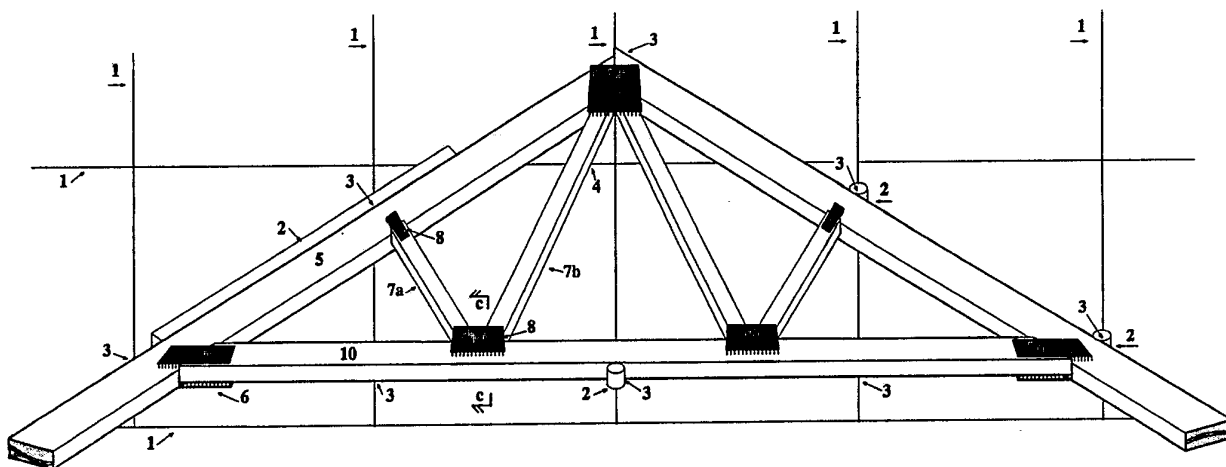


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(54) Title: METHOD FOR PRODUCTION OF TRUSSED RAFTERS WITH NAIL PLATE JOINTS



(57) Abstract

A method for production of a trussed rafter, where the nail plates are fixed to timber members at cutting before they are brought to the assembly station. The assembly station can be any type of a rafter jig but it can also be a levelled surface, e.g. a factory floor, whereby an assembly jig is not needed at all, the labor and force required for timber member jointing are minor, because the nail plates are already fixed to the timber members and assembly can take place completely or at least to the main part by means of upper plates (8). The assembly surface has a mesh pattern (1), by means of which side guides (2) needed at assembling can be positionned. Markings indicating prefixed platings and/or nail plate positions are used in quality control.

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Method for production of trussed rafters with nail plate joints

This invention relates to the production of a trussed rafter with nail plate connections. Trussed rafters of timber members and nail plates are today produced as follows: Timber members are cut by length and by angle with special saws, generally with four blade saws where the timber moves transversely with respect to the saw. Timber members are assembled in a special jig fixed according to rafter measures and nail plates are manually positioned in the joints of the jig and pressed into the timber by means of clamping arrangements and a press in the jig. In the jig the plates can be pressed also only to the half, whereby the final pressing takes place usually in a s.c. finalizing roller. The jig can also be of such a construction that the nail plates are fixed and pressed first on the one side and then rafter is turned around and the plates of the other side are fixed and thus fixing of plates underneath the timber members is not necessary.

There are a lot of problems in the present trussed rafter production:

