Roof bracing for enhance the overall rigidity of the roof.

IS IT:

- [ ] *Product*
- [X] *Technology*
- [ ] *Equipment*

APPLICABLE FOR:

- [X] *Restoration*
- [X] *Rehabilitation*
- [ ] *New Construction*

APPLICABLE ON:

- [ ] *1. Foundations and underground structures*
- [ ] *2. Vertical structures*
- [ ] *3. Horizontal structures and vertical connections*
- [X] *4. Roof and terraces*
- [ ] *5. Façade and building envelope*
- [ ] *6. Finishes and completion elements*
- [ ] *7. Integrated services*
- [ ] *8. General strategies for building recovery*

Related companies: *No companies; university research; structural study.*

DESCRIPTION

The roof bracing has the task of withstanding the wind forces in a roof and stabilizing the roof also from the point of view of seismic actions.

The pitch braces can be positioned at the head with respect to the planimetric development of the roof or laterally (lateral braces).

Where the roof is not visible and does not hinder the spatial perception of the environment below the roof pitch, or, for example, there are no attic spaces that can be inhabited or inspected, so-called "floor" braces can also be used, positioned on the eaves of the pitch.

WHY TO USE

The bracing systems for wooden roofs, and therefore if the roof is ancient it is more affected by rehabilitation and structural reinforcement interventions, widely provide for the addition to the main structural elements of tension-adjustable steel tie rods, with the creation of anchoring seats for the same.

The added steel tie rods should always be characterized by efficiency and minimal invasiveness. These can be arranged between the beams and the purlins in the two dimensions of the inclined plane of the pitch, but also brace different planes made up of the elements of the truss, such as the timber tie rods, the struts, tie beams, ridge beams and contiguous structural units.

The roof braces, whether they are applied on the pitch plane or horizontally between the height of the trusses, tend to connect the different structural units to favor the formation of a reticular system with mixed trusses, capable of resisting horizontal actions: wood and steel thus collaborate in the global equilibrium of the roofing system, acting at different scales of the structural system according to different levels of action and reaction.

Those called "head wind braces" counteract the forces of the wind precisely in correspondence with those areas and report them on the underlying vertical structures (continuous or isolated).

They also stabilize the upper beam of a truss, reducing the free inflection span in the roof plane and also avoid the possible vertical out-of-plane of the truss which could overturn on the immediate and nearby one.

HOW TO USE AND APPLY

The technique of reinforcing trusses by means of bracing, in the most classic version, involves the plane on which the pitch itself lies, with the provision of steel diagonals to integrate the structural fields defined by the beams and purlins.

Other systems, on the other hand, provide for a stiffening of the roof by means of braces developed according to the tax plan of the roof.

In the most advanced solutions, the roof bracing tie rods are made with flexible stainless steel cables of small diameter (ropes or strands). These cables, which can also cover considerable distances, can be left exposed or, to protect them, they can be coated according to the design needs.

Bracing ensures that trussed rafters maintain a rigid, secure and stable roof structure. If the bracing provided is not used entirely, positioned incorrectly or not securely fixed, it can result in a distortion or failure of individual trusses or in a worst case scenario - the whole roof so it’s safe to say they’re pretty important.

Bracing can be used temporarily for safety whilst erecting the trusses, for stability on a permanent basis (to keep the trusses in place) or to combat wind where bracing can transmit wind forces to suitable load bearing walls.

TECHNICAL CHARACTERISTICS

This type of intervention is totally different from the existing structure and is highly appreciated in the recovery of existing wooden roofing structures for its lightness, minimum visual encumbrance, easy execution and total reversibility.

Roof bracing is one element in a continuum that provides resistance to horizontal loads. It works with the wall and foundation bracing to supply a total bracing package for a building.

Bracing the roof framing allows the frame to resist horizontal loads and is a part of the total bracing required within a building to resist wind and earthquake loads. The roof-framing-bracing/wall-framing-bracing/ foundation-bracing *continuum* is similar to the vertical or uplift load paths that must be continuous through the structure.

RECOMMENDATIONS AND OTHER INFORMATION

When considering the structural work that trusses have to do, it can be easy to overlook the important responsibility that roof bracing undertakes.

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Assuming that the foundation bracing is taken care of in the design, and adequate connections are made to the walls with wall bracing in place, then the roof bracing must also connect to the wall bracing to enable it to transfer loads back to the ground.

