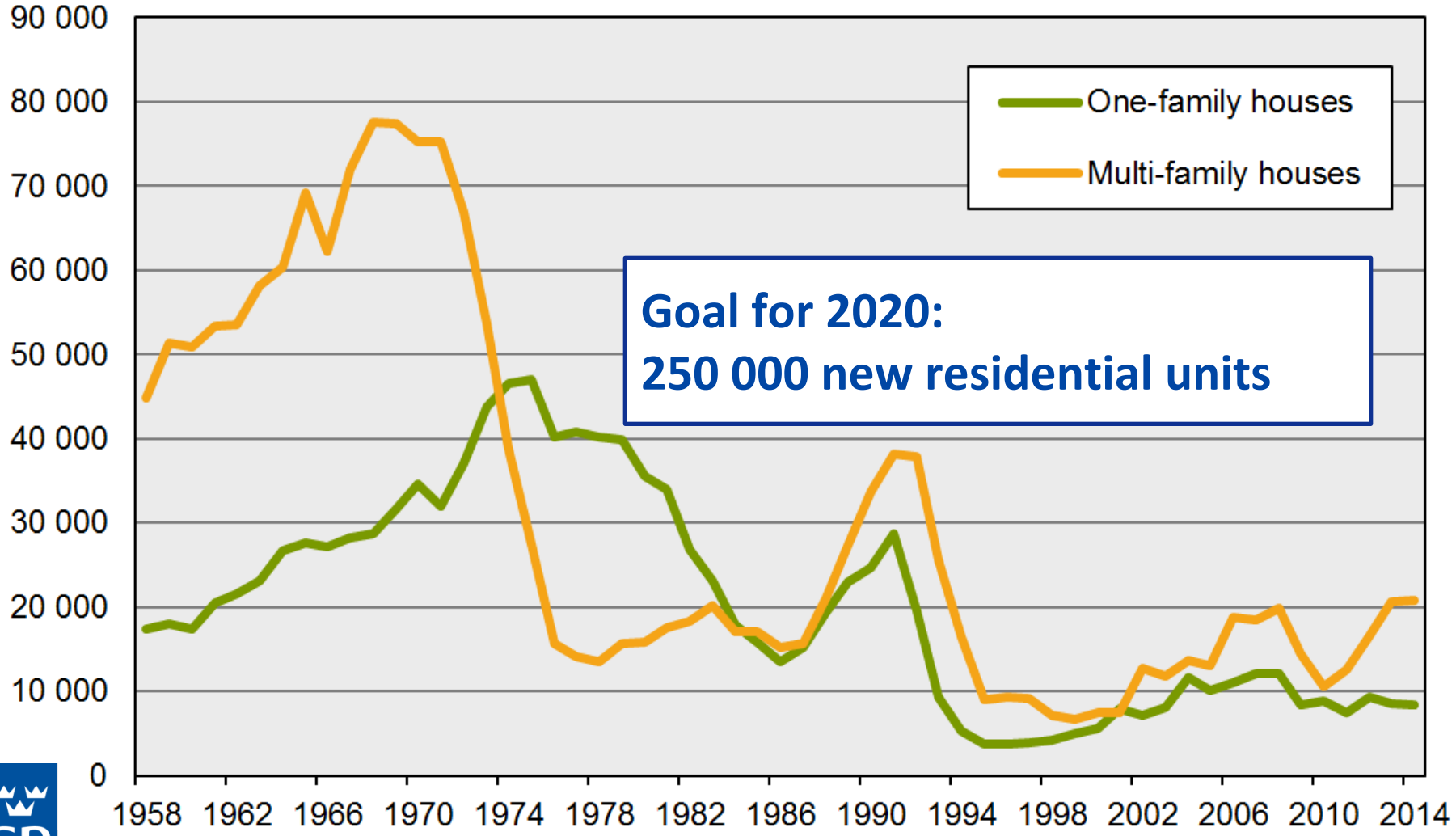
Modern timber construction in Sweden

SP Technical Research Institute of Sweden

Pierre Landel
SP Wood Building Technology
2015-05-20 Copenhagen

Long tradition of prefabricated single-family houses

Amount of completed residential units 1958-2014



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Source: SCB

Some dates

~ 1875 Building of timber houses in cities stop (max. 2 floors)

Development of the ”County governor’s houses” in Gothenburg, 1877

Some dates

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1994	Change in building code from prescriptive to performance/function based rules → Multi-storey timber houses are allowed

Wälludden was the first five storeys timber house in Växjö and in Sweden for around hundred years. It was built 1995.

Architect: Tina Wik
Structural engineer and contractor: Skanska

More dates

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1995-2005	Development program for techniques on Nordic basis. Weak market development.