- a) In all trussed rafter jigs nail plates are fixed manually, whereby the possibility of errors is remarkable, even up to 10...20 mm, which must be taken into account by making the plate bigger, which means an essential increase of nail plate costs. Even though the plate size is made bigger, the final result would anyhow be unreliable, since an error in plate positioning would be difficult to detect and control.
- b) The rafter assembly jig is expensive. If the plate is pressed by the direct method, i.e. usually by a s.c. beam press or a C-press, the jig and the pressing element must be robust because of the great pressing force of the nail plate. If pressing is made by the roller method, it is mostly carried out by a prefixing roller or a prefixing beam and even then the necessary components, i.e. the prefixing jig station and the plate final-fixing roller as well as the conveyors between them, form an expensive equipment. If the production is based on turning the trussed rafter, two separate jigs and plate positioning stages are needed, which makes the method complicated and not frequently applied.
- c) On starting the production of a trussed rafter batch, the jig must be installed, a form exactly similar to the trussed rafter found and the positions of joints and plates determined. This is made usually by manual measuring, which means a time-taking job. For jig setting also many kinds of measuring automations and/or purely data controlled jigs have been developed. However, jigs of this kind are expensive and generally applicable only to the production of standard type trussed rafters or they do not carry out the setting completely but often a lot of manual operations have to be done e.g. positioning of joints and plates is to be determined.
- d) The percentage of waste in production of trussed rafter timber members is remarkable, $\approx 5\%$ of all timber. This is mainly due to two reasons: firstly, cutting is usually made by four blade saws which always means some waste, because almost in every case a small bit has to

be sawn off for member head formation and secondly, the timber member length very seldom corresponds to the length of timber members to be sawn but are somewhat longer which means waste peaces that can not be used in the production.

e) It is difficult to integrate the trussed rafter timber handling to automatic stress grading. This is due to the fact that in stress grading timber members move lengthwise and thus four blade cutting and stress grading cannot be combined economically. Present cutting saws are manual and it has not been possible to combine them with stress grading a.o. due to slow motion.

f) By its basic principle the present both manual and mechanical quality and stress grading are very uneconomical. Since the grading is based on the principle that in the design for each timber member the greatest stress is determined and accordingly a strength requirement for this timber member is set with the principle that the weakest strength has to correspond at least to the greatest stress. Timber strength is determined by defect and is almost always quite small with respect to the whole timber member. It is typical that in a trussed rafter the stress is also very small, because in the trussed rafter dimensioning the stress is a peak type moment load. Since the decisive stress and the decisive defect coincide with a very little probability, very high standards are set to timber quality in present methods. The effect of this fact is rather great in trussed rafters with dominating peak-type stress (contrary to other constructions e.g. beams and pillars). This is of great importance, because timber is the biggest cost item in trussed rafter production.

A basically similar requirement of excessively high quality timber is related to timber wane and to the fact that wane cannot be allowed in joints under the nail plate. Trussed rafter timber members could have much wane outside the joint area without any practical harm but this is not possible in present production methods as the requirement calls for full-edged timber.

By this invention all above mentioned disadvantages can be eliminated or reduced to a great extent and, furthermore, advantages are gained which are not possible in prior art.

1. The nail plates are prefixed to timber members before they are brought to the trussed rafter assembly station. Generally, the plates are prepressed most advantageously underneath the chord beams and on the upper surface of diagonals and verticals. Alternatively, a part of the plates, especially the upper ones, can be positioned only at the assembly station. The nail plates can be pressed in an assembly device especially constructed for this purpose but it is most advantageous to arrange plate fixing (or at least plate marking) in connection with timber member cutting. This is very easy and economical if cutting of timber members takes place in one line with timber moving lengthwise. Fixing nail plates to timber members is known per se but in present production methods this is done inaccurately by hand either only at the assembly station by turning the chord beam around, whereby it has been possible, in any case, to fix the plate to the upper side or so that the nail plate on the underside has been fixed lightly with a

hammer or a corresponding tool to the diagonals and verticals thus avoiding fixing of the underside plate in the jig.

Essential in this new invention is the fact that plate fixing is accurate and the underneath plates are fixed, at least to the main part, to the chord beams but most advantageously all nail plates are fixed to the timber members in the plate assembly device before they are brought to the assembly station. In such an assembly device the plates can be fixed with reliable accuracy, quickly, mechanically and automatically. Essential is also that the plate is so fixed that the tooth penetrates into the timber by its whole length or mostly by its whole length, whereby joint connections at the assembly station can be minor and the required force minimal.

