

Timber and construction: Trends, Opportunities and Risks

Pascal Schappes, Marc Schmassmann - October 5th 2021



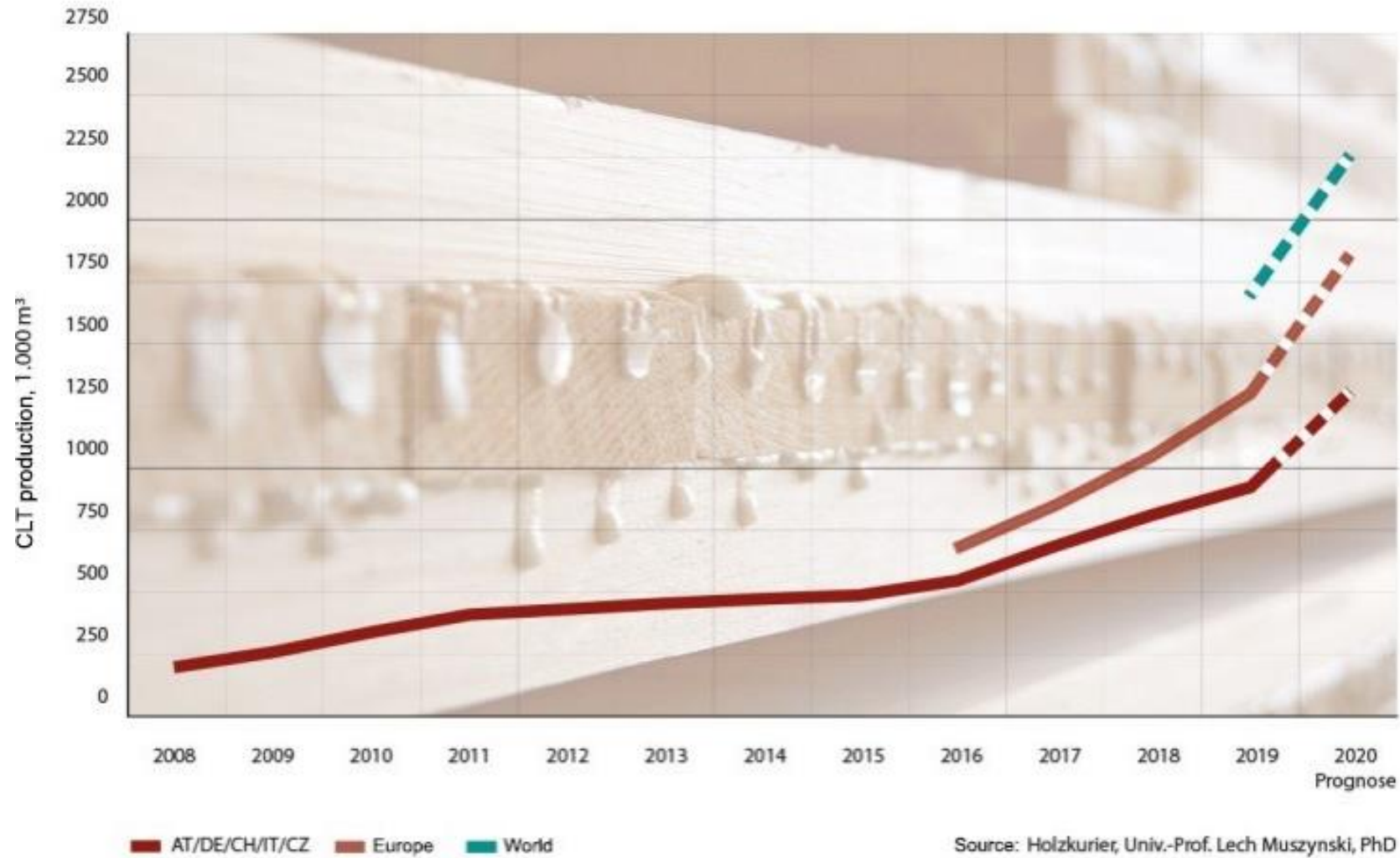
Kapellbrücke/ Kapellbridge: Built in 1360 in Luzern



Mass Timber – What is it?