Examples of national research funding and activities with focus on building with wood

- National research agendas, based on FTP
- National research programs for forest and wood industry (Vinnova) Industry clusters (TCN and CBBT)
- Wood Wisdom net projects
- EcoBuild competence center
- Trästad 2012, network
- Lean Wood Engineering, Wallenberg Wood Science Centre, BIMAC Innovation…

Tove Bygg - Winghård

More dates

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2000-2004	Weak interest from big building companies Building of student houses is more successful

Vetenskapsstaden - Source: Setra

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2004-2009	A number of timber based systems are developed

Source: Martinsons

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2010-2015	Growth of the timber market

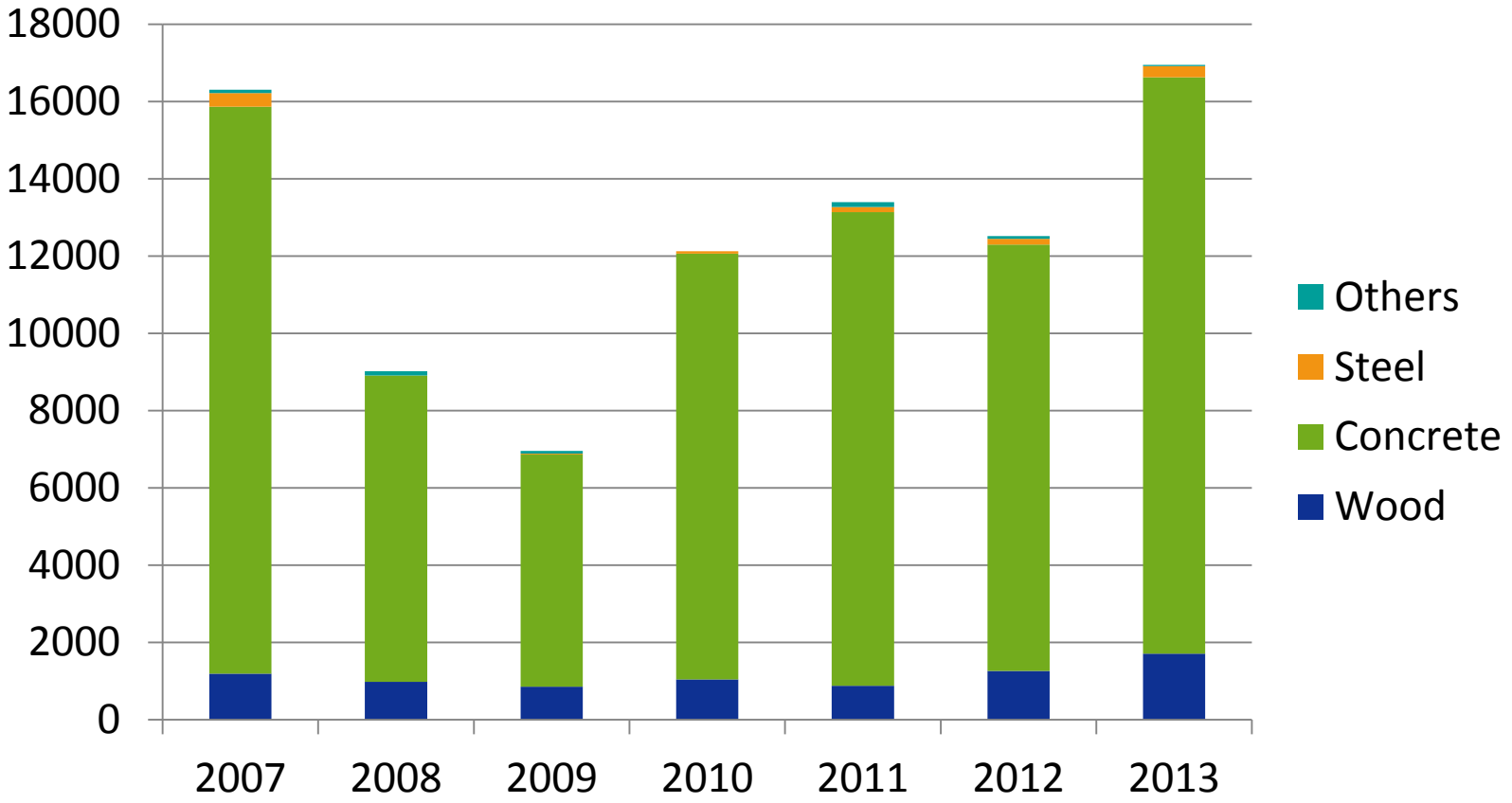
Source: Martinsons

Share of timber vs other material

- For single-family houses: 90% in timber (90% prefabricated)

Share of timber vs other material

- For single-family houses: 90% in timber (90% prefabricated)
- For multi-family houses:



Source: TMF and SCB

Timber building systems

STRUCTURAL MATERIAL

- Timber frame (C24)
- Glued laminated timber
- Cross laminated timber (CLT)
- LVL…

