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REGULATIONS AND STRUCTURAL REQUIREMENTS FOR SEISMIC RESISTANCE

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dedaleGNO design & research of timber structures

Firenze, Italy
Introduction

2009
Murray Grove
London - UK
1+8 storey
Low Seismicity

2011
Bridport House
London - UK
8 storey
Low seismicity

2014
Bergen - Norway
14 storey
Low seismicity

2011
Holz8 - Bad Aibling
Germany- 8 storey
Low seismicity

2012
Via Cenni
Milan - Italy
9 storey
Low-moderate seismicity

2016
Pesaro- Italy - 7 storey
Medium seismicity

2016
Florence - Italy - 6 storey
Medium seismicity

2012
Roccaraso (AQ)- Italy
- 6 storey
High seismicity

2009
Limnologen Vaxjo
Sweden: 1+7 storey
Low seismicity
Tall Wood Buildings

CLT = Cross Laminated Timber

4 CLT buildings, 9 Storeys, Milan, Italy, 2012

6 Storey CLT building Florence, Italy, 2016
Hybrid Wood Buildings

Brock Commons, @ UBC Vancouver: 18 storeys, 53.5m tall. 17 storeys of mass timber construction on top of 1 concrete storey, in addition to two concrete shafts.

Photo from Acton Ostry Architects INC website
REGULATIONS AND STRUCTURAL REQUIREMENTS FOR SEISMIC RESISTANCE

SOFIE Project NIED/CNR-IVALSA 2006-07
Miki, Kobe, October 2006

6 storey concrete JMA Kobe 60%
SAFER WITH RESPECT TO OTHER MATERIALS

SAFE EVEN FOR STRONG EVENTS

LIMITED DAMAGE EASILY REPAIRABLE

POST DISASTER IMMEDIATE OCCUPANCY

RESILIENT

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REGULATIONS AND STRUCTURAL REQUIREMENTS FOR SEISMIC RESISTANCE
LESS EXPENSIVE WITH RESPECT TO OTHER MATERIALS

DRY CONSTRUCTION PROCESS = LESS TIME
EASE IN THE ASSEMBLY OF CLADDINGS AND INSTALLATIONS
LIGHTNESS OF CONSTRUCTION MATERIAL AND TOOLS = LESS DANGER FOR SITE OPERATORS

CONSTRUCTION = CHEAPER AND SAFER
EXPERIENCALLY FOR HIGH SEISMICITY AREAS !!!

Concrete floor
Construction time: 1 month

Timber floor
Construction time: few hours
However...

The share for timber construction is 90% in North America, 45% in Japan and 8-10% in Europe

Source: Takle climate change: use wood. CEI – BOIS 2010
1 – Lack of education on the use of wood for construction and consequently...

...lack of technical knowledge of wood by architects, engineers and contractors

In Germany the course of «design of timber structures» is mandatory at all universities

Permanent courses of «Design of timber structures» for engineers in Italy

- Trento
- Bologna
- Firenze
- L’Aquila

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REGULATIONS AND STRUCTURAL REQUIREMENTS FOR SEISMIC RESISTANCE
...often projects of timber structures are «adapted» on the base of a concrete project, resulting in very complicate design.
Which are the key barriers? – 1 Education...

...well trained architects and engineers, who knows how to use wood-based products, make excellent design!
Some engineering wood-based product, like CLT, need a better harmonization. Different Producers:
- Different sizes, different thicknesses, different layer configurations, different mechanical properties.
Commerically available connections are able to resist forces deriving from the seismic design for buildings up to a maximum of 3 or 4 storeys (depending on the seismic zone).

Which are the key barriers? – 3 Improvement of connection systems...

Engineers have to make a “special” connection design for taller buildings.
Which are the key barriers? – 4 Revision and harmonization of structural building codes

The current version of the Chapter for the seismic design of timber buildings in very old (2004) and short (only 5 pages), missing the provisions for the seismic design of some structural types widely used all over Europe.

The seismic design of hybrid buildings with two types of Lateral Load Resisting Systems, made with different materials, and working together is rather complicated.
Which are the key barriers? – 4 Revision and harmonization of structural building codes

Partial safety factors for timber and wood-based products

\[ R_d = k_{mod} \frac{R_k}{\gamma_m} \]

### Eurocode 5

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<tr>
<td>Solid timber</td>
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<tr>
<td>Glued laminated timber</td>
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</tr>
<tr>
<td>LVL, plywood, OSB</td>
<td>1,2</td>
</tr>
<tr>
<td>Particleboards and fibreboards</td>
<td>1,3</td>
</tr>
<tr>
<td>Connections</td>
<td>1,3</td>
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### Italian Building Code (NTC 2008)

<table>
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<td>Particleboards and fibreboards</td>
<td>1,5</td>
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<tr>
<td>Connections</td>
<td>1,5</td>
</tr>
</tbody>
</table>

Timber structures in Italy are strongly penalized with respect to other construction materials!
What can be done to remove these hurdles?
What can be done to remove these hurdles?

1 - Education

Architects and engineers decide upon structural material, envelope and finishing materials therefore they need a comprehensive knowledge of wood products and of the design of structural timber systems in order to propose the use of wood as a structural material.

Teaching of «Timber construction» should be mandatory for Engineer and Architects at all European Universities.

Also training regarding the use of wood-based materials and construction of timber buildings should be made for builders and constructors.
What can be done to remove these hurdles?

2 – Harmonization of products

European Standard for CLT: 102 pages in total, complicate rules for panel composition and testing

Japanese Standard for CLT: 49 pages in total, very simple rules for panel layup and testing

Product standards should be simple and clear in order to «ease» the work of producers, builders and designers
What can be done to remove these hurdles?

3 – Improvement of connection systems

Connection producers should develop new types of connection systems for the seismic design of tall wood buildings which should be commercially available.
Building codes for the static and seismic design should be updated, including provisions for all structural types and simple design rules, not too complicated.
What can be done to remove these hurdles?

4 – Harmonization of Building Codes

When I am in Italy and I want to use my laptop I just connect this plug to the electric socket....

When I travel to Germany, Austria or France I need this adapter....

Now I am in Switzerland and I need also this!

We need the same plug and the same socket as we need the same Structural Codes with the same safety coefficients for all European Countries!
In conclusion...

Wood buildings are ideal for seismic design... if we remove the hurdles... ...and I’m not lying!

Thank you very much for your attention!

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