POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE 2
Degree in Architecture
Honors theses

Structural constructive elements in hybrid technologies:
Lox -cost laminated wood

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This thesis is the result of a research project aiming to analyse and think over up-to-date research and experimentation on low-cost laminated wood, so that it can be a starting point for future experimentation.
The main purpose for the following dissertation is to underline the fact that there are "alternative technologies" interested in men and their most basic needs.
Since 1980's, at "Politecnico di Torino", faculty of architecture, a research stream on hybrid technologies has been followed thanks to researches and experimentations realised at the Specialisation School of Technology, "Architecture and Cities in developing countries", at the Home-City Department and at the Structural engineering Department.
"Hybrid technology" is a kind of appropriate technology which links together traditional materials and low-energy construction techniques with highly innovative ones.
The study starts from an experimental research base on low-cost laminated wood, trying to improve it, focusing on one of the structural elements: the beam with rectangular section. The aim is to find a sampling methodology ffor future experimentation.
The innovative elements considered are:

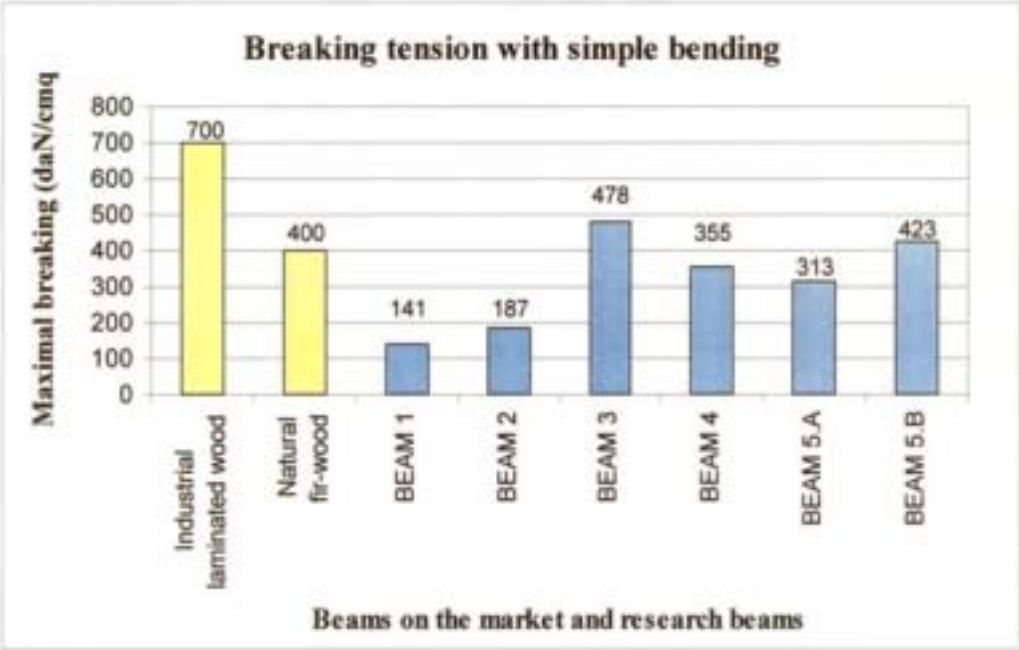
- Use of new gluing substances (melammine-urea-formaldehyde) in order to get optimal cohesion with wood and in conformity with the new normative law in force which doesn't allow the use of old glues involved in some of the previous experimentations anymore;
- Studies on optimal stratigraphic disposition of laminae in order to avoid mistakes during the assembling phase which could invalidate all results of the experimental tests;
- studies on modification of laminae's disposition and orientation in order to verify further improvements in structural behaviour for low-cost laminated wood beams.

This part deals with experimentations which have been followed personally during the realisation of low-cost laminated wood beams and with their relative breaking and bending tests together with data elaboration on tests.

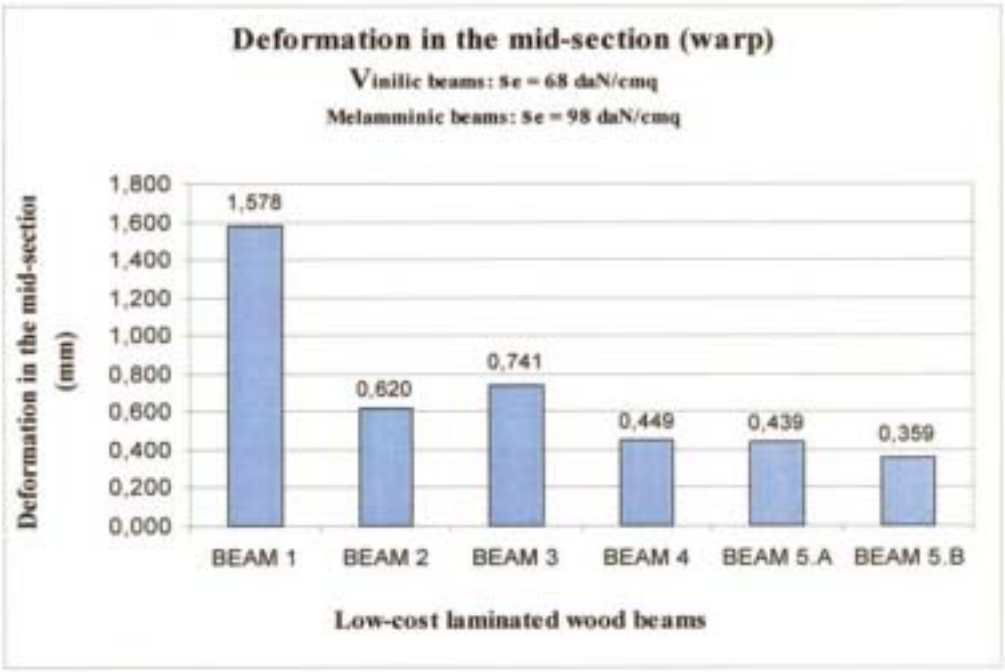
The wood used as raw material is totally free because it has been taken from production wastes of semi-manufactured products or by-products of wood, the production process doesn't need specialised workers and the exploitation of our forest estate is optimised.