FABRICATION METODS

- On-site construction
- Prefabrication plates
- Prefabricated volumes

ELEMENTS GEOMETRY

- 1D beams and pillars
- 2D plates

HYBRID SYSTEMS

- Concrete/steel core

COMPOSITE MATERIALS

- Wood/concrete with steel connectors

Some industrial actors…

Some actors: Glulam manufacturers

Martinsons

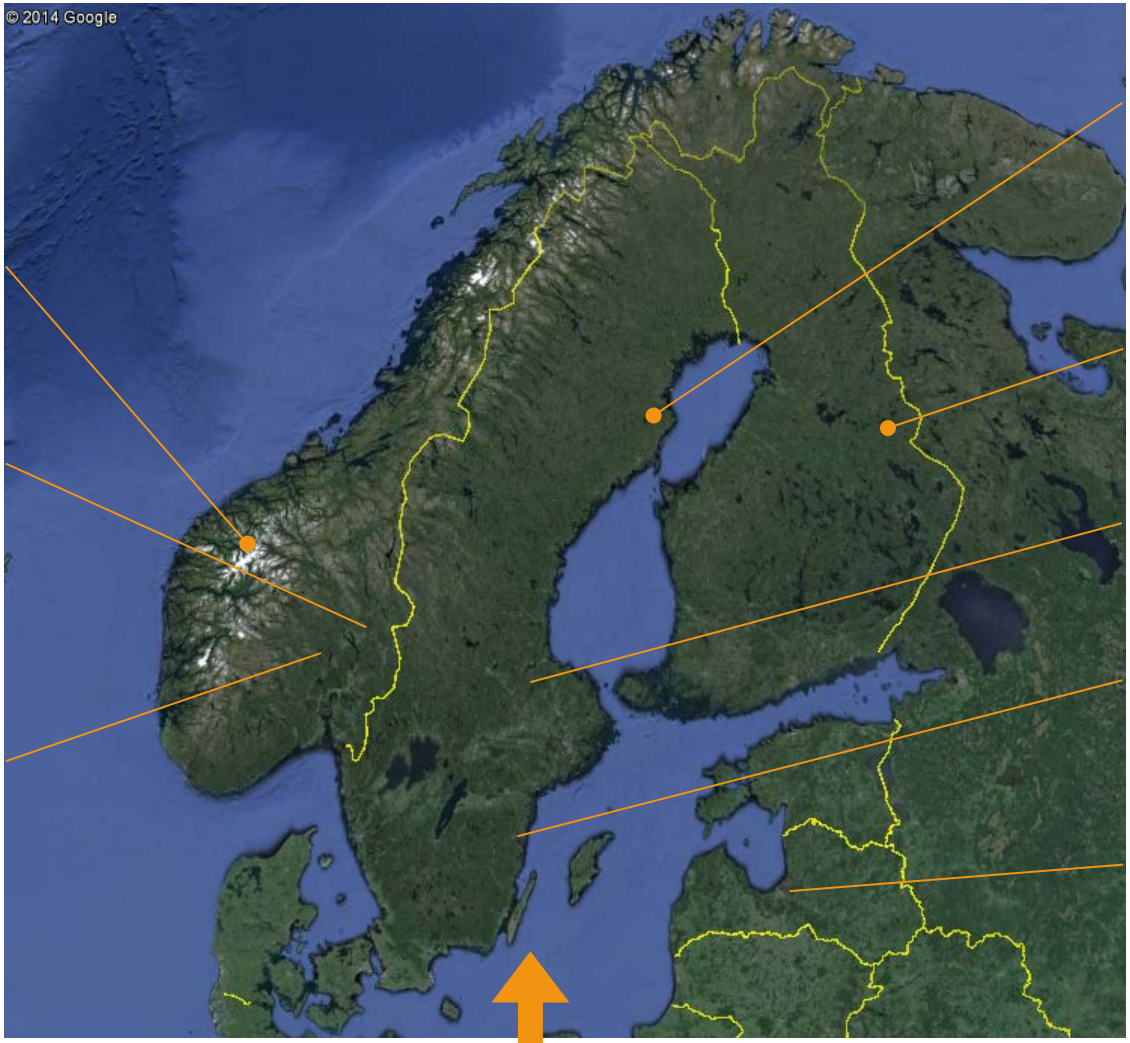
Glulam of Sweden

Setra

Moelven Töreboda

MOELVEN
SP
your Science Partner
TRÄ8
PELARBALKSYSTEM

Some actors: CLT manufacturers



Martinsons KL-trä

MassivLust

Crosslam Kuhmo *2015*

Holz 100 Norge ?

Setra

MHM Scandinavia (2007-2011)

Moelven MassivTre (2005-2010)

Cross Timber Systems

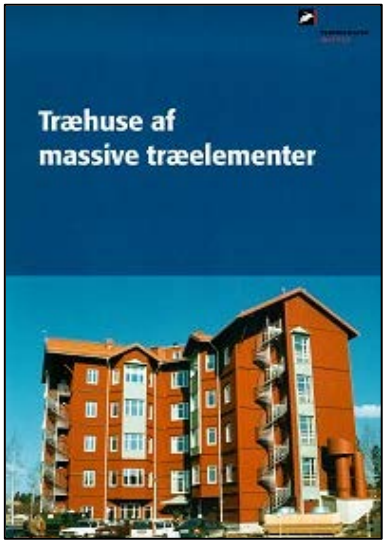
OBS: import

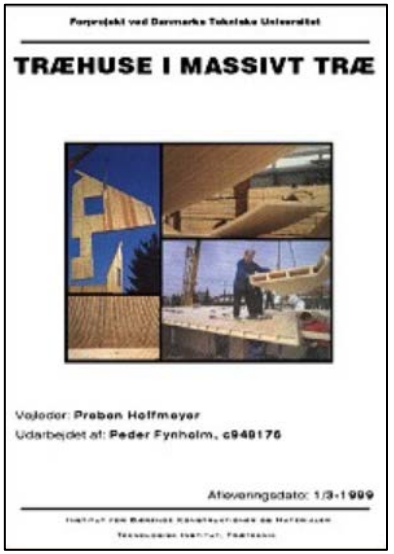
CLT Handbooks

Massivträ.
Handboken 2006

1 Byggsystem
2 Stomsystem
3 Byggnadsfysik

Updating...





