



***A case study: evaluation of state of conservation of wood panels and beams of a CLT kindergarten.***

***Proposal of a diagnostic approach and realization of an Italian register of service life condition of recent wooden buildings.***

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# Introduction

- CLT structures are becoming more and more popular in Italy, especially for new public buildings. Tuscany has been really active in the construction of public CLT structures during the last ten years and also in spreading the relevant knowledge as specific guidelines.
- Panels and beams are generally of Austrian – German production and are made of Norway spruce (*Picea abies*) without any treatment to artificially improve their durability because their use is previewed in use class 2 according to the standard EN 335: 2013.



***Guidelines for wooden building in Tuscany ,***  
AA VV, 2009

<http://www.regione.toscana.it/-/linee-guida-per-l-edilizia-in-legno-in-toscana>).

# Aims

- The presentation shows a diagnosis performed on a public, box-framed building. After only two years of service life a diagnosis showed some severe fungal attacks on both CLT panels and roof beams.
- The case study is aimed at understanding the cause of early severe decay and at proposing a diagnostic methodology.

*Northern side*



*Southern side*



*The beams on the roof of building after the opening of the sheath.*



*Extensive brown rot on the roof joists*

# The CLT building, the kindergarten



1 OSB panel.



2 Transpirable barrier



3 Wood fiber panel.



4 CLT panel

- The roof of the kindergarten is made of principal horizontal CLT panels, supported at the two ends by glulam transverse beams.
- The CLT elements support small section joists to create an insulating volume, filled with low density fibreboards and a sweating sheet, covered, on other small joists, with OSB panels and finally a impermeable layer.
- Over the impermeable layer in a first moment, was placed a hanging garden, removed after the occurrence of first moisture spots.



# The CLT building



*Building site of the CLT structure (2010)*



# April 2014: survey inside the structure

- The request of evaluation of wood decay was asked after two years of service life, in spring 2014. The users saw some humidity spots in the plasterboard inside the buildings, so they asked for a survey to establish their origin. The users thought that this high level of humidity was due to the condensation of inside water vapour. So a first survey on the glue-lam beams and CLT panels showed that the moisture content was in some cases higher than 20% and a fungal mycelium was already visible on wood surfaces.



*The CLT panels and glulam beams of the building*



# April 2014 survey inside the structure



On the outside roof it was visible a great deflection, due to the collapse of OSB panels, completely decayed; we asked to analyse the wood structure from the extrados, directly by the roof, in order to correctly evaluate the state of preservation of the CLT panels.



# September 2014 survey

- During the second survey it was measured the moisture content on the extrados side of the CLT panels in correspondence with inspection windows opened on the roof. A large inspection window was opened above the main entrance of the building, removing the impermeable layer and the OSB panels. In this area a severe decay of the rafters and of CLT panel, due a fungal attack (brown rot), was clearly visible.
- The moisture content of wood in this area was high, always more than 20 %, up to 58 %.





# September 2014 survey

- During this survey four inspection windows were opened on the roof and in some of these high moisture content of the joists and on the CLT panel was measured. The higher moisture content was, as obvious, in correspondence of high fungal decay as shown in the images below.





# September 2014 survey



# Results and conclusion

- The survey and the moisture measurements clearly showed that water entered from the roof, most probably due to not complete sealing of the impermeable sheath and not to water vapour condensation.
- A further cause of the fungal decay could be the water entrapped during the assembling of the structure, that lasted too much, due to a series of technical delays.



# Proposal for a correct approach with CTL structures

1. It is important to remark that a critical point during the construction of a CLT structure is the correct organisation of the **site building phases**, where it is really important to avoid the entrapping of water due to meteorological events. **Before sealing the wooden elements, moisture content should be checked.**
2. During the service life, some inspection windows should be accessible in order to check the moisture content, or even the presence of decay, on a regular base .
3. These inspection windows should be designed in correspondence with critical points into the building, e.g. bathroom, kitchen, etc.. This precaution permits of occurring very early in presence of high wood moisture, avoiding the developing of decay.
4. Or in alternative hand, moisture content sensors maintained during the service life in the critical points.

# Proposal of correct approach with CTL structures

- The **design of details** is crucial for the durability of a timber structure.
- **Spreading** the wood knowledge between engineers, architects, especially in Italy where only few Universities have wood technology courses in their program.

# Proposal of Italian database

- Our proposal is to create a database of service life condition of the most recent wooden structures (CLT, glulam).
- At the moment we know only some cases studies due to request of intervention due to fungal attacks. Probably these are only the most critical cases and not the general condition: ***We hope that it is !!***
- To obtain a status of art of the Italian recent wooden structures (with respect to the state of conservation/decay) a national project could be a good opportunity.