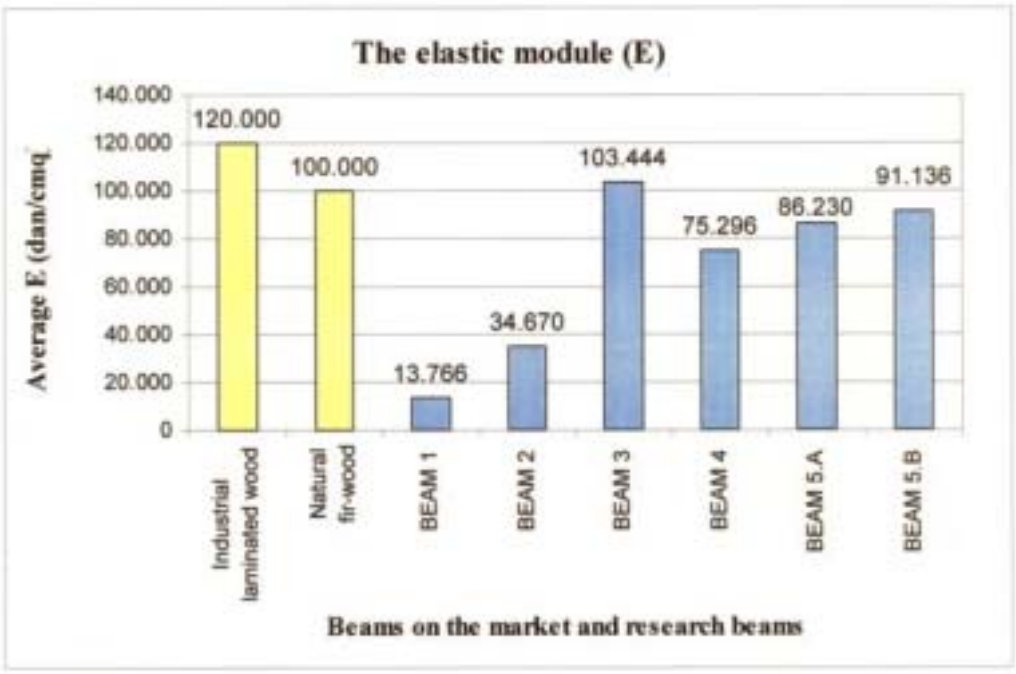
Gluing materials, calculations and testing methodologies are the most high innovative parts.
Realisation of low-cost laminated wood elements is made of four important phases:
a) transformation of leftovers from listel materials in laminae with costant thickness;
b) preparation, gluing and jointing of laminae's layers in order to realise a beam;
c) removal from clamps after a certain period of time depending on the glue being used;
d) finishing the beam by planing it.

Breaking and bending tests
Beams break suddenly in a loud but unexplosive way (no particles burst out of the beam).
After the breaking it's possible to check how the glue resisted perfectly along the fibres while wood broke up.
The glue doesn't resist perfectly only on listels' heads. Sometimes heads are jointed badly and glue is absorbed by the higher porosity of wood in this part.
By elaborating all breaking and bending tests, the results obteined on graphs follow exactly the Hooke's law (the general law of mechanics assuming that stress is directly proportional to strain) up to almost half of the breaking load (when the elastoplastic phase begins).



Breaking tensions obteined in laboratory tests reached great results, particularly for beams realised with melamminic glue which reached a breaking as good as heart-wood's one.The beam made disposing laminae vertically even exceeded natural fir-wood's breaking tension. All beams have regular deformations (arrows and lenghtenings/shortenings of the centre-line section) both when adding load and when taking it away.





Centre-line deformations (all but a beam realised with vinylic glue) are less than one over two hundred (1/200) of the beam's opening in respect of the normative law in force.
Even the elastic modules obteined are as good as those obteined with heart-wood (natural fir-wood). All results are shown in the resuming graphs.

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