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Some actors: Timber frame prefabrication

Lindbäcks

Setra

Moelven
Byggmodul

Åtvidabergs
Hus

Derome

Flexator

LINDBÄCKS
rationellt byggande – sunt boende

Derome

→ Timber platform developed with Tyréns and LTU
→ 4-8 storeys houses

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Building references

Challenges faced and solutions adopted for:

- Sound
- Vibration
- Stability
- Connections
- Weather protection
- Durability
- Fire safety
- Energy efficiency

Limnologen ”Stora Samhällsbyggarpriset 2010”

VÄXJÖ

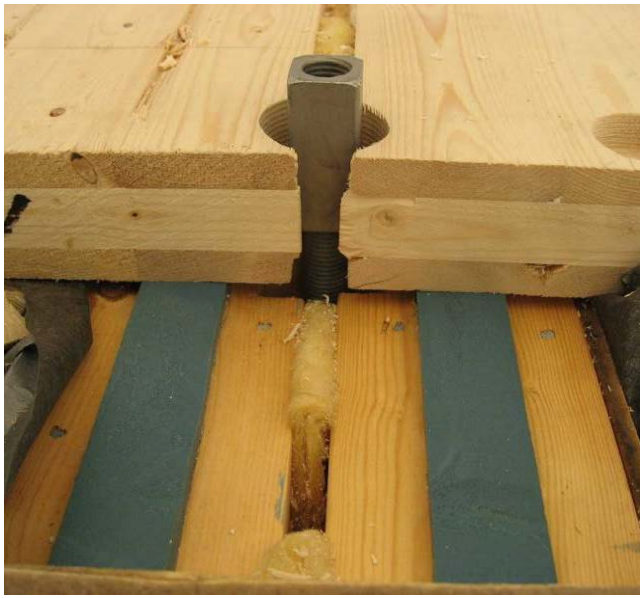
Midroc, Martinsons, Tyréns, Ola Malm

4 houses - 8 storeys
Prefabricated CLT-elements
2006 – 2009

Limnologen: Weather protection

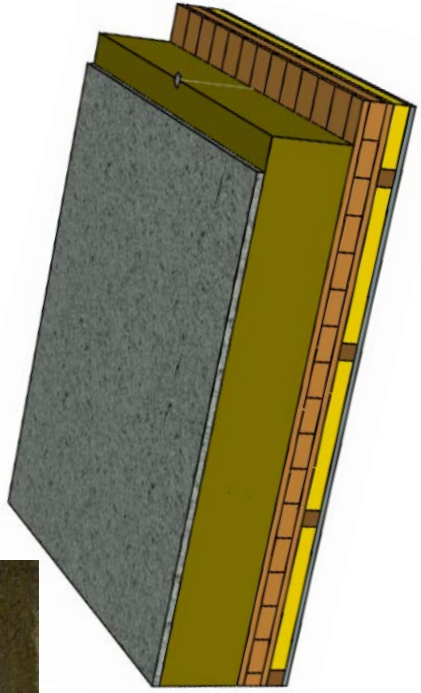
Limnologen: Weather protection

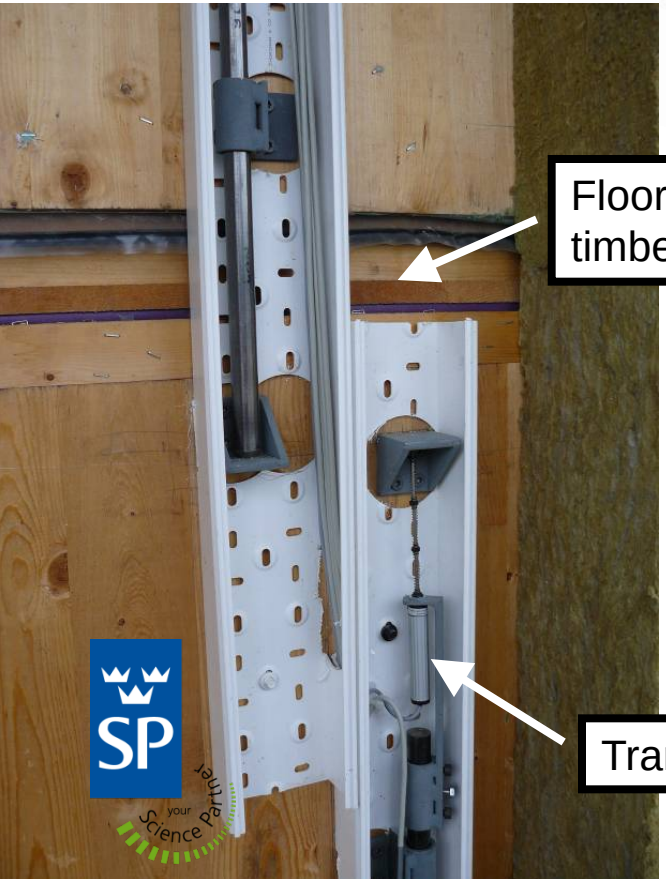
Limnologen: Stability with tie down steel-rods



