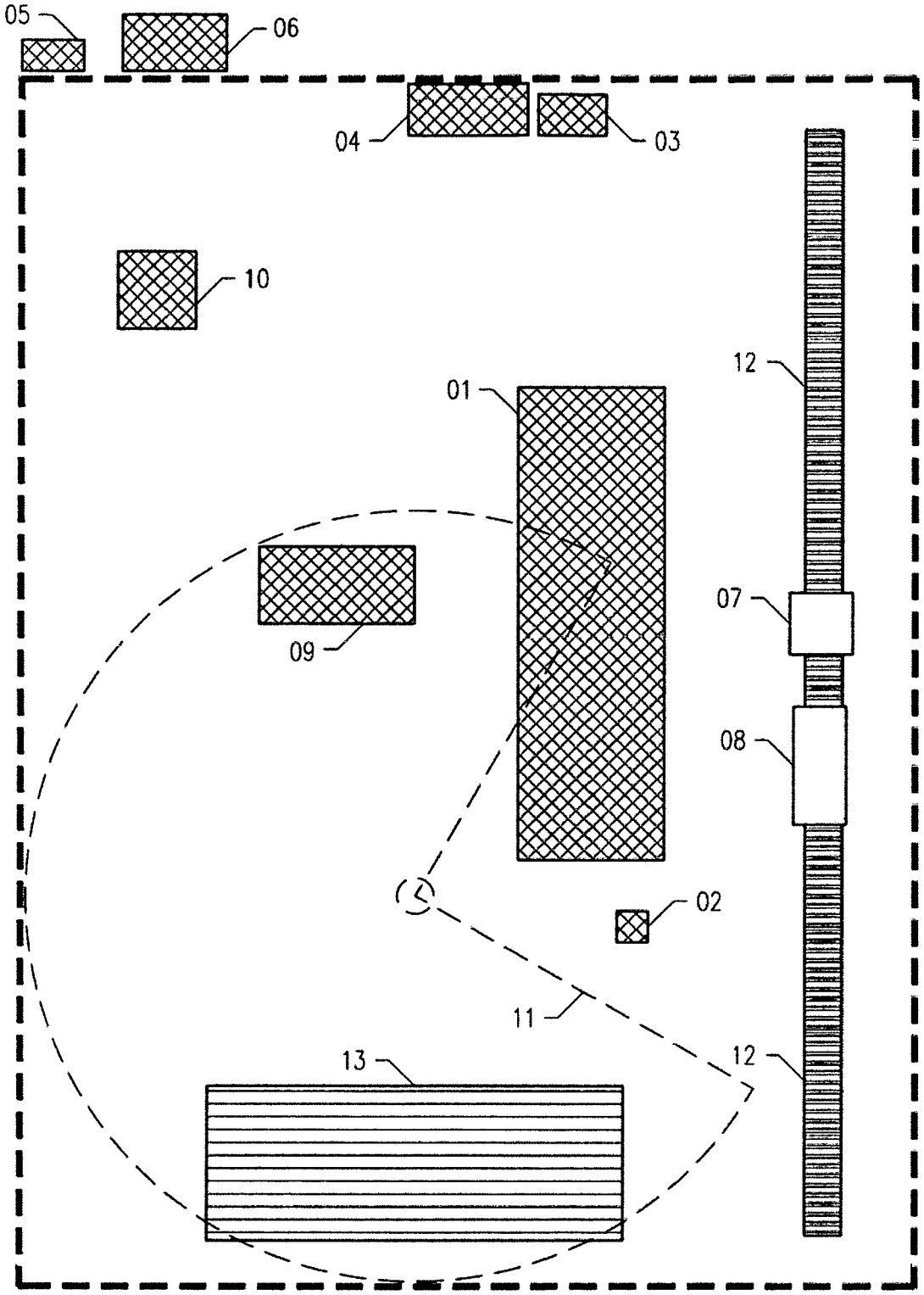

Fig. 1

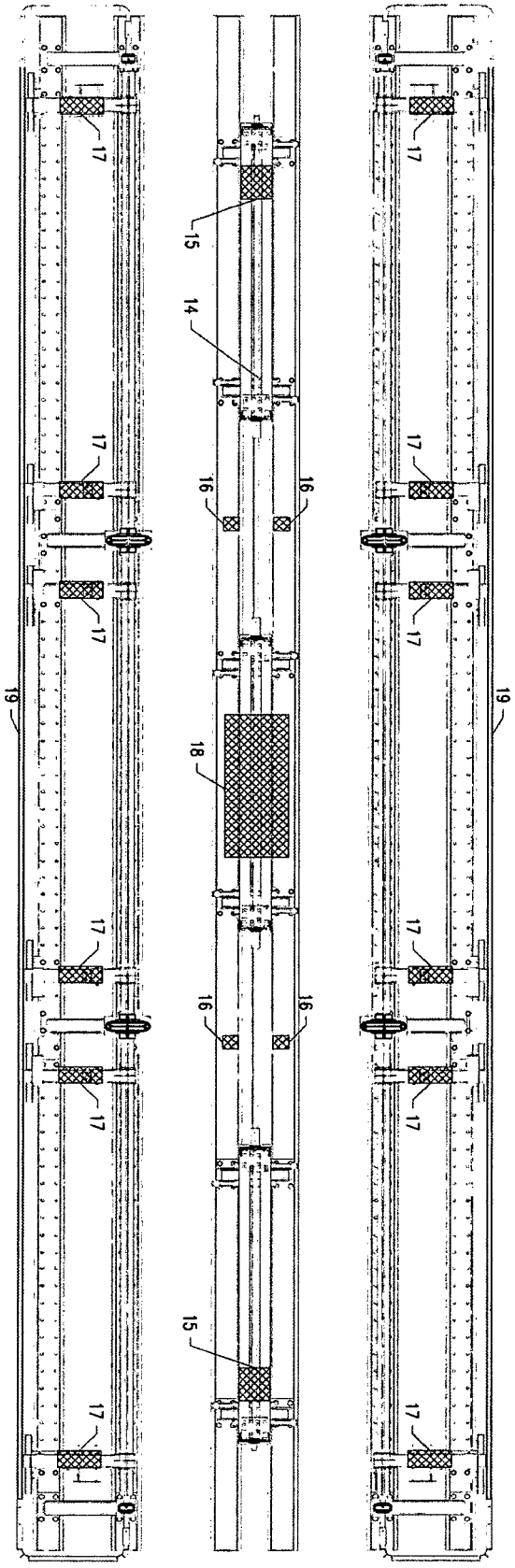

Fig. 2

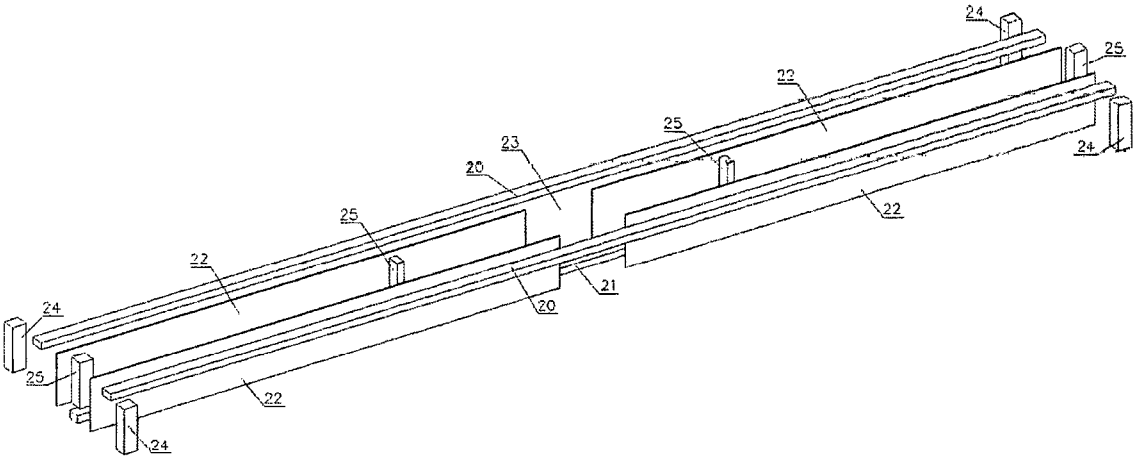

Fig. 3

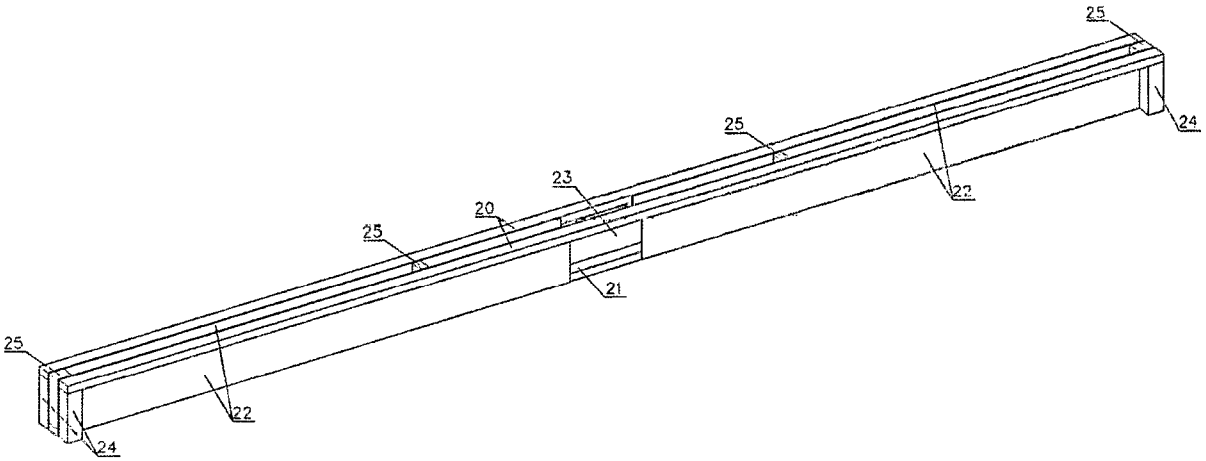

Fig. 4

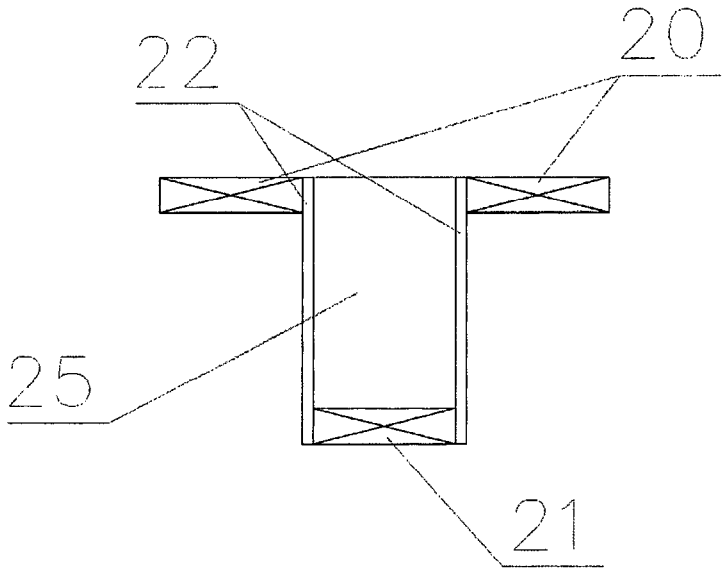

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 23 46 0023

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 625 996 A (BECHTEL FRIEND K [US]) 6 May 1997 (1997-05-06) * column 2, lines 63-66 * * column 3, lines 11-15 * * column 5, lines 41-52 * * figures * * claims *	1-13	INV. B27M3/00
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TECHNICAL FIELDS SEARCHED (IPC)

B27M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 January 2024	Hamel, Pascal

CATEGORY OF CITED DOCUMENTS

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16-01-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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