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Research Article

The Control of the Execution of Closed Structures of Wood to Improve Quality

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Abstract

There are many cases of destruction of closed wooden structures, caused primarily by the effect and impact of the wind, the load and weight of snow precipitations as well as the improper maintenance and human error. This paper examines the reasons that lead to the fall of the quality of enclosed structures of wood, wooden roofs, wooden buildings and ceilings, with the execution of processes and quality management, and finding common ground that allow quality construction to improve quality. The proposed concept and algorithm solution aim to focus on the permanency of control in all stages of construction themselves. A survey was conducted on the roof structures that had collapsed as well as in newly constructed or reconstructed structures, pursuant to the needs and demands of international standards, primarily standards SK EN 1995-1-1:20 XX, as a subgroup of Euro code 5, which relates to the design of timber structures - general part 1-1: I, as well as common rules and norms under which the construction is done. The results research should provide the impetus for new research models in context of an intimate further improve performance, construction and reconstruction of wooden construction and development of the proposed algorithmic model.

Keywords: *Control of execution, wooden structure, increase of quality*

1. Introduction

As a gift of nature, wood is a basic and irreplaceable material that is used for various engineering constructions. Constructions for their purpose can be helpful and permanent. The construction itself consists of wooden elements, and in order for the construction to be as rigid and as stable as possible, they join together with carpenters or in combination with coupling agents, and sometimes with the use of adhesives.

For the construction, we can use processed or unprocessed wood, wood products or processed products. In engineering designs and architecture, they are used alone or in combination with other materials, especially steel. Formwork is auxiliary structures that enable the formation of fresh concrete or specific shapes of masonry elements according to the designs. The scaffold is also a provisional or ancillary construction that carries the formwork as well as the material before it gets the appropriate hardness and at that time, it must not deform or loosen. In building and construction of wooden constructions can be made:

- Log cabinets;
- Roofs of buildings (residential buildings, factories, towers, etc.);
- Temporary residential buildings;
- Constructions for warehouses, exhibition spaces, agricultural facilities;
- Walls, ceilings, floors, stairs, ceilings, covers;
- Beam and frame main and secondary carriers;
- Formwork and scaffolding of masonry and concrete elements;
- Wooden bridges, bridged wood-concrete bridges;
- Temporary buildings and fences on the construction site;
- Formwork and scaffolding of tunnels and bridges;
- Special spatial structures, etc.

The subject of this work is the so-called closed wood constructions (according to the author of this paper), and it should be noted that many of the above constructions when completed have a structure that is invisible and the same is welded or closed.

Mostly almost all wooden roof structures can be closed type, with constructions in which users have no access and are susceptible to starvation by different causes. Failures arising from the procurement of materials, processing and execution of works, as well as due to intentional abuse and profit cannot be noticed after the closure of the structure, which leads

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to the development and action of mushrooms, insects, rodents, birds and other organisms. The efforts change the microclimate, increase the relative humidity of the ambient, they pollute the interior with their feces, thereby contributing to the destruction of the structure itself.

Wooden buildings in the form of closed constructions include: barracks, temporary objects made of wood, walls, ceilings (interconnected structures), stairs, covers, wooden bridges, formwork, special spatial structures, etc.

2. Quality executing construction

In practice, when constructing closed wooden constructions, especially in roofs, there is a problem of permanent monitoring of the quality of all construction operations, and during the technical reception, it is not possible to access the interior of the construction itself. In recent years, in the area of Macedonia, there have been several disasters in public buildings, where roof structures were damaged, which resulted in the collapse of buildings and buildings and threatened people and property due to wind or snow. Roof structures were built in three hospitals: in Ohrid, Gostivar and Tetovo, as well as in several schools: inelementary schools in Trapcin-Dol near Kicevo, in Ohrid, in the village of Debarce and in the village Bogovinje near Tetovo, as well as at the gymnasium in Tetovo. When a roof fell from a hospital building in Tetovo, one person was killed and serious injuries were caused by several people. Considerable material damage was been done. The roof construction of the hospital in Tetovo was previously reconstructed twice; however, it collapsed under the influence of the wind. In January 2012, the roof of the school in the village of Debarce near Tetovo collapsed. During the inspection and documentation of the factual situation, many defects were found in all performances or reconstructions, primarily in the construction and installation of wooden constructions themselves, but also in the process of tender, supervision and technical acceptance. The anomalies that led to the demolition of roofs are mostly subjective.