2. In the practice an assembly jig is not needed at all, timber members of trussed rafters can be simply prefixed at the assembly station, which can be a levelled surface, e.g. a factory floor. However, a metal or a wood surface is preferable allowing fixing of side guides or some other arrangement and, furthermore, a possibility to use lifting and conveying devices. According to the trussed rafter form, side guides are fixed to the floor with nails, screws etc. to form, in a way, a simple "jig", i.e. assembly station, and to steer the chord beams to position. However, an assembly station of this construction is not a rafter jig in its present meaning, since there are not necessarily any permanent devices at an assembly station, which would disturb any other use of this space and therefore the assembly station can at any time be used as storage space, for traffic etc. This increases remarkably the applicability of this space.

When the chord beams have been assembled, the diagonals and verticals can be placed inside of them. Thereby, measurings are not necessarily needed, because the nail plates in the rafter beams steer the diagonals and verticals to their right places. In such a rafter assembly it is advantageous to apply a method by means of which the diagonals and verticals are tightened against the chord beams, whereby there must be at least in one joint a gap for tightening and inaccuracy of measure. Joints of this kind can be easily made with nail plates described in the PCT patent publication FI89/00168.

In trussed rafter production according to the invention, handling of timber members and plates is typically automatic or semi-automatic and the assembly manual. Even though the assembly of timber members is manual and in addition, with respect to work ergonomics, seemingly disadvantageous, the method is anyhow a good one both with respect to workmanship and work ergonomics, because assembly of timber members and joint and plate position measurings go without squatting and the assembly is fast, since on one hand, there is enough clearance between the timber members and, on the other hand, they are efficiently steered to right position.

3. In this new production line the use of roller fixing is advantageous. Prefixing is hereby especially easy, because nail plates are pressed into timber to the half. Prefixing is an easy job and can be simply be carried out with a rod, a pneumatic or hydraulic hammer, roller etc, which means that no heavy fixing tools are needed. Theoretically, fixing takes appr. 50% of the workmanship needed in present methods, because half of the nail plate areas are prefixed.

In the practice fixing is still smaller, because only the upper plate has to be fixed to the rafter on the assembling. Workmanship and force needed in this job are only a fraction of the present, especially when also the upper plates are prefixed and only the timber members are prefixed on the floor and the final fixing is made in the next stage of production.

Thanks to this method the plates can also be fixed to their full depth at the assembly station, especially when the trussed rafter is a small one and the nail plates are also small. This method is most applicable, when fixing of plates is carried out with some kind of a hammering tool.

4. In setting the rafter measures and defining side guide positions, the mesh pattern on the floor can be used, which makes the setting very fast as the required mesh measures are shown in the drawings. It takes only a few minutes for one man to fix the side guides, whereas present manual jigs take 30...60 min. and even the automatic ones appr. 5 min. The mesh pattern can be vertical and also horizontal at the same time. As in this method the measuring of joint positions and plate positions is not, as a matter of fact, needed at the assembly station, the s.c. setting time of this method is only a fraction of the present methods according to the total workmanship and the total working time.

5. At the assembly station plate handling is not necessarily needed at all, because the nail plates are already fixed to timber members. This means great time-saving beside setting but also in the production itself, since fixing of a nail plate, especially underneath timber members, is difficult and time-taking in all present both manual and automatic assembly jigs. In a production method according to the invention the need of labor is reduced while the working process becomes faster also in the real production beside setting.

6. When the underneath and the upper nail plates are prefixed to every joint, the fixings are completely independent from each other but in the final outcome the plates in the joints must coincide. If this is not the case, it will be due to some error easy to detect. Therefore, this new production method offers an easy and advantageous way to check the accuracy of plate positioning. This fact is of great practical importance in this invention. Even though the nail plates are fixed only on the one side, preferably underneath, it is still possible to make an accurate checking of the positioning. In fact, the timber members are precut and generally do not fit to a trussed rafter but only in one way. The heads of the diagonals and verticals must match with the nail plates, whereby an approximate checking of the accuracy of the nail plate positions and timber members is reached.

If the nail plates are fixed on both sides of the timber members (generally, on the one side of the chord beams and on the other side of the diagonals and the verticals), a triple checking of the accuracy of nail plate positioning and the whole trussed rafter is possible: 1) Overlapping of plates 2) matching of timber members 3) coincidence of timber member heads with nail plates. The last mentioned is most applicable and reliable if the joints are so formed that the plates are placed, at least to some part, in the joint using as reference the timber member corners. This kind of method is described a.o. in the PCT publication no FI/00168.

