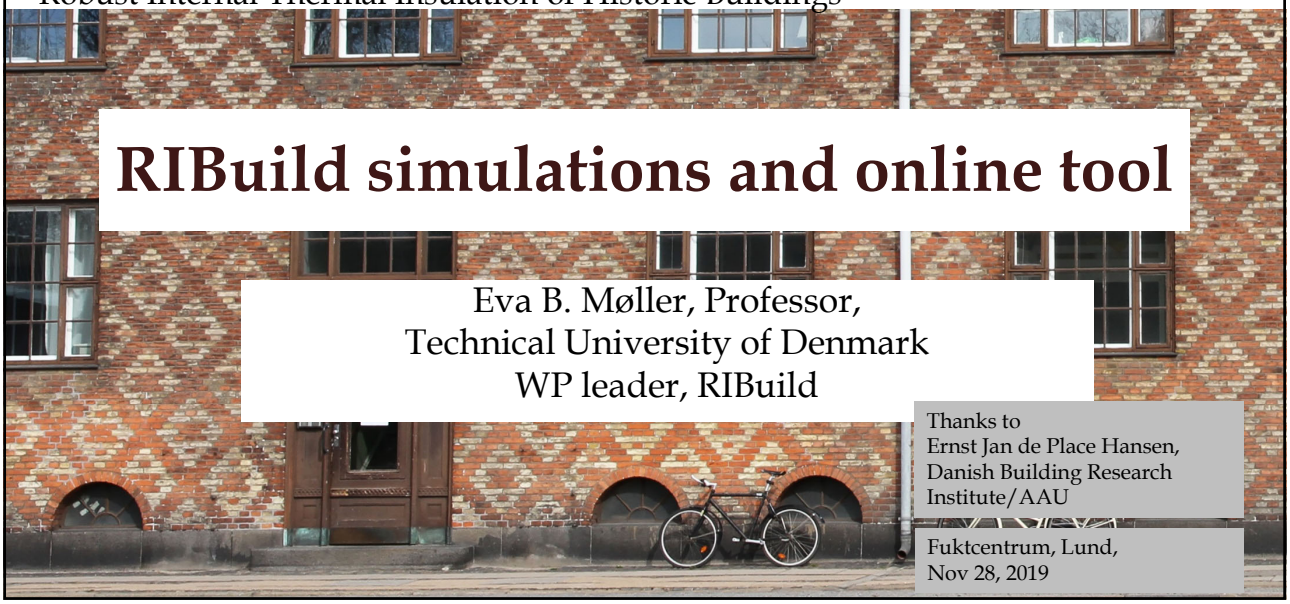
RIBuild

Robust Internal Thermal Insulation of Historic Buildings

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 637268



RIBuild simulations and online tool

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Thanks to
Ernst Jan de Place Hansen,
Danish Building Research Institute/AAU

Fuktcentrum, Lund,
Nov 28, 2019

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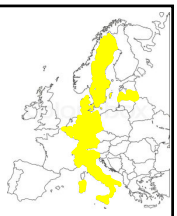
List of partners



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- Technische Universität Dresden (TUD) (D)
- Università Politechnica delle Marche (UNIVPM) (IT)
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- ERIK Architects (DK)

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Elements of WP6 and connections

Web-site:
Assessment of buildings:
- What to look for
- Risks

Want to know more?

Building is suitable

Web tool:
Input
Simulations
Output

What about sustainability?

Written Guidelines:
Goals
Assessment of building
Methods of insulation
Savings

Want to know even more?