Limnologen: Measurement of deformations

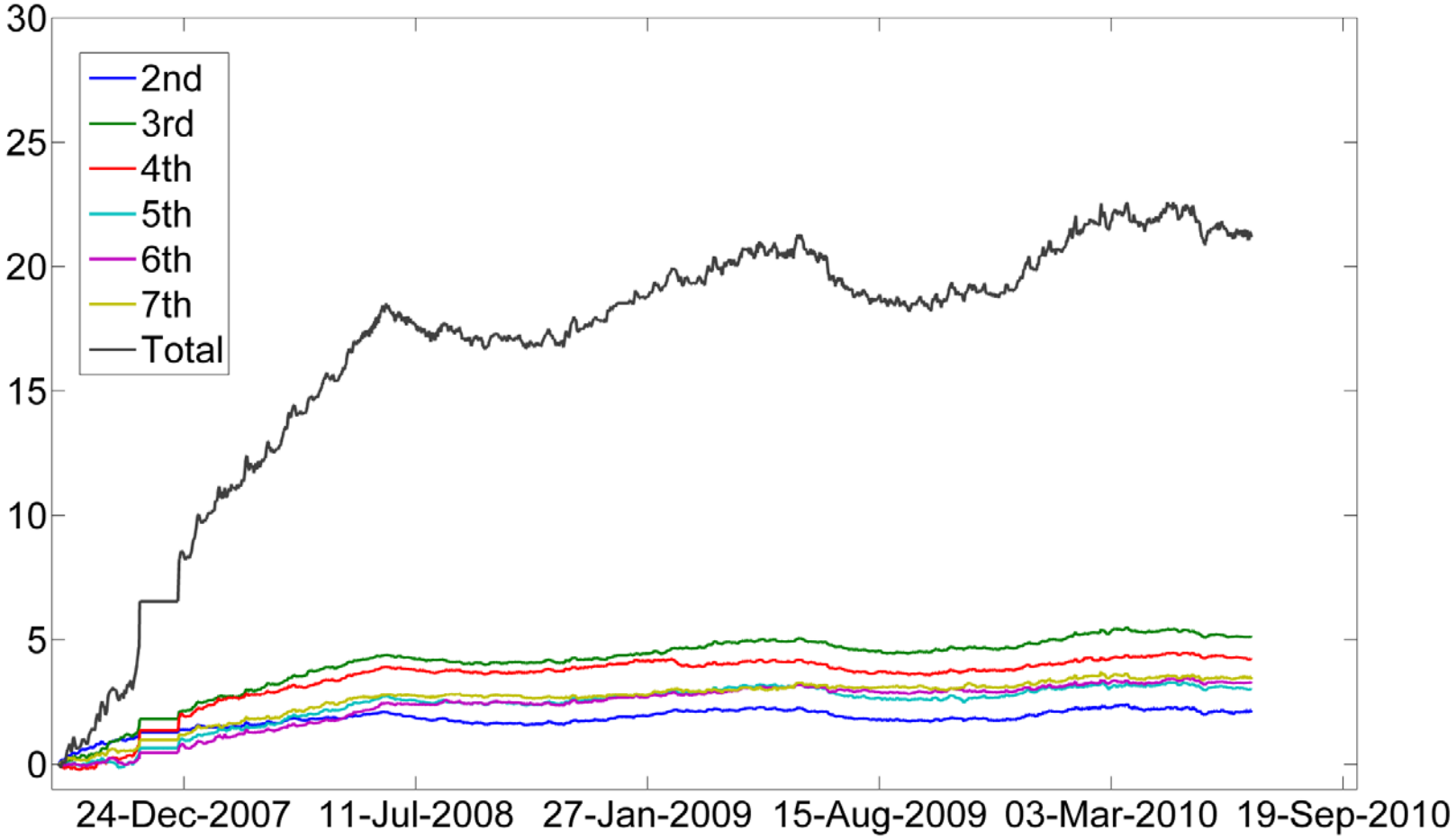
- Relative deformations in the timber frame are measured
- Movement between each storey along a line
- Permanent (built in) measurement equipment
- Continuous measurement
- The goal is knowledge about how different parts of the timber frame are displaced and when the deformations stop




Floor structure, massive timber
Transducer

Kanaler med mätstänger och givare
Datalogger placerad i elcentral

Limnologen: Deformations after 3 years



Limnologen: Evaluation

1. Information spreading
2. Planning, design and tendering
3. Climate effects of timber construction
4. The market for multi storey timber houses
5. Cooperation of contractors and logistics
6. Assembling techniques
7. Deformations in the structure (hybrid!)
8. Temperature and moisture in the structure
9. Stability vs. vibrations and sound