EXAMPLES

BRACES DEVELOPING ON THE INCLINED GROUND FLOOR OF THE ROOF

In this case, the bracing is carried out extensively by interposing the cables with St. Andrew's crosses between the structural fields of the wooden framework, arranged according to diagonal configurations.

This type of bracing incorporates older systems used to stabilize the pitches, such as diagonal wooden beams wisely connected with semi-thick joints and nailed connections.

The most advanced technology, on the other hand, requires the metal braces to be solidarized to the inclined secondary beams by means of metal connections.

The goal is to stiffen and stabilize the structural fields formed by the more or less orthogonal intersection of wooden rods, preventing the lability of the quadrilaterals from causing deformations on the entire support due to horizontal stresses.

This protection therefore opposes the local and global instability of the wooden roof structure, counteracting the risk of rotation and stacking of structural units such as trusses, positively limiting other types of static instability.

In particular, the diagonal tie rods are useful to contain the deformations of competing rods and to counteract the oscillations due to instability due to horizontal load at the level of the pitch, both orthogonally and parallel to the ridge. The efforts are alternately reported on the parallel walls, avoiding dangerous displacements of the attic masonry and of the external walls of the building.

BRACES LOCATED AT THE LEVEL OF THE SUPPORT PLANE OF THE ROOF

The bracings with metal tie rods can also be positioned on the support plane of the roof, therefore horizontal and in the space of the spans marked by the timber or metal tie rods of the trusses.

To promote stability and union between the main structural units, the tie rods of the trusses can be connected to each other in the horizontal plane by means of bracing tie rods with an X arrangement; these bracings can be hooked to the masonry, or even better to the perimeter curbs of the masonry, if present. Or, the same bracings can be anchored in correspondence with the support nodes of the trusses.

This bracing solution makes it possible to make the spans stable with respect to the lateral actions, acting horizontally, that is, in the same plane of the bracing.

The horizontal positioning of the bracing on the support surface of the trusses is also useful in the box-like connection of the attic masonry and with this bracing system it is also possible to make a connection among vertical load-bearing isolated structures, such as pillars or columns, above which the roofing system is set.

REFERENCES / SOURCES AND LITERATURE

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WEBSITE OF THE COMPANY

N/A

IMAGES AND CAPTIONS

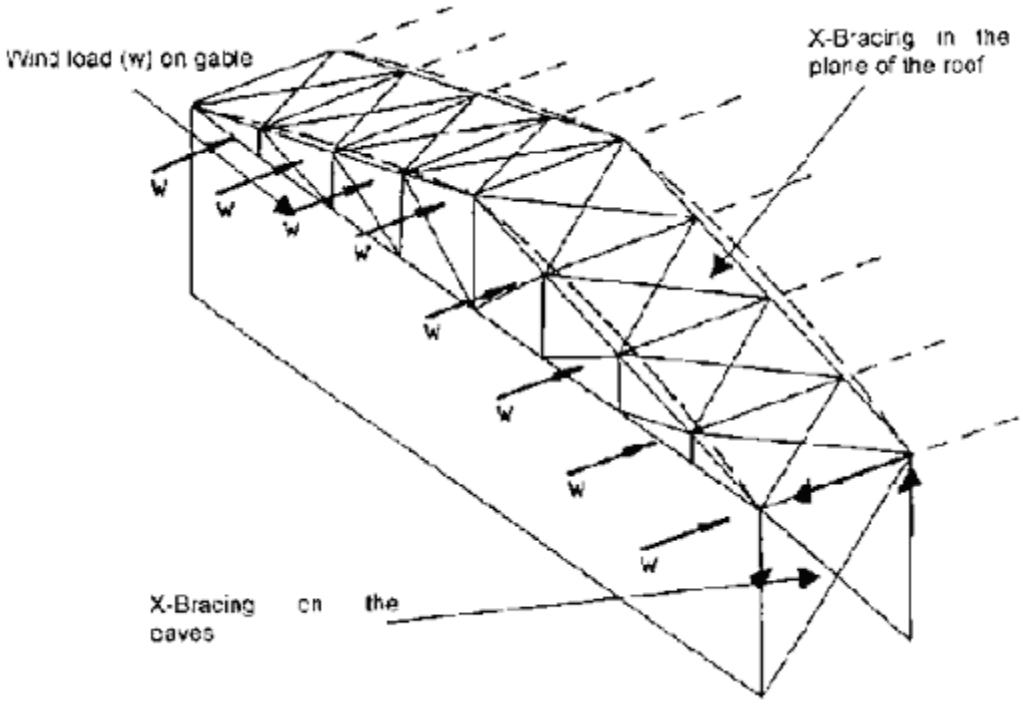

Fig.1: Bracing against overturning of the individual trusses due to wind loads on gables and buckling of the compression chords is accomplished by welding X-braces onto the top chord of the truss in every fifth field. These X-braces for lateral restraining (bracing) trusses together with the purlins.