3. Control of quality of execution of construction

In determining the reasons that led to the demolition of roofs, it was established that all planning stages did not comply with the design, audit, material quality, quality control, quality of production and technical reception. In order to increase the quality of the performance and to improve the current state of construction, the algorithmic solution is shown in Figure 1:

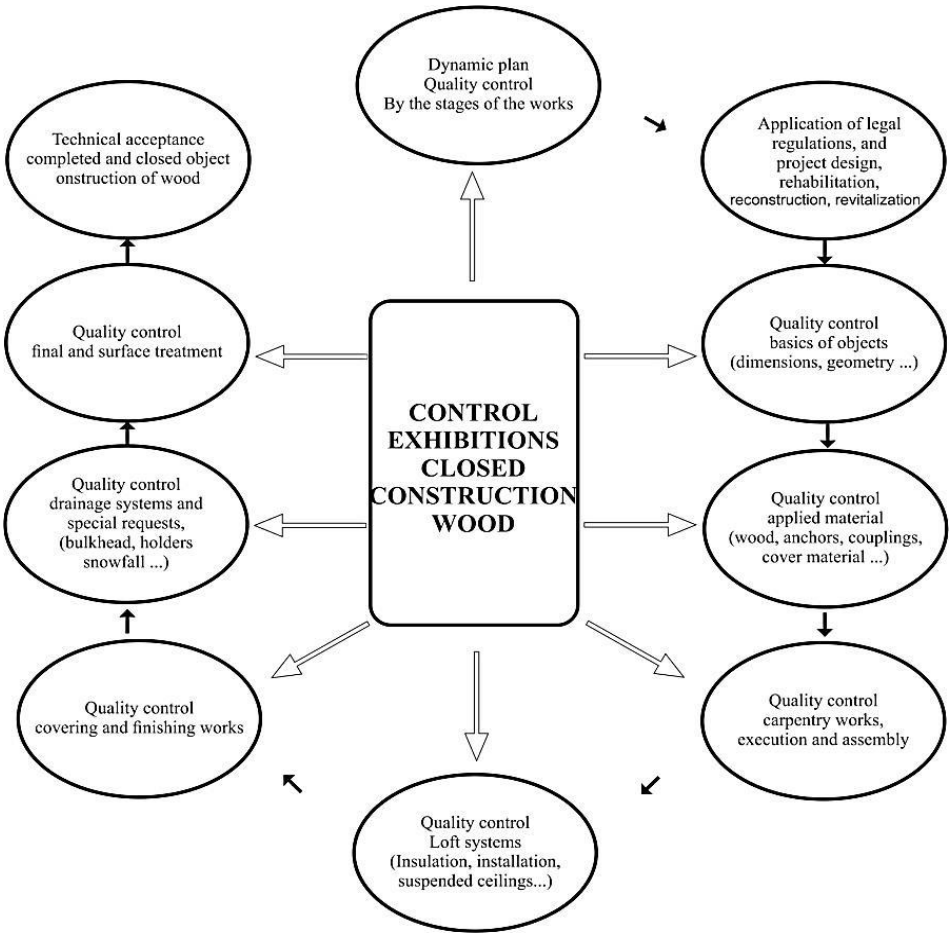

Fig.1 A basic model of approach to controlling the execution of closed structures of wood. Source: Originally authored

The schematic display of the control of the performance of closed wood constructions makes it clear that the quality control cycle is without interruption. It begins by compiling a quality control dynamics plan that must be clearly defined in all phases of the work, and ultimately ends with the technical reception and handover of the facility for use.