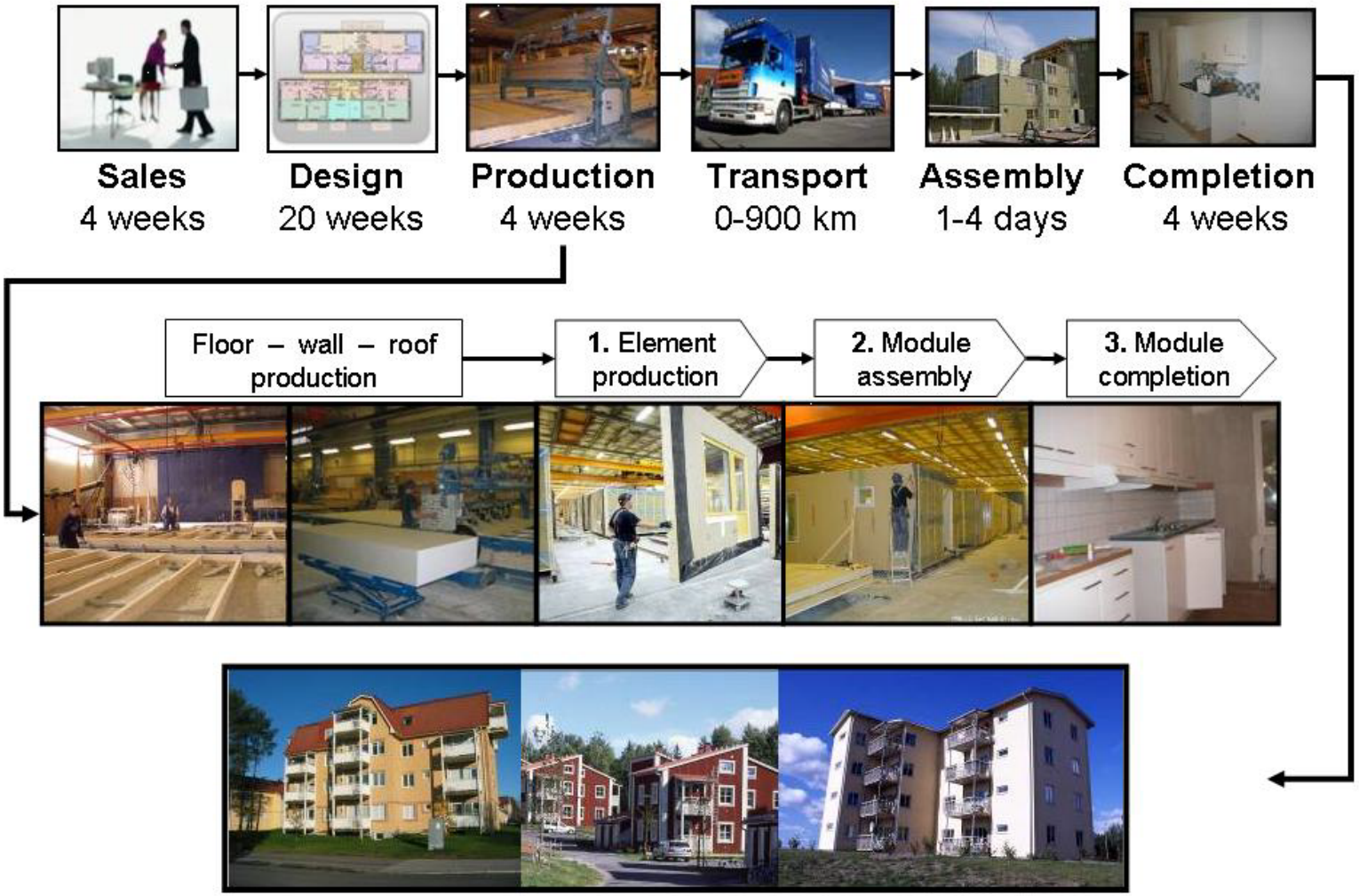
Limnologen: Documentation and reports

PORTVAKTEN VÄXJÖ

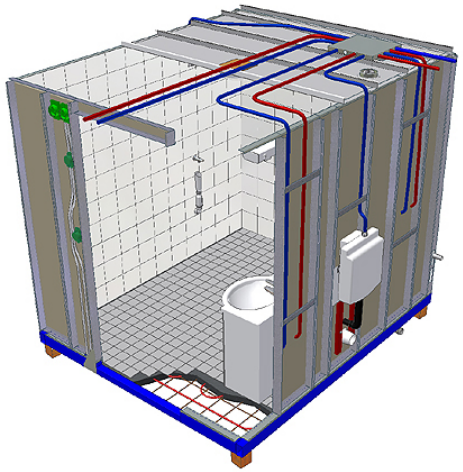
Hyresbostäder i Växjö AB, Martinsons, NCC

4 houses - 8 storeys
64 apartments
Prefabricated CLT-elements
2007 – 2009

Portvakten: Building process for volume elements

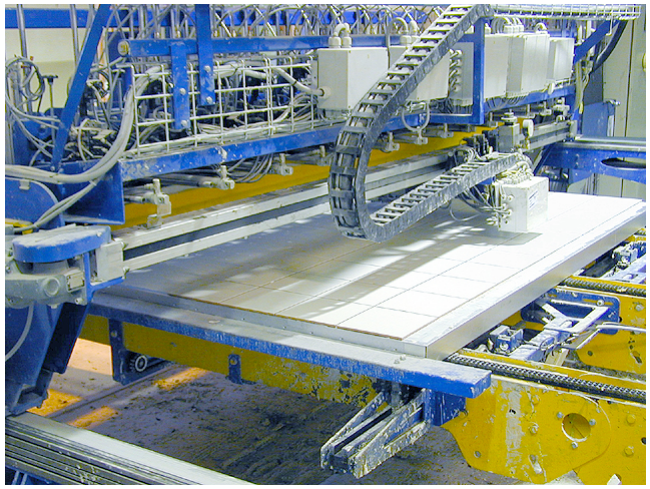


Portvakten: Prefabricated bathrooms



Integrated IT-design

Floor manufacturing



Portvakten: Timeline

October -08

November -08

Portvakten: Timeline

December -08

January -09

Portvakten: Timeline

February -09

Portvakten: Evaluation

1. Technical competence both from the contractor and the builder are required
2. Positive with higher grade of prefabrication
3. Passive house – air tightness is important