7. Today cutting of timber members is most usually carried out with a s.c. four blade saw where timber moves transversally through the saw. If cutting is done with a s.c. cutting saw, timber moves lengthwise in the same way as in a finger joint line, a nail plate splicing machine and a stress grading machine. When the sawing process, where cutting of timber members, finger jointing and/or possibly also nail plate splicing and, furthermore, nail plate prefixing are carried out in one line, a complete arrangement is reached, which can be automaized advantageously. This is mainly based on two facts, firstly: due to the natural inaccuracy of timber, variation of cross section measures, crookedness etc. it is difficult to grip the timber accurately. By combining these steps, the error due to gripping is diminished since the timber member gets its form by the first gripping and cuttings and in this respect the plates can be fixed with accuracy without any gripping error, as accurate gripping can easily be shifted over from one working stage to another, e.g. from cutting to plate fixing and secondly: all stations can be controlled by the same automation which simplifies the process and reduces risk of error.

8. Cutting of timber members with two cuts in the head is slow with a cutting saw. A considerably better application of the invention is when the joint could be so made that at both timber ends there is only one cut at least in timber members which are furnished with nail plates and made in the same line with an ordinary cutting saw. This is a rather easy procedure, because the timber members of chord beams have almost always one cut and it is possible to design diagonals and verticals so that approximately half of them have one cut and the nail plates fixed to them while the other half of the verticals and diagonals are without nail plates and could be cut with any method, e.g. with a four blade saw.

9. Perpendicular cuttings are easily done with cutting saws. Accordingly, the joint can be so made that in cuttings with two cuts one is always perpendicular. The joints are then so formed that there are even great gaps but such joints are not allowed according to present regulations. It is however possible to make a nail plate and a nail plate joint with big gaps. This procedure has many advantages: a) total length of timber members can be smaller than in present trussed rafters and production methods, i.e. the total length of timber members is smaller than the theoretical one calculated from the physical total lengths and so this production method includes a "negative waste" i.e. saving of timber. b) Cutting of all timber members is easily carried out with a cutting saw. c) The timber inventory can be comprised of precut and possibly also stress graded planks. When this timber inventory is automized in the same manner as present inventories, a remarkable increase of speed and material saving is obtained: For each unit such a timber member can be selected as required and unnecessary waste of a.o. timber member stress reserves is avoided. The timber members can be automatically picked-up for production which is of great importance when rafter batch size is small.

10. Generally, in present trussed rafters all diagonals and verticals are straight but in certain cases, usually only in bottom chord, a camber is made and generally curved beams and cambers are not well applicable to present rafter production methods or they can not be used at

all. However, upward curvedness similar to camber would be most advantageous in top chord, because the top chord has a much bigger load than the bottom chord and also because the top chord is anyhow more heavily loaded, e.g. due to buckling risk. Curving can be done for aesthetical reasons, whereby it can be directed also downwards. Making use of the mesh pattern, it is very easy to make all rafter diagonals and verticals, especially the rafter chord beams up or downward. Forcing the chord beams into curvedness can simply be carried out by means of diagonals and verticals and/or wedges or such fixed to the assembly floor. Thanks to the easy handling of curved members, in addition to the advantages of setting and production, the invention makes it possible to produce trussed rafters which can not be made with present methods.

If the beams are curved, it is of great advantage that there is only a little variation in the joints, because even the smallest error in a curved beam can be of great disadvantage. There is little variation in stiff joints and in any case these kinds of joints are advantageous a.o. with respect to stress distribution. The means to make stiff joints are described in the above mentioned PCT patent publication and producing a joint like this by means of this invention is most easy, e.g. because of the slight variation in plate positioning. It is very demanding to make beams curved also because of the difficult positioning of joints and plates. In the method according to the invention measuring and its control is easy and reliable and accordingly the method is also in this respect most applicable to the production of trussed rafters, where at least some of the members are curved.