For MCR roofing material, the purlins have a spacing of 400 mm and must be of equal angle bars of at least EA 50 × 50 × 5 sizes. The X-brace uses the same angle size and a flat 50 × 5 as a cross brace. These cross braces are welded to the top chord members and also to the purlins at each intersection. As the purlins are welded with the leg facing upwards, a support made of a flat (from cuttings) is to be added to secure the connection at each truss.

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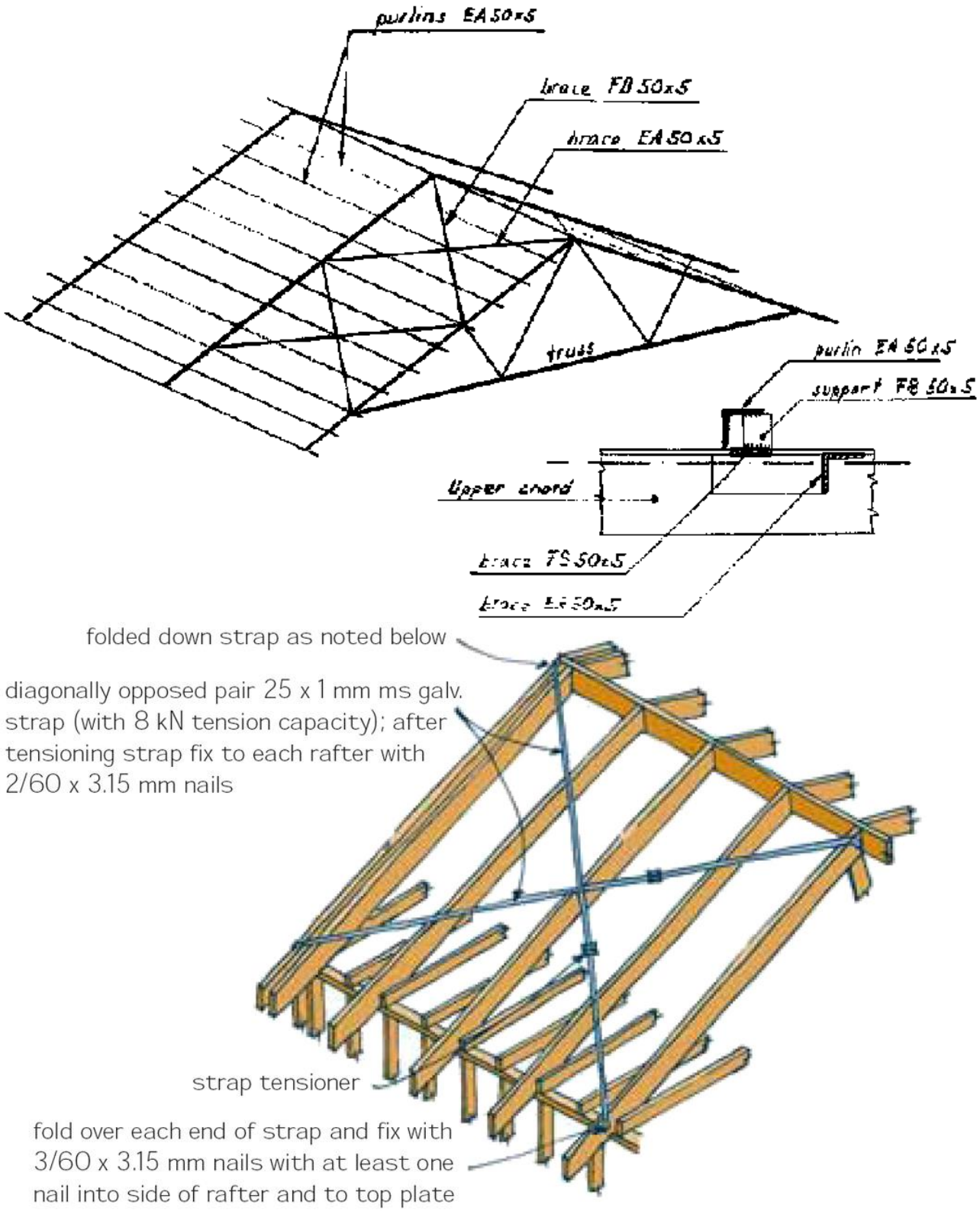