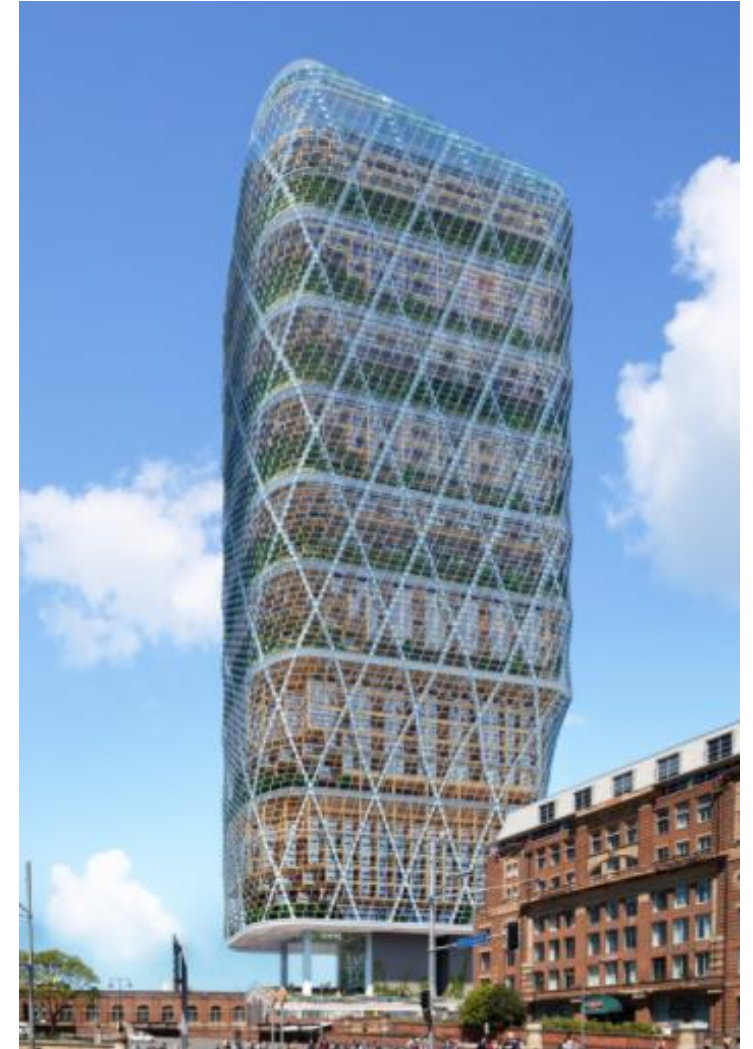
- Mass timber belongs to the Engineered Wood Products family
- Mass timber combines wood's inherent strength with modern engineering
- Manufactured by using adhesives to bind strands, particles, fibers, veneers or boards of wood to form a composite products
- Types of mass timber:
 - Glue Laminated Timber (GLULAM)
 - Nail Laminated Timber (NLT)
 - Dowel Laminated Timber (DLT)
 - Laminated Veneer Lumber (LVL)
 - Cross Laminated Timber (CLT)
 - Mass Plywood Panel (MPP)
- Mass timber construction methods:
 - Post and Beam (Glulam / LVL)
 - Post-tensioned (Glulam / LVL)
 - Panelized (CLT)
 - Timber composite (Hybrid slabs made of timber and concrete)

Mass Timber – Trends



Mass Timber – Trends

- Use in the past:
 - low-rise buildings
 - simple design
- Current use:
 - low-rise and mid-rise buildings, usually not more than 8 stories
 - partly complex design and geometry
- Anticipated future use:
 - high-rise buildings with more than 40 stories
 - extension and modification of existing buildings
 - fancy design with partly very complex structural systems



Source: <https://www.faz.net/>

Mass Timber – Opportunities

- Sustainability / Green building
- Attractive design due to hybrid construction allowing a “gradual” approach to new building technique.
- Costs reduction due to shorter construction period and less labor on site
- Weight reduction compared to concrete or steel
- Seismic performance due to material’s characteristics
- Fire resistance