11. The production of timber members according to the invention is most advantageous in a line with the timber moving lengthwise. Splicing of timber members is then easy either with the finger splicing method or with nail plate splicing or such. The advantage of this kind of timber member splicing is the fact that timber waste is practically totally eliminated. In the practice, no timber splices are not so strong as the timber itself, therefore it is important to put the splice in such a place where stresses are not greater than allowed for the splice. When such a line is automatized, it is easy to check the joint positions without any special measures.

12. A simplified application of this invention is that the nail plate positions are marked in the timber members at the above mentioned cutting station and/or still more simplified, in a special device for measuring and marking of plate positions and cuttings. Such a nail plate position can be painted or only marked with a light ray or such in the timber members, e.g. so that the timber member is marked with the positions of the nail plate edges or only the corners and if possible also the plate size in figures. Such a line can be easily put into practice as handling of nail plates is eliminated.

In the same simple or more sophisticated line, also other rafter codes can be marked in timber members, such as "location of support", "buckling support required", "date of production", "drwg-no", "code of rafter", "max load", "max spacing of battens", "location of a secondary construction to be fixed in the rafter, e.g. hip roof eave beam or inclined eave beam", "customer data", "site address", "handling instructions", "critical area re rafter strength".

Today many of these markings are written in the rafter or marked by stamping or stickers. Markings as per this invention is much faster, there can be many markings and they can differ between rafters and rafter members. In accordance with this invention there is non-manual data transmission between trussed rafter design and the station for marking and cutting and therefore different markings with much information can be made with very small extra cost and labor.

13. In applying the solution of chapter 12 further to the marking of the timber strength, a new procedure for stress grading in rafters is obtained by this method. The utilization of stress graded timber is based today on the following principle: Minimum strength of timber is determined by design and fulfillment of the same by grading, that means first comes design and then timber of required strength is selected from the timber inventory. In this invention this procedure could be made as follows: By design the spots in the timber, which require special strength, are defined and then checked in production, i.e. design comes first and then ungraded (or only roughly graded) timber is selected, whereupon it is determined if the timber for the rafter is rejected or not on basis of the strength markings, wany joints or other reasons. This procedure is much cheaper because of simpler machines and thanks to the method the demand of high quality timber is reduced, since in a very small part of the timber, strength (or full edge) is required. This method is very practicable in trussed rafters with greatly varying stress and dimensioning often according to stress peaks. Accordingly, this method is applicable as the only stress grading method and especially well suitable also for adjustment of mechanical stress grading methods, because the present stress grading machines cannot detect timber defects.

The invention is illustrated in figures 1, 2 and 3:

Figure 1 is a perspective view of trussed rafter production with timber members assembled on the assembly surface.

Figure 2 is a nail plate joint with a timber member of two cuttings, one of them perpendicular.

Figure 3 is a cross-section of rafter chord at a joint with the timber members assembled on the assembly surface and the diagonals and verticals and nail plates of the chords not yet fixed together.

Figure 1 is an assembly of (W-type) trussed rafter on the assembly surface, e.g. factory floor. On the assembly surface there is a mesh patterns 1 for measurement. This may be vertical with appr. 1 m spacing and horizontal with 1...2 m spacing and by means of which side guides 2 can be fixed as the rafter drawing shows the mesh pattern measures 3 of the rafter outer dimensions. In addition, there can be other mesh pattern measures in the drawing, e.g. mesh pattern measures of diagonals 4 a.s.o. By means of these measures the accuracy of the positions of diagonals and verticals can be checked a.o. upon special need, e.g. when curved members are used, when there are gaps in joints and/or when an exact outcome is wanted.

Nail plates 6 are pressed underneath the members 5 and the nail plates 8 on the upper side of diagonal 7a. In this stage of production the diagonals and verticals are fixed into position, whereby it can be checked that the lower and the upper plates are overlapping. Nail plate 8 is hammered or pressed so that the diagonals and verticals and the chord members stick together mainly by the upper plates, whereafter the rafter is lifted from the assembly surface and conveyed e.g. to the roller, where the plates are finally pressed together. The finalizing roller and the lifting and conveying equipment are not shown in the figure, these can be arranged by conventional means. Alternatively, especially in case of small size trussed rafters, the plates can be pressed or hammered to their full depth, whereby no finalizing roller is needed. In both cases fixing is reduced compared to present methods and as fixing tool, e.g. a pneumatic hammer (in the same principle as a nail gun), a hydraulic hammer, a roller a.s.o., can be used. This prefixing tool can be light and manually transportable and so floor- or roof-fixed conveyors are not needed as in present methods.

