

Minutes – Meeting 4 - Zoom (Day 1)

When: The 22nd of September 2020 at 09.30-11:30 and 13:00-15:30

Where: Digital via Zoom

Aim of the meeting

- Presentation of results from each partner modelling and/or measurements.
- Discussion on dissemination and final guidelines.
- Administrative routines and reporting.

Agenda

Part 1

09:30-10:00	Welcome	RISE
10:00-10:30	Presentation of project results	InnoRenew
	<i>Short break</i>	
10:30-11:00	Presentation of project results	Uni Ljubljana
11:00-11:30	Presentation of project results	Uni Exeter

Part 2

13:00-13:30	Presentation of project results	CSTB
13:30-14:00	Presentation of project results	LNU
	<i>Short break</i>	
14:05-14:30	Presentation of project results	RISE
14:30-15:00	Presentation of project results	NTNU
15:00-15:30	Discussion dissemination and final guidelines	InnoRenew

Part 1 – 09:30-11:30

1. Welcome and start of the meeting

Marie welcomed everyone to this web-based meeting that was necessary due to travel restrictions. Marie also gave a short presentation about the aim of the meeting, the agenda, the time plan and milestones for the project.

A short round the table regarding local Coronavirus situation in each country. In general, everyone was back to working in the office but with travel and meeting restrictions. The restrictions in the UK was raised the same day to limit meetings to a maximum of six persons.



Time-plan and milestones

The project follows the time-plan in most aspects – there is however a delay in the full-scale measurements due to travel restrictions due to the Corona virus pandemic. The measurement plan looks like:

(34)	Status and plan for full-scale measurements of buildings <ul style="list-style-type: none">• France<ul style="list-style-type: none">• Treed-IT measured - Dec 2019 and June 2020• Hyperion measured - July 2020• Slovenia<ul style="list-style-type: none">• Flower Valley - Several occasions• UK<ul style="list-style-type: none">• Yoker – Jan 2020• Eventually an extra building in Cambridge – Autumn 2020• Norway and Sweden<ul style="list-style-type: none">• Moved to spring 2021 due to travel restrictions.
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File storage

InnoRenew opened a new file storage space on a OneDrive account in June 2020. All files have been moved to that server. Invitation to the server was sent by e-mail in June to all partners. If you have not received an invitation from OneDrive send an e-mail to Iztok (iztok.sustersic@innorenew.eu) for a new invitation.

Info from ForestValue

A mid-term report was sent in to the ForestValue organization in April 2020, can be found in the administration folder on the file server. There will also be reports sent in April 2021 and a final report in April 2022 that will include impact assessment.

The project also has to write stakeholder oriented articles three times during the project. One was sent in May 2020 and can be found through www.forestvalue.org homepage.

ForestValue have annual seminars, the seminar in 2020 will be held in a digital form the 17th of November 2020. <https://forestvalue.org/annual-seminar-17-nov-2020/>. Marie will give a short (maximum 10 min) presentation of the project. Marie will make a presentation based on results presented at the meetings 22nd of September.

The final conference for ForestValue is planned for mid 2022 in Spain, more info to follow.

Publications

Summarized this far in the project:

Eurodyn 2022 – 3 papers

WCTE 2020 – 3 papers

Journal papers – 1 submitted

Forthcoming meetings

Discussion on dates for forthcoming meetings in the project. Dates for the next two physical meetings were decided with the note that we will have to follow the development regarding the Coronavirus.

2020-09-21: Scientific discussions – FE-models, measurement evaluation, guidelines.

- 18-19th of March 2021 in Paris, France
- 6-7th of September 2021 in Exeter, UK (For info: Conference on Human Responses to Vibration at Exeter 8-9 sept 2021, <https://emps.exeter.ac.uk/hrv-conference/>)

(35)	Date for project meetings: 18-19 th of March 2021 in Paris, France 6-7 th of September 2021 in Exeter, UK (For info: Conference on Human Responses to Vibration will be held in Exeter 8-9 th of September 2021)
(36)	Meetings will also be held once every month with the research partners, Marie will send out Outlook bookings for these meetings.

2. Presentation of project results

InnoRenew

Procedure for cyclic test on connections with 8 mm steel plates and 12 mm dowels are settled and a test campaign at the WKI Fraunhofer institute is planned. In-situ measurement at the CLT building Flower Valley: 3 campaigns of ambient vibration tests have been performed at different construction phase and a fourth is planned. Iztok presented the results from the measurements at Flower Valley and compared them to the results from an FE-model developed in RFEM from Dlubal.

Forced Vibration Test with a shaker is planned to be performed at one building, the shaker is scheduled to arrive in the beginning of October 2020. One possibility will be to perform tests on InnoRenews new office and lab-building which is under construction. The building is four stories and made of CLT with a concrete core.