Other RIBuild documents:
Insulation systems
Material data (methods)
1D, 2D
……

Sustainability
WP5 tool

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Entering the tool

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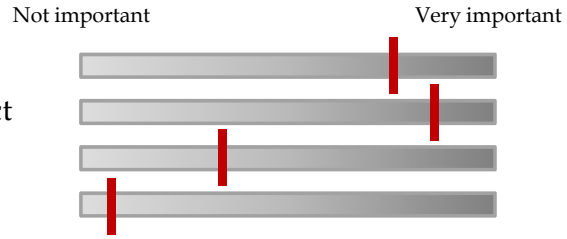
Prioritise

- Setting the goal
- What is the most important for the user of the tool



  - U-value
  - Environmental impact
  - Mould
  - Algae

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Prioritise

Type of systems

- ☑ CaSi based capillary active system
- ☑ Mineral wool with vapour barrier
- ☑ Cork
- ☑ PUR with CaSi channels
- ☑ …..

Thickness of insulation

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Web tool – output (at present)

- Table with a number of possible solutions selected among precalculated simulations
  - Insulation system and (minimum) thickness
  - Internal surface temperature
  - U-value
  - Mould risk
  - Algae risk
  - Environmental impact
  - (Cost)

Insulation System	Insulation Thickness	Interior Surface Temperature	U-value	Mould Risk	Algae Risk	Environmental Impact
iso type 2	23	12 ±1.3	4.2	2 ±0.3	1 ±0.3	3 ±0.5
iso type 2	30	15 ±3.7	3.2	3 ±0.3	1 ±0.2	4 ±0.2
iso type 3	30	20 ±3.3	4.2	4 ±0.5	3 ±0.7	2 ±0.4
iso type 3	50	22 [illegible]	2.1	4.5 ±0.5	3.2 ±0.5	3.4 ±0.3
iso type 3	20	18 ±2.6	4.2	1.2 ±0.6	1.0 ±0.7	1.5 ±0.4
iso type 4	50	21 ±2.7	2.1	4.1 ±0.7	2.7 ±0.5	4.1 ±0.5
iso type 3	40	20 ±3.3	4.6	3.1 ±0.2	1.8 ±0.9	3.1 ±0.2

Prototype

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Detailed information

Insulation material

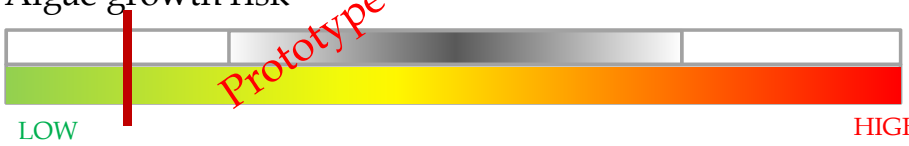
Mineral wool

Thickness

12 cm

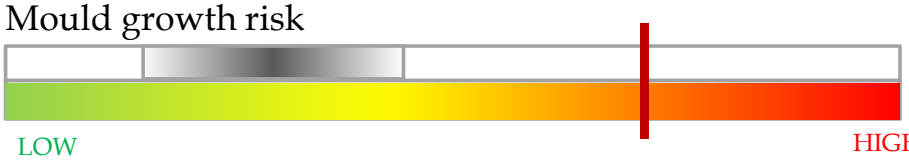
Heat loss reduction

Algae growth risk



Prototype

Mould growth risk



RIBuild Web tool – input and simulations

- Many systems
- Many inputs
- Simulations take time
- Has to be user friendly ⇒ no traditional simulations
- Catalogue of precalculated solutions
  - Similar situations describe what is most likely
  - The (lack of) accuracy becomes visible