Figure 2 in an ordinary K-joint, where one (or both) of the diagonals has two cuts (one of them perpendicular), the other diagonal 7a is shown in the figure with one cut but this one can also have two cuts (along the dotted line 9) so that one of them is perpendicular. In both cases the effective length of the diagonals is shown, i.e. the length required to make diagonals in the practice.

It is assumed that the cutting of 7a is made symmetrically thus obtaining two similar diagonals. The effective member lengths by the new production method are l_a and l_b , correspondingly the lengths L_a and L_b of the present method are also shown. The figure also shows that in both cases timber saving is reached.

Figure 3 is the cross-section of a rafter joint with timber members assembled on the assembly surface. In this case the upper plate 8 is fixed to diagonal 7a. Generally, it is preferable to fix the plate into the diagonal with the greatest fixing area, on the other hand, it advantageous to arrange the fixing at both diagonal heads, whereby about half of the diagonals can be without nail plates. Both of these objectives can be reached simultaneously when the nail plates of the diagonals are fixed to the members with the greatest forces.

Further applications of this invention are self-evident in the light of this example.

Claims

1. A method for production of a trussed rafter (fig 1), especially a method for production of timber members for this trussed rafter and handling of nail plates **characterized** in that the nail plates are fixed to the timber members before the assembly station either completely or at least mainly to the chords (5, 10) and, in any case, at least mainly to timber members (7a), the heads of which have a single cut, and fixing to chord is made at least mainly to that side which in the horizontal assembly of the trussed rafter is on the underside and that the plate fixing is made simultaneously with timber member cutting so that the cutting and plate fixing are based on uniform accurate measuring with respect to plate fixing and/or trussed rafter measure accuracy.
2. A method according to claim 1 **characterized** in that a marking device is connected to the working stage where nail plates are fixed and timber members cut, in order to mark codes related to the trussed rafter, the timber member and/or marking location of the timber member, especially so that the required strength is marked in the timber member, e.g. with a light ray, and on this basis the timber member is either selected for the purpose or rejected.
3. A method according to claim 1 or 2 **characterized** in that timber moves lengthwise in tool or another device where plate fixing and timber cutting are combined as an automatic unit.
4. A method according to claim 1, 2 or 3 **characterized** in that tool function is automatic at least so that data from trussed rafter design about cutting, plate positioning and/or marking are automatically put in the tool.
5. A method for production of a trussed rafter (fig 1), especially a method for assembling timber members to a trussed rafter **characterized** in that assembly is carried out on a levelled surface, e.g. a floor which has at least mesh a pattern (1) by means of which the surface can be furnished with stoppers (2) according to the outer dimensions of the trussed rafter and furthermore nail plates (6) have been fixed underneath chord members at least to the main part so accurately that prefixed nail plates can be used to facilitate determination and/or checking of accuracy of joint positions.
6. A method according to claim 5 **characterized** in that at least one joint is made in the trussed rafter with a gap (fig 2) allowing easy assembling and pressing of diagonals (7a, 7b) against chord members (5,10) in spite of slight variations of diagonal length and chord depth.
7. A method according to claim 5 or 6 **characterized** in that at the assembly station the timber members are fixed together only to their half with a rod-type manual or mechanical tool and the final nail plate pressing is carried out at a separate pressing station especially in a pressing roller.

8. A method according to claim 5, 6 or 7 **characterized** in that also the upper side nail plates are fixed to the timber members and displacement of upper and lower plate is used as means for checking the plate position and correctness of final trussed rafter.
9. A method according to claim 5, 6, 7 or 8 **characterized** in that the method is applied for production of a trussed rafter with at least one curved chord member so that the curvature is made at least partly by embossing of diagonals (7a, 7b).