Olivier asked about the frequency for the cyclic connections tests and why they are low compared to what we have usually in buildings. Iztok answered it depends on the testing machine capacity.

3. Presentation of project results

Uni Ljubljana

Blaz presented the work done on the model of the Yoker building on Ansys earlier and how it has been updated. The Yoker is a CLT building of eight stories built using the platform framing technique. The model is made using the same type of elements representing the whole wall including the low out-of-plane stiffness, E90, of the CLT slabs in the platform-based system. The influence of some different in-plane stiffness parameters of the CLT elements on the modes by comparing MAC values (both E and G) is pointed as parameters with large influence. Uni Ljubljana is now planning to look at the sensitivity analysis on the foundation modelling and how to calibrate this part of the FE-model.



4. Presentation of project results

Uni Exeter

Alex presented the modal analysis of the ambient and shaker shut down test data from Hyperion Bordeaux (performed by CSTB). The results from the analyse show that damping is prone to amplitude dependency with higher damping at lower amplitude of acceleration. Work on the data from Yoker's test are on-going to evaluate the amplitude dependency of the mode shapes with the CMIF analysis.

Alex presented the horizontal shaker with reaction mass system and what can be done using this system. The outline of a journal paper and an abstract to IMAC 2021 were presented and the PDFs are available on OneDrive.

Uni Exeter has now the possibility to perform forced vibration tests on a CLT building: Trinity Round Church Building, Cambridge, UK.

Part 2 – 13:00-15:30

5. Presentation of project results

CSTB

On-site testing of Hyperion building in Bordeaux with CSTBs shaker and 9 accelerometers and comparison of the three first modes from two FE-models (with and without balconies) were presented. The comparison shows that the balconies play an important role in the dynamical behaviour. The shape of the vibration decay of the first bending modes from the shaker shut down test is typical of viscous damping whereas for the decay of the second mode (a torsion mode) is more typical of friction damping (solid-friction). A comparison of the acceleration magnitude with the acceleration acc. to wind model EC-B were presented.

The second FVT campaign on the Treed-It building were performed with all the partitions installed (adding mass and stiffness). In this case all vibration sensors were placed at the top level. The partition walls increased the mass and the stiffness. The frequencies were not decreased or even increased a bit compared to the first measurement. Comparison of damping between the two campaigns is difficult because of more construction activity during the 2nd campaign.

Univ. Ljubljana asked if they have you looked to some MAC-values? Not yet according to the CSBT.

Alex says it is important in serviceability to consider all "non-structural material" in the dynamical behaviour of a timber building, but how can we do it in the code?

6. Presentation of project results

LNU

Not present due to illness. Work is on-going on the FE-model of the building in Sweden and supervision of Pierre's PhD work.

7. Presentation of project results

RISE

Pierre presented results from the study on the FE-modelling work on large glulam trusses. Results will be published at the Eurodyn conference. Plans for investigations of the glulam truss in the lab. Some results from the survey of connections types where data has been collected from France and



Sweden. Pierre also showed some data from a comparison of calculation of maximum acceleration of some tall timber buildings using Eurocode 1 – Annex B and C and the National Annex in Sweden.

8. Presentation of project results

NTNU

Saule presented an FE-model of Mjöstårnet and an update of the Abaqus FE-model including connection stiffness, vertical foundation stiffness, and the external walls. More on this model in notes from the second day of the meeting.

Haris presented some research on energy dissipation on various timber components: beams, floors, moment resisting frames with threaded rods and GLT, CLT/GLT connections with inclined screws, CLT walls on glulam structure with inclined screws.

9. Discussion dissemination and final guide-ines

InnoRenew

Iztok presented an out-line for the guidelines. The out-line contains three main parts;

- Technical guidelines – compilation of advice on design of tall timber buildings
- State-of-the-art – including three main parts, structural systems for tall timber buildings, measurements on vibrations and modelling.
- Report per building including data on structural system, measurements and modelling. Different experimental campaigns on the same building should be included in the same building report.

Iztok is also proposing a template in Word for the guideline. The template is made to be able to read on the screen with two pages shown at the same time. Updated news will soon come on the website, everybody can send text and pictures to Iztok or Igor.

There will be meetings with one representative from each research partner every second month for discussions of the guidelines.

Olivier asked: how should we organize the directories for the storage of all the different kind of files (data, FE-models, CAD, pictures...). This will be discussed during the WP5 meetings.

10. Presentation material

The ppt-presentation from each partner can be found in the One-drive folder for the meeting.

10. Other questions

Marie will send a new question to the ForestValue organization whether it is possible to get a prolongation of the project time (no more funding will be possible). The answer from ForestValue during May 2020 was that it is not possible at the moment.

Marie will send out invitations to research partners for a project meeting each month.