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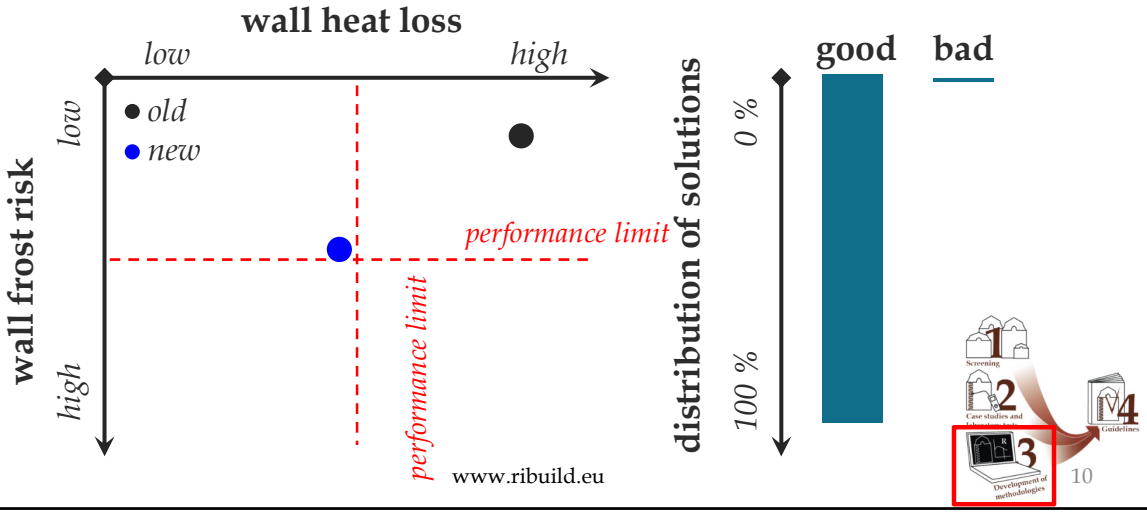
RIBuild Deterministic vs probabilistic assessment

Deterministic assessment of heat loss and frost risk



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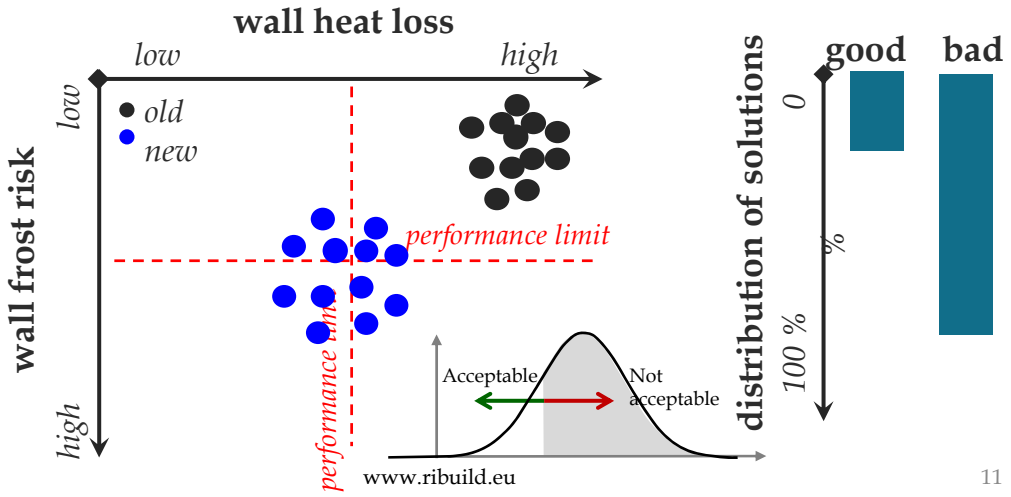
Deterministic vs probabilistic assessment

Probabilistic assessment of heat loss & frost risk



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Detailed information

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Thickness

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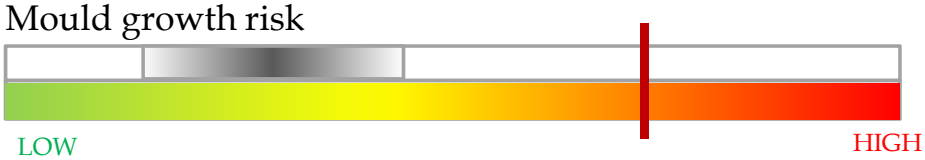
Heat loss reduction

Algae growth risk

Mould growth risk



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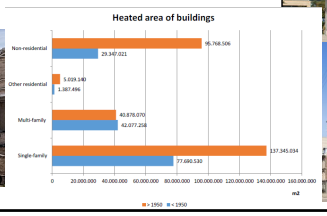
Typical materials in historic buildings