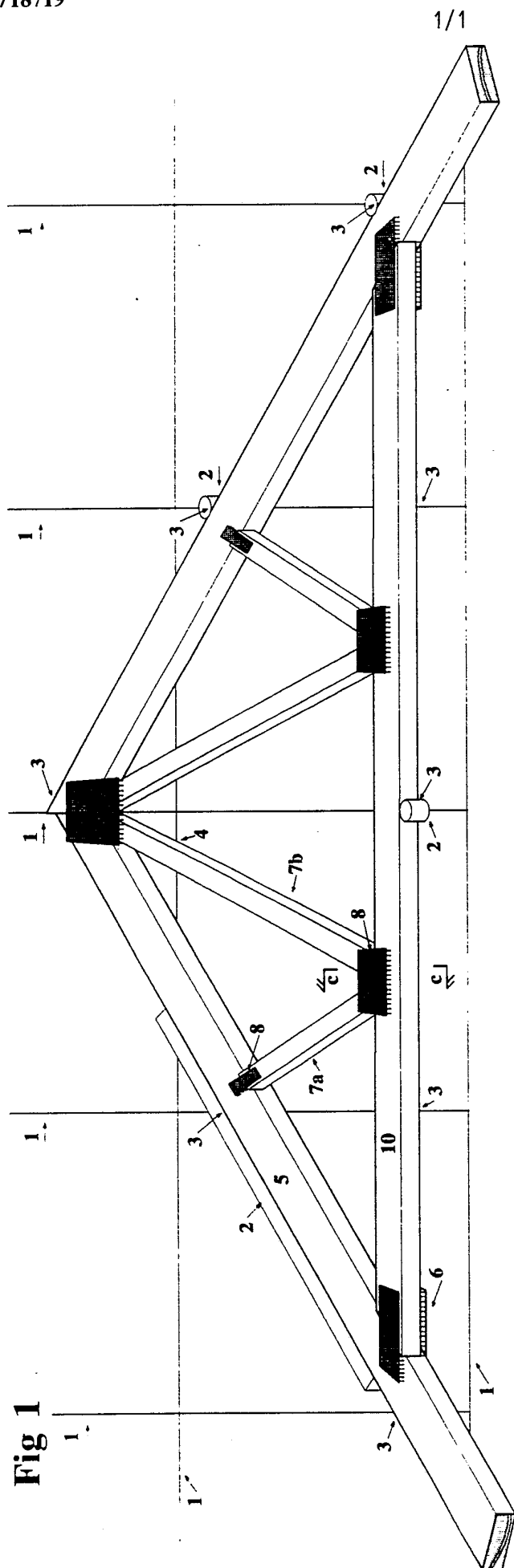


Fig. 1

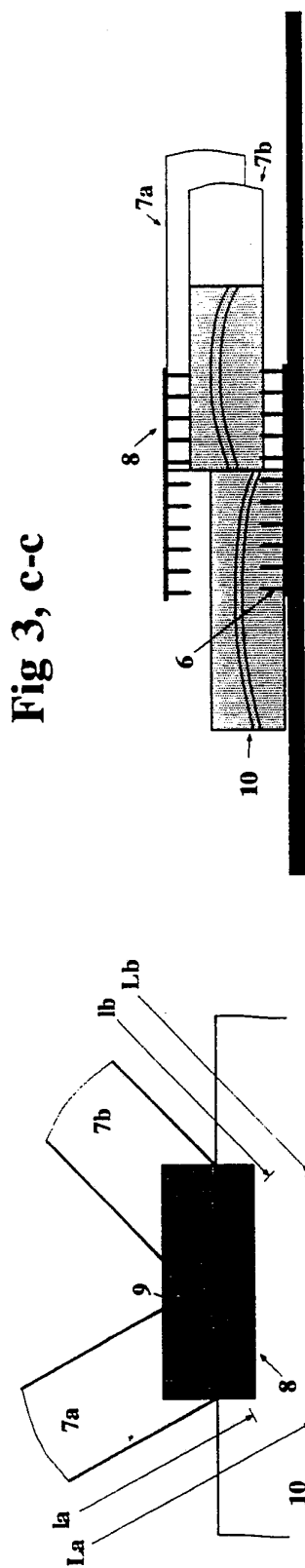


Fig 3, c-c

Fig 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI 91/00104

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: E 04 C 3/17 // E 04 B 1/49																	
II. FIELDS SEARCHED Minimum Documentation Searched⁷ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border: 1px solid black; padding: 2px;">Classification System</th> <th style="border: 1px solid black; padding: 2px;">Classification Symbols</th> </tr> <tr> <td style="border: 1px solid black; padding: 5px; vertical-align: top;">IPC5</td> <td style="border: 1px solid black; padding: 5px; vertical-align: top;">E 04 B; E 04 C</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸ SE,DK,FI,NO classes as above			Classification System	Classification Symbols	IPC5	E 04 B; E 04 C											
Classification System	Classification Symbols																
IPC5	E 04 B; E 04 C																
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; padding: 2px;">Category *</th> <th style="width: 60%; padding: 2px;">Citation of Document,¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 30%; padding: 2px;">Relevant to Claim No.¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">AU, B, 291878 (AUTOMATED BUILDING COMPONENTS, INC.) 13 January 1966, see page 11, line 17 - page 12, line 17; figures 4,5 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,3</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">US, A, 4738071 (EZARD) 19 April 1988, see column 4, line 45 - column 5, line 31; figures 1-4 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">US, A, 3530790 (POST, D.P.) 29 September 1970, see column 2, line 5 - line 40; figure 1 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">5</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">US, A, 3599562 (HUTCHENS, SR. R.W.) 17 August 1971, see column 2, line 41 - column 3, line 17; figures 1-3 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">5</td> </tr> </tbody> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	AU, B, 291878 (AUTOMATED BUILDING COMPONENTS, INC.) 13 January 1966, see page 11, line 17 - page 