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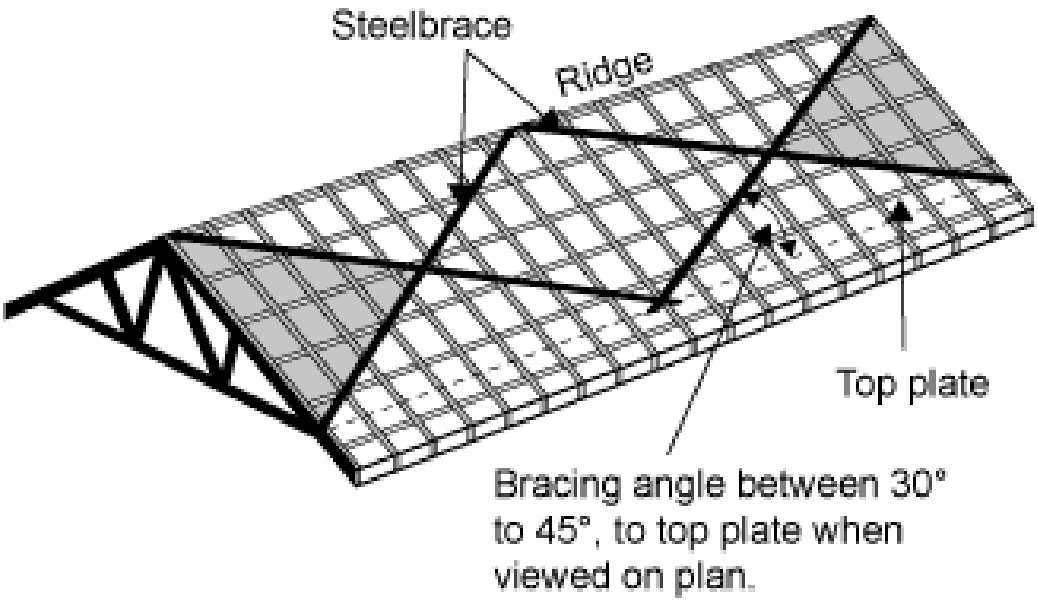

Fig.4 The steel brace only works in tension, therefore it is applied in X or V patterns across the roof planes. The steel brace is nailed through its holes to the members it passes over. This ties and assists the restraint provided by roof battens. © *https://emedia.rmit.edu.au/dlsweb/Toolbox/buildright/content/bcgbc4010a/12_roof_systems/05_roof_trusses_bracing/page_004.htm*

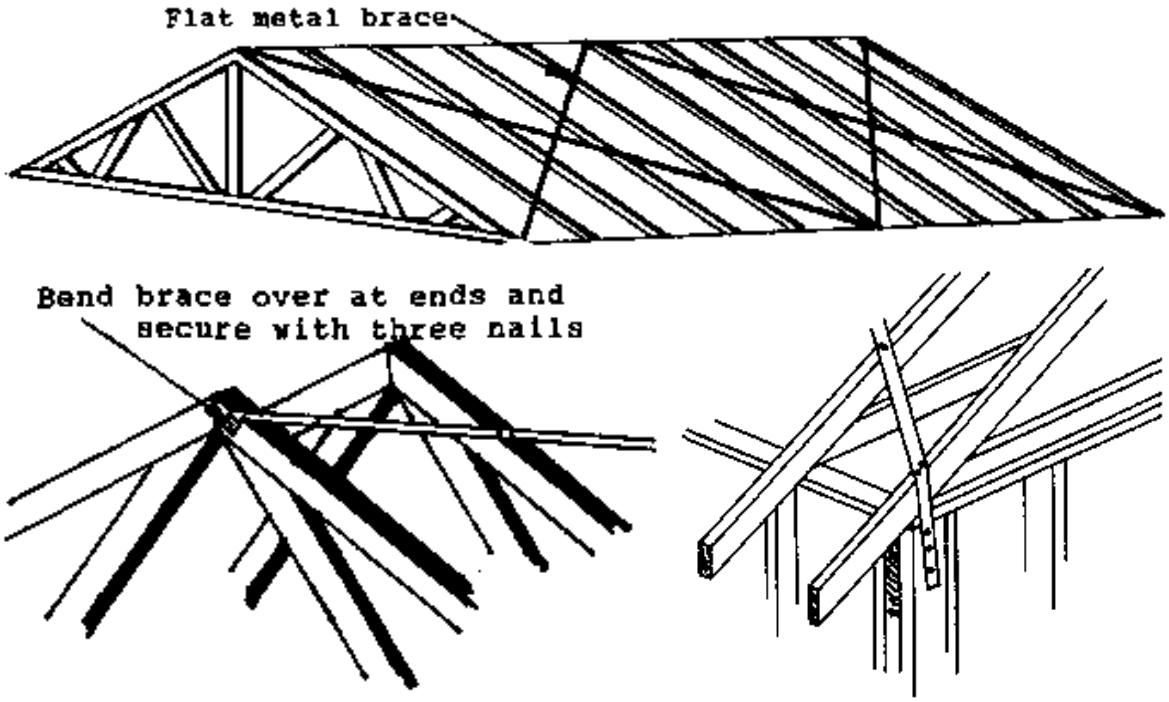

Fig.5: For bracing the roof a flat metal brace is used. The roof has to be braced diagonally on both sloped sides. The braces are fixed to the purlins or battens. It is of advantage to secure the brace at every crossing with two nails. The top end of the brace is fixed to the rafter. © *http://www.nzdl.org/cgi-bin/library?e=d-00000-00---off-0gtz--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0--4----0-0-11-10-0utfZz-8-10&cl=CL2.1&d=HASHb4b49db42e20f70bd59425.15.6&x=1*

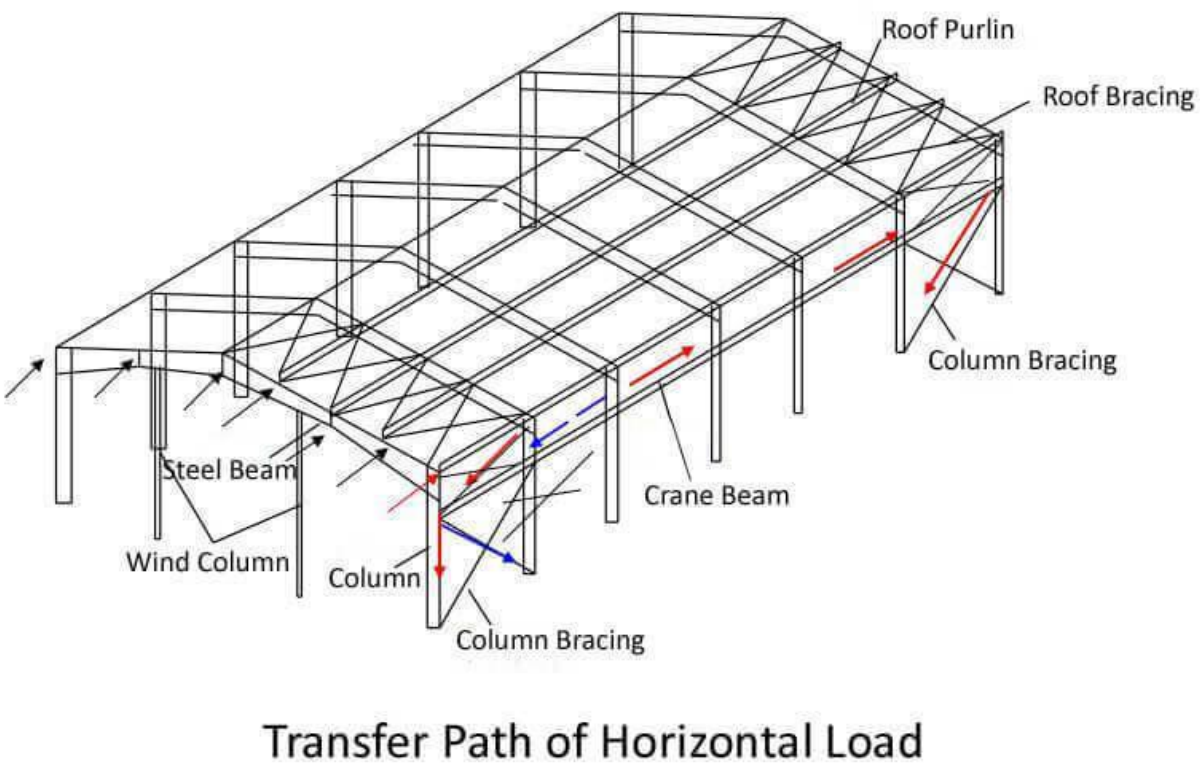

Fig.6: © *https://havitsteelstructure.com/specification-of-portal-steel-frame-buildings/*