- The dominating **wall type** of historical building is brick masonry
- Stone walls and wooden frame walls are more rare
- The most common types of **mortars** and **plasters** used in historical buildings are made of gypsum and lime



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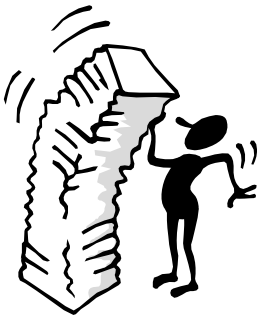
Sampling

16 Sample Parameters:

- Wall Core Material
- Wall Core Thickness
- Wall Orientation
- Plaster Thickness
  - Outside
  - Inside
- Plaster Material
  - Outside
  - Inside
- Exterior Climate
- Interior Climate
- Exterior Heat Transfer
- Exterior Vapour Transfer
- Solar Absorption
- Rain Scale Factor
- Interior Heat Transfer
- Interior Vapour Transfer
- Start Year

>80 Design Samples:

- Plaster
  - Exterior-Interior
  - None-Interior
  - Exterior-None
  - None-None
- Insulation Systems
  - Insulation Materials
  - Insulation Thickness
  - Interior Sd Value



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Systems for simulations

Wall Core Materials:

62 Bricks

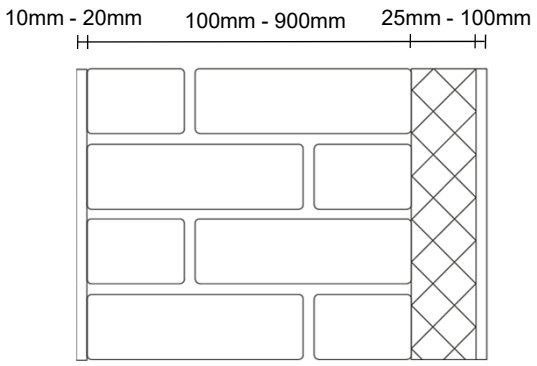
25 Natural Stones

Plaster Materials

11 Lime Cement Mortars

Insulation Systems

11 systems



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Inputs

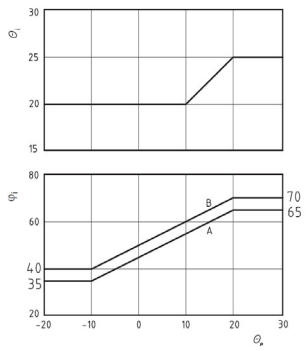
Weather Stations

Partner Countries

159 weather stations

Indoor Climate

EN13788 - Class A and B



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Inputs

Orientation

Degrees from North: 0, 360 [°]

Wind Driven Rain

Rain Exposure Coefficient: 0.0 - 2.0 [-]

Short Wave Radiation

Short Wave Absorption Coefficient: 0.4 - 0.8 [-]

Long Wave Emission

Long Wave Radiation Components: 0.9 [-]

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Inputs

Heat Conduction

Interior: Heat transfer coefficient: 5 - 10 [W/m^{2}K]

Exterior: Heat transfer slope coefficient: 1.0 - 4.0 [J/m^{3}K]

Vapour Diffusion

Interior and Exterior:

Moisture transfer coefficient: $4*10^{-9}$ - $10*10^{-9}$ x heat conduction

Initial conditions

Temperature: 20°C

Relative Humidity: 80%

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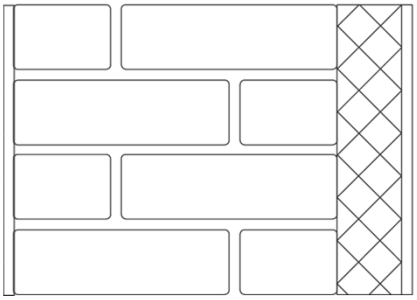
Simulations



- 1-D simulations