(37)	RISE will send question to ForestValue regarding a prolongation of project time.
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11. End of the meeting

(38)	RISE will prepare meeting notes and send out for comments.
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Marie concluded the meeting and thanked all participants for a good meeting and fruitful discussions.

Notes:

Pierre Landel, RISE

Marie Johansson, RISE



Attendance list

Alex Pavic – Uni Exeter,
Anders Rönquist NTNU,
Blaž Kurent – Uni Ljubljana,
Boštjan Brank - Uni Ljubljana,
Fernando Pérez - Smith & Wallwork,
Haris Stamatopoulos – NTNU,
Igor Gavrić – Innorenew CoE,
Iztok Šušteršič – Innorenew CoE,
Kjell Arne Malo – NTNU,
Manuel Manthey – CSTB,
Marie Johansson – RISE,
Olivier Flamand – CSTB,
Petter Juell Nåvik – NTNU/Sweco,
Pierre Landel – RISE,
Rune Abrahamsen – Moelven
Saule Tulebekova – NTNU,
Vincent Ao Wai – Uni Exeter



Minutes – Meeting 4 – Zoom (Day 2)

When: The 23rd of September 2020 at 09.30-11:30 and 13:00-15:30

Where: Digital via Zoom

Aim of the meeting

The discussions should have an aim on what common guidelines and recommendations we can give after the project for practicing engineers and scientists.

- Discussion on FE-models for complete buildings
- Discussion on measurement evaluation of complete buildings
- Discussion on final guidelines and publications

Agenda

09:30-09:40	Welcome	RISE
09:40-11:30	FE-models for complete buildings <i>Lunch break</i>	NTNU
13:00-14:30	Measurement evaluation of complete buildings	Uni Exeter
14:30-15:00	Final guidelines and publications	InnoRenew

Part 1 – 09:30-11:30

1. Welcome and start of the meeting

Marie welcomed everyone to this web-based meeting that was necessary due to travel restrictions. Marie also gave a short presentation about the aim of the meeting, the agenda, the time plan and milestones for the project. Marie also presented the work on-going within each WP.

All participants agreed to recording the Zoom meetings. The recordings from the meeting can be found in the folder for the meeting on the OneDrive folder. The notes from the discussion is therefore short and it is possible to see the complete discussion in the recordings.

(39)	Presentations and recordings from the meeting will be placed in the meeting folder at the OneDrive.
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2. FE-models for complete buildings

NTNU

Kjell-Arne started the discussion with a re-cap about aims and milestones for the work. He had also tried to make a summation of the different modelling strategies used by various partner for different types of building systems. The main question for the group can be summarised as:

How can we transform our collected knowledge into design guidelines?



In this case we aim at predicting comfort properties, meaning the serviceability limit stage. For this model will use: Mean values of material properties, SLS Load levels: 0 – 55 % of design loads (50 years) and study comfort vibrations: 0 – 40% (1-2 year).

The main elements in a building can be modelled as:

- Components
 - Columns and Beams (1D)
 - Plates and shells (2D)
 - Composites (2D), External walls, Internal walls, Deck elements
- Connections
 - 1D (pointwise or per unit) and 2D (per area)
- Foundation
 - Points (piles), Beams, Plates, Boxes 1D – 3D
 - Soil 1D - 3D

Kjell-Arne and Saule then presented a study done on the Mjöstornet building that included the glulam structure with all connections modelled as tied. In the connection zone a small zone (length = maximum element width) is introduced where the area and/or 2nd moment of area is set to a fraction (0-1) of its original value to model the real stiffness in the connection. In the same manner connection zones are introduced in the floor elements. The model is thereafter updated so that area and/or moment of inertia of the connection areas give the correct eigenfrequencies for mode 1-3. The parameters that were most important in the model were Diagonals area, External beam inertia, Inner beam area and External wall connection.

NTNU suggested the following advice for modelling with Finite element programmes.

- Components
 - If mean values are known: Mean values should be used.
 - If mean values unknown: Range of values, Sensitivity studies, Model updating (component scale)
- Connections in Timber Structures:
 - Mass: insignificant
 - Damping: may be significant
 - Stiffness: only a fraction of connected components
 - Stiffness: relative to the connected component
- Foundation
 - Rigid high-rise timber buildings: Half of the response due to foundation? May be the most important condition
 - Different for all buildings
 - Stiffness of the soil cannot be related to the building, but is “absolute”
 - Piles and foundation structures; Modelled explicitly (structures + soil), modelled by springs
- Element types;
 - Simple as possible, but not simpler



- Our building components are either plates or beams: Shell and beams
- Volume elements: Only studies of details, Foundation?

Discussion and questions:

How should the concrete core, stabilizing hybrid timber-concrete buildings be modelled? Should it be calculated as solid or cracked concrete in the serviceability limit state?