12, line 17; figures 4,5 --	1,3	X	US, A, 4738071 (EZARD) 19 April 1988, see column 4, line 45 - column 5, line 31; figures 1-4 --	1	X	US, A, 3530790 (POST, D.P.) 29 September 1970, see column 2, line 5 - line 40; figure 1 --	5	X	US, A, 3599562 (HUTCHENS, SR. R.W.) 17 August 1971, see column 2, line 41 - column 3, line 17; figures 1-3 --	5
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* Special categories of cited documents:¹⁰ "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 "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																	
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; padding: 5px;"> Date of the Actual Completion of the International Search 12th November 1991 </td> <td style="width: 50%; border: 1px solid black; padding: 5px;"> Date of Mailing of this International Search Report 1991 -11- 13 </td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;"> International Searching Authority SWEDISH PATENT OFFICE </td> <td style="border: 1px solid black; padding: 5px;"> Signature of Authorized Officer Ingemar Hedlund </td> </tr> </table>			Date of the Actual Completion of the International Search 12th November 1991	Date of Mailing of this International Search Report 1991 -11- 13	International Searching Authority SWEDISH PATENT OFFICE	Signature of Authorized Officer Ingemar Hedlund											
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	US, A, 3771439 (MORT) 13 November 1973, see column 1, line 58 - column 2, line 14; figures 1,2 -- -----	5

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/FI 91/00104**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 27/09/91
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
AU-B- 291878	66-01-13	NONE	
US-A- 4738071	88-04-19	AU-B- 579827	88-12-15
		AU-B- 605636	91-01-17
		AU-D- 3011384	84-12-18
		CA-A- 1231219	88-01-12
		CA-C- 1234471	88-03-29
		DE-T- 3490247	85-09-05
		FR-A- 2546945	84-12-07
		FR-A- 2553133	85-04-12
		GB-A-B- 2152551	85-08-07
		JP-T- 60501469	85-09-05
		SE-B-C- 447144	86-10-27
		SE-A- 8500374	85-01-28
		US-A- 4653242	87-03-31
		WO-A- 84/04787	84-12-06
US-A- 3530790	70-09-29	NONE	
US-A- 3599562	71-08-17	NONE	
US-A- 3771439	73-11-13	NONE	