ÅSBOVÄGEN

FRIBO

Tengbom

Fristad Bygg / KLH

2 houses - 6 storeys

44 apartments

CLT structure

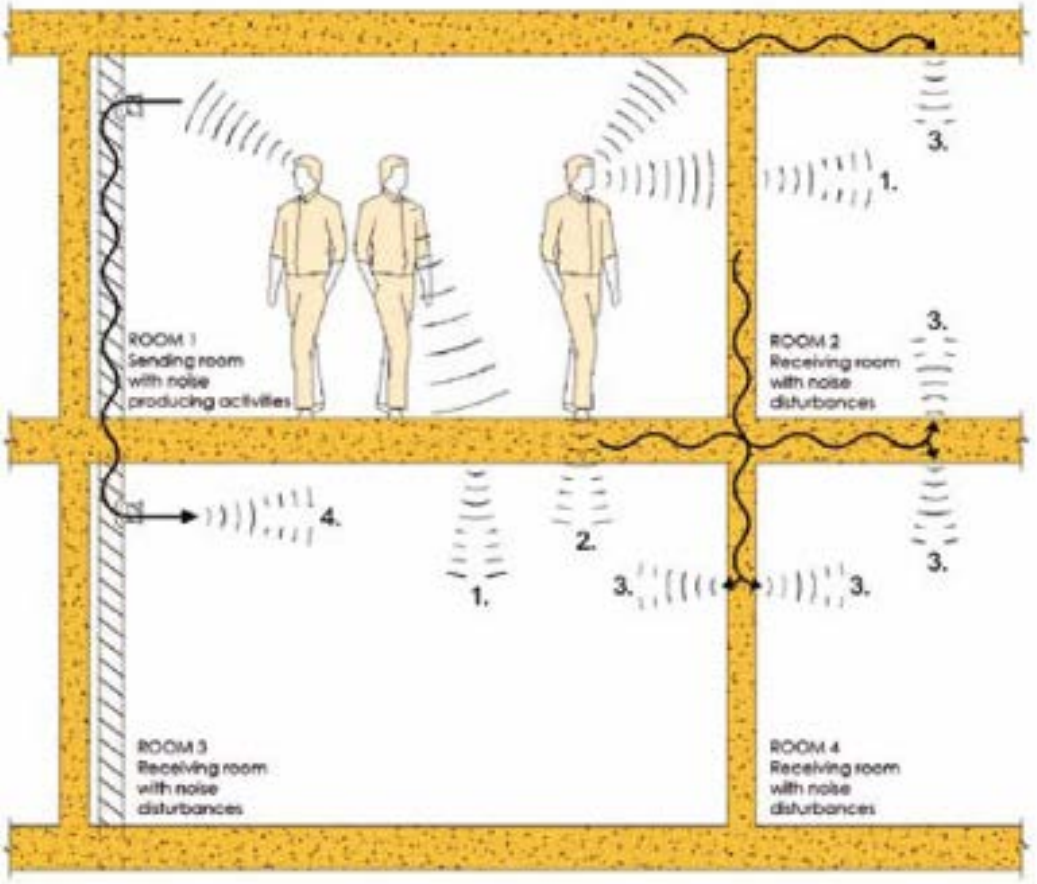
Maj 2013 – Maj 2015

Reports online for designers and contractors

Acoustic and vibrations

R&D projects:

- AkuLite (2009-2013)
- AcuWood (2010-2013)
- Silent Timber Build (2014-2016)



Acoustic and vibrations

Results and recommendations:

- Low frequencies in lightweight structure are disturbing: 20 to 200 Hz
- Increase weight / stiffness to improve acoustic performance

  → total thickness of floor and wall increase also !
- Flank transmission vs. stabilization fasteners !
- Development of calculation methods and tools (with SEA and FEM)
- Harmonization of acoustic standards and tests in Europe
- Vibration criteria in the Eurocode is too low

- But seems to be more wireless and radio-wave friendly ☺

  → more researches are still needed

Durability / Prediction of service life

- Building envelope
- Wood above ground
- Engineering tools for service life prediction
- Weather protection under construction

Moelven - Martinsons

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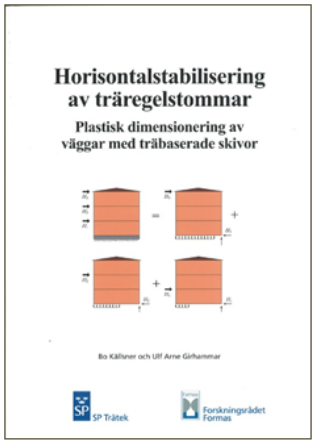
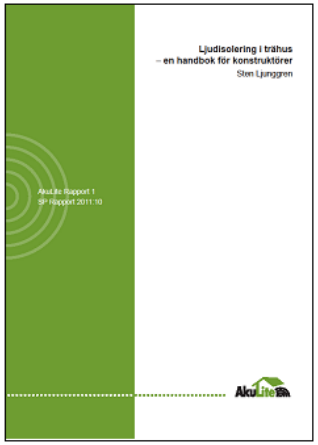
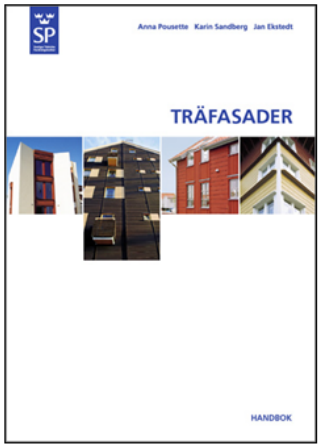
WoodBuild

More guides and handbooks





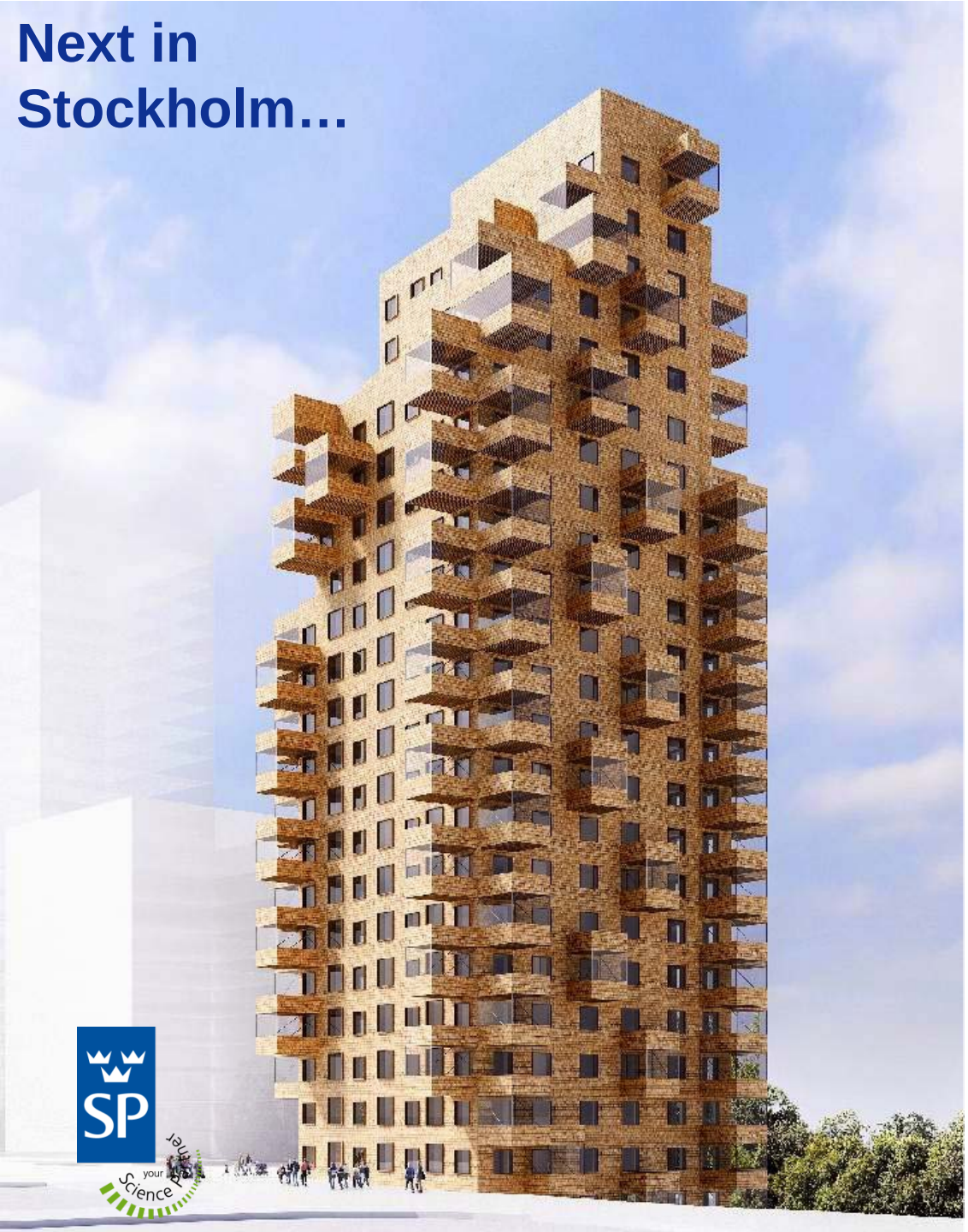


Next in Stockholm…

13 storeys
(2018)

CEDERHUSET
General Architecture
and Folkhem

Next in Stockholm…



22 storeys
(2018)

HALLONBERGEN
Wingårdhs and Folkhem

Next in Stockholm…

20 storeys
(2025)

LOUDDEN
Tham Videgård and Folkhem

Other constructions…

Summary

- Construction of multi-storey timber houses is well established today in Sweden, effectively and industrially
- Building with wood is part of the solution for increased housing

  → 250 000 is the goal for 2020
- Building with wood is a natural resource essential in a bio-based economy for a sustainable future
- Continue to document building projects, build up knowledge and improve systems
- Stretch the boundaries, major buildings, infrastructure solutions...
- Other benefits to develop: renovation, extension, earthquake
- Time for next step: more bio-based society with a new business sector for Timber Construction

ÄLVSBACKA STRAND
Byggiträ, Martinsons, Lindbäcks, White

SP Wood technology in brief

Through the wood/biomass value chain

Sawmills | Process | Construction

R&I areas

Processes and processing | Materials and products | Building and housing

Quality and testing

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Thanks for your attention !

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