Source: <https://www.structuremag.org/?p=1129>

Mass Timber – Challenges – Fire and its consequences

- Mass Timber is considered fire resistant, not fire resistive. This means that it is still a combustible product that will burn until extinguished
- Although fire resistant at the first glance, a kind of peeling effect was observed for laminated timber beams. The heat caused fail of the glue layer by layer, eventually resulting in the total destruction of the beam.
- Water damage due to extinguishing water can cause massive harm to a wooden building also affecting the structural system.
- Restoration of damaged structure (by fire or water) must be considered as challenging.

Mass Timber – Challenges – Other

- Mass timber manufacturing capacity will need to increase significantly to meet the increasing demand
- A new wave of companies is expected to enter the Mass Timber market with potentially lack of experience
- Logistics: With just-in-time delivery of mass timber materials and panels designed for specific sequencing of placement in a structure, logistics planning and building materials storage and management are critical
- Continuous adaptation of building codes (e.g. Eurocode 5 - Design of timber structures). Potential of promoting sustainability at the expense of security

Mass Timber – What can go wrong?

- Siemens Arena in DK, built in 2001
 - Sudden collapse of two trusses a few months after inauguration
 - Root cause: 3 critical design errors



Source: ©Peter M. Thorup

Mass Timber – What can go wrong?

- Oregon State University building, 2018
 - Failure of cross laminated timber panel during construction phase
 - 1,000-pound section of the third floor buckled and crashed onto the floor below
 - Root cause: delamination due to temperature changes during glue application



Source: statesman journal

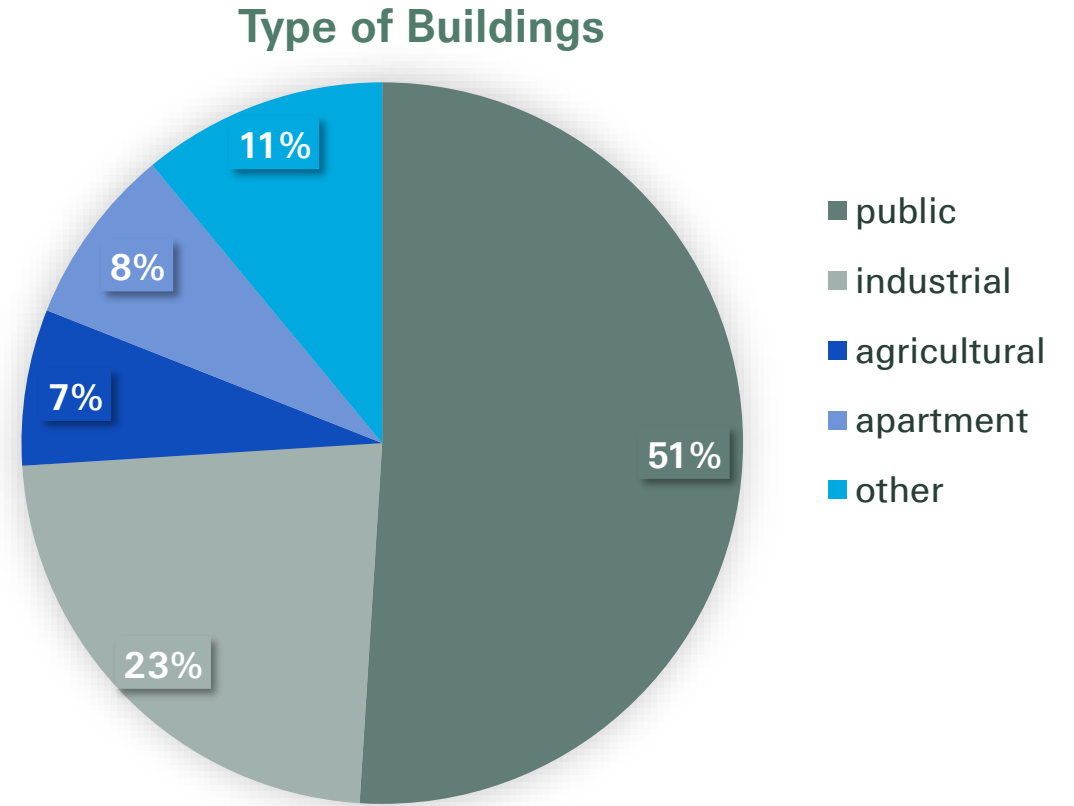
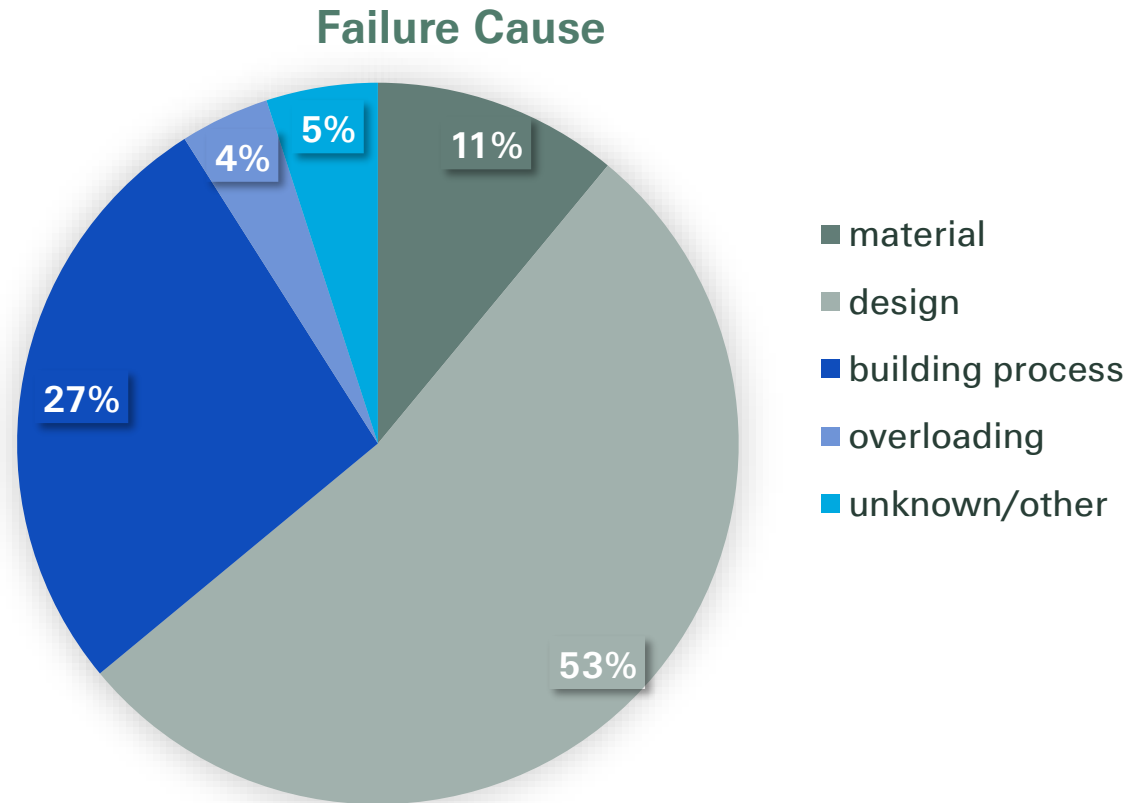
Mass Timber – What can go wrong?

- Multi-use gym Bad Reichenhall, DE, 2006
 - sudden roof collapse, 15 fatalities, 34 injured
 - Root cause:
 - delamination due to humidity (wrong glue)
 - mistakes in structural roof design
 - insufficient maintenance (35 years old)
 - high but expectable snow load
 - Lead designer was given a suspended sentence (18 months)



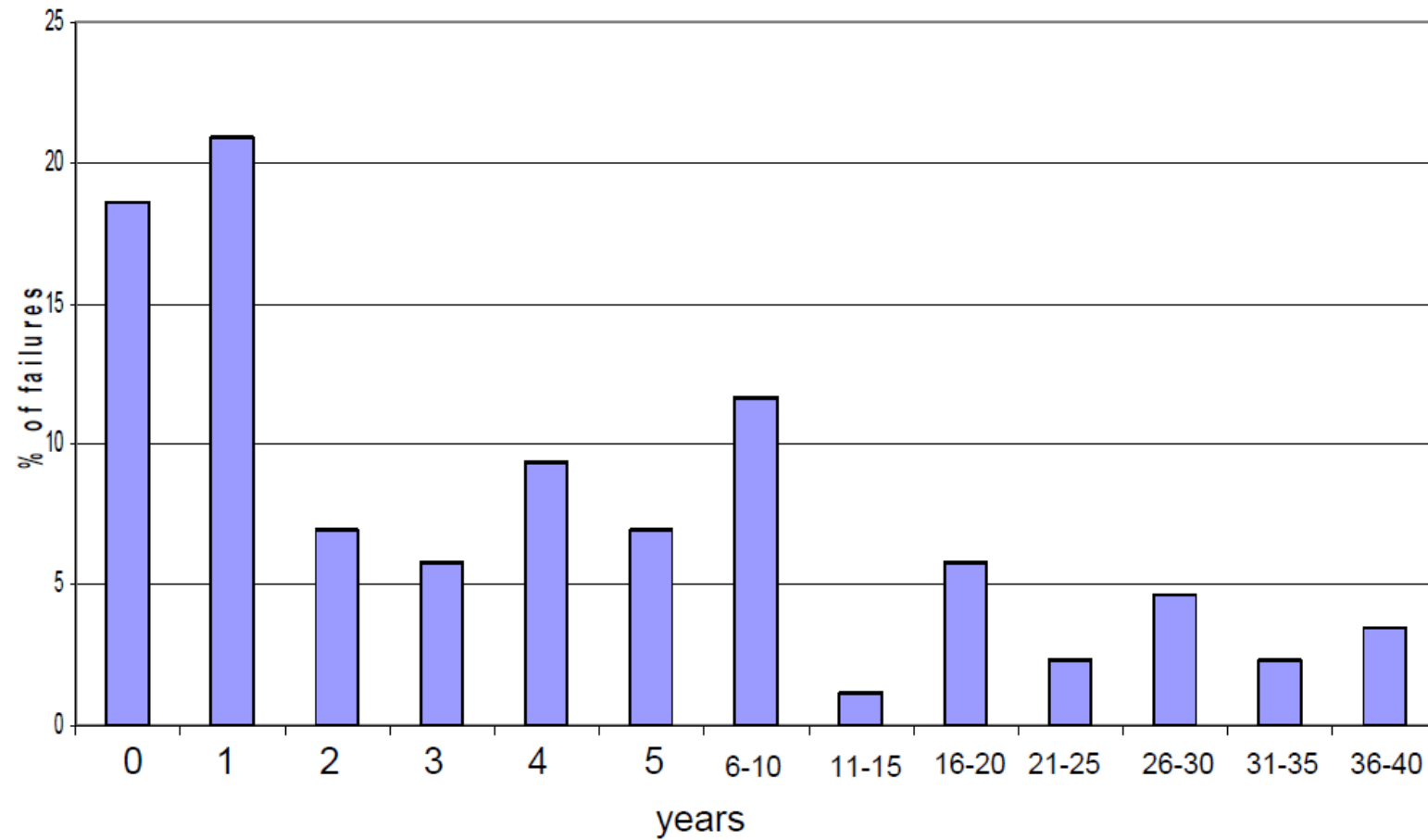
Source: www.augsburger-allgemeine.de

Mass Timber – Main Failure Causes



Source: University of Lund

Mass Timber – Age of Failures



Source: University of Lund

Mass Timber – Conclusions

Although timber has been an indispensable building material for thousands of years now, new ways of workability can still be explored today.

Chances and challenges must be observed closely to ensure a future-oriented, attractive but also safe use of this sustainable and versatile material.

It is inevitable to find the right balance between sustainability and reliability!



Thank you!

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