- It should be as structural engineers do today for concrete buildings, but the connection between the concrete core and the timber structure should be carefully modelled.

NTNU propose to consider the damping of timber components as the sum of material and structural damping (due to connections and interactions between different parts). The range of total damping in timber components seems high. Therefore, calibration of the material damping model is necessary. Discussion that either friction or viscous damping models should be used.

NTNU suggested that they can do the same type of modelling approach as for Mjöstornet also on the Treed-It and Hyperion building.

NTNU suggested cancelling measurements on the Treet building as it is very irregular and with a building technique that might not be used again. No decision taken yet.

3. Measurement evaluation of complete buildings

Uni Exeter

Alex presented several important aspects on full-scale measurements and evaluation of measurement data.

- Measurement data – what can we get?
 - Ambient vibration data – assumes flat excitation which is unknown. Pros: Easy, Cons: only lowest modes, no amplitude dependent data.
 - Forced vibration data – known force and evaluation of amplitude decay or Frequency Response Functions. Shaker shut down test; Pros:– amplitude dependent data Cons: difficult to set up, focus only on certain modes. FRF measurements; Pros: good for amplitude dependent data, can identify higher modes and give theoretical modal mass, Cons: Difficult to set up.
- What type of evaluation is made?
 - Raw data: acceleration and force time history or acceleration time history with force data points.
- What type of data is generated?
 - Amplitude dependent behaviour, natural frequencies and damping, possible to also get modal shape and modal masses.
- Effect of shaker and measurement points?
 - check the modal response from the preliminary FE-model of the building so that you do not place your shaker or measurement points at the anti-node of a mode.

Concerning the analysis of test data and of the results the following aspects are important:

- The modal mass, it might be important to evaluate it for some modes for the different buildings.
- Damping seems strongly dependent on amplitude but less on frequency
- The results should be analysed at load levels corresponding to wind loads.



- The modal damping, how to link all the different sources of damping (friction, material, structural....) to physical phenomenon?

Discussion and questions:

Can we get a final result in recommending a measurement and evaluation strategy? Yes. But another question arises: Shall we propose dynamic testing as part of normal design strategy for Tall timber buildings. It is done for footbridges and grandstands in the UK. Maybe not, but suggesting a strategy for measurements of tall timber buildings for collection of similar types of data for modelling would be valuable.

Are MAC values good to correlate experiment to model? Yes, and might even be good to look at FRAC values (comparing experimental FRF to numerical FRF).

4. Final guidelines and publications

InnoRenew

Short continued discussion regarding guidelines from the meeting the day before, see meeting day 1. Igor showed the webpage and what news updates would be good to show. The following news can directly be seen as necessary:

- Yoker test Responsible: Uni Exeter
- Flower Valley tests Responsible: InnoRenew
- Treed-It (2nd test) Responsible: CSTB
- Hyperion test Responsible: CSTB

Additional content that is possible is: lab experimental tests, numerical modelling, meetings, conferences and publications. For the webpage 50-100 words and 3-4 pictures is what is needed.

There is a Linked-in account for the project www.linkedin.com/company/dynattb. If you publish and news related to DynaTTB on your account, please also send a link to Igor for publishing on the project Linked-In. There is also a project page on ResearchGate, here it is possible to publish papers related to the project.

(40)	<p>All partners will send info for the social medias to Igor. News with text and pictures is to be sent for publication on the www.dynattb.com. :</p> <ul style="list-style-type: none"> ▪ Yoker test Responsible: Uni Exeter ▪ Flower Valley tests Responsible: InnoRenew ▪ Treed-It (2nd test) Responsible: CSTB ▪ Hyperion test Responsible: CSTB
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5. Other questions

RISE

ForestValue will have a mid-term seminar the 17th (and 18th) of November where all projects will be presented. The agenda can be found at <https://forestvalue.org/annual-seminar-17-nov-2020/>.

ForestValue has also presented a new possibility with a New joint call that will open in 2021, see more info <https://forestvalue.org/joint-call-2021/>.



End of the meeting

Marie concluded the meeting and thanked all participants for a good meeting and fruitful discussions.

Notes:

Pierre Landel, RISE

Marie Johansson, RISE



Attendance list

Alex Pavic – Uni Exeter,

Blaž Kurent – Innorenew CoE,

Boštjan Brank Uni Ljubljana,

Fernando Pérez - Smith & Wallwork, Afternoon

Haris Stamatopoulos – NTNU,

Igor Gavrić – Innorenew CoE,

Iztok Šušteršič – Innorenew CoE,

Kjell Arne Malo – NTNU,

Manuel Manthey – CSTB,

Marie Johansson – RISE,

Olivier Flamand – CSTB,

Petter Juell Nåvik – NTNU/Sweco,

Pierre Landel – RISE,

Saule Tulebekova – NTNU,

Vincent Ao Wai – Uni Exeter