3.1. Quality control dynamics

The overall quality control actions of the sea have a pre-designed plan for the dynamics of all activities. As one of the most important elements, there must be a connection between the stage of execution of the works and the time interval of the foreseen control. Depending on the type of construction, quality control activities can be foreseen from the very beginning of the purchase of materials that will participate in the construction, especially the wooden material in which they occur and the biggest defects, and must fulfill all the requirements of the construction.

People in charge of building construction quality control must comply with legal regulations and standards relating to wood conservations, as well as to respect the dynamics of control at every stage of the works. For all phases of the performance, the observation log must be kept by the person in charge of control and supervision of the quality of construction.

3.2. Quality control by construction phase

Depending on the type of construction and the designed quality requirements, the control itself can be provided to be carried out in the plants for the construction, transport and construction of the structures where the structure will be installed. The quality of the purchased material as well as the processing itself must be determined by the empiric or by the use of scientific lab methods.

Prior to the assembly of wooden elements and the construction of the structure, it must be done and determined what qualities are the basis of the objects, first of all it must be checked its dimensions and geometric parameters that are stipulated in the project documentation.

Anchoring of objects is one of the most important moments for the stability of the wooden structure itself. In practice, anchoring is performed by assembling the anchors themselves in the reinforced concrete structure during concreting, but there are cases when the anchoring is done by drilling at the base of the objects and by inserting the steel anchors. Due to negligence or other factors, it often happens that the anchoring of the base of the wooden construction is not performed well (Fig. 2), and later there are major disasters caused by wind blows or other factors.

Fig.2 Inadequate anchoring with armature "mustache" and damage to the wedding dress

In closed wood constructions, a lot of solid wood from fir (Abies alba), spruce (Picea excelsa) and pine (Pinus sp.) are used as the primary material. Legislation as the design principles foresees that the material to be incorporated into structures must meet certain requirements; in particular, it should be within the limits of the permitted and standardized. In the case of roof constructions, in the course of costing and dimensioning, materials II are usually envisaged. Class. Wood used for enclosed wood constructions must not primarily have flaws such as: bumps larger than 1/3 of the cross-section that pass through the whole cross-section of the beam; Rot and color of wood; Insect damage; Bugs in construction, unmanaged finishes; Irregularity and sharpening of fibers; Untreated core and bark of wood, etc. In Figure 2, works on the construction of the elementary school are shown, where the inconsistency in the performance and use of the attacked wood from mushrooms and insects is clearly evident, and after the closure of the structure in the sandwich interior, the destruction of the basic building material will be prolonged.

Examples of enclosed wooden structures that were the subject of research showed that all carpentry works were carried out using primitive and inadequate tools and machines, in which the requirements for the

geometry of carpentry connections were not considered, only nails were used as connecting means in insufficient quantities. A general opinion emerges that there was no phase quality control, which led to crashes and damage.

Fig.3 Hinged roofs and skeletal construction in the construction phase before closing

Conclusion

In order to apply the proposed algorithmic scheme of the model for quality control of the performance of closed wood constructions, complete control of the raw material or the material, i.e. all elements, assemblies or the overall structure of the wooden structure should be applied, in all phases of the execution (Fig.1). In addition, all the above operations should be done before closing the construction itself.

Quality control itself is applied to the construction of structures requiring a very precise manufacturing process, after the operations of decisive significance for the further technological process of execution, for operations and machines that do not ensure the required processing accuracy for materials that do not guarantee a certain quality (large deviations) and for testing of open or completed and closed structures.

In certain phases of construction, partial control based on sampling at random moments should be performed, followed by quality determinations and their deviation from the planned one.

Because of the specificity of closed wood constructions, their use over time, the changes that result from the specificity of the used material (biological wood), which, in unfavorable conditions of exploitation, are starving, we suggest the introduction of revolving openings (gateways), which would allow entry into the interior or possibility of insight into the soundness, construction and other general conditions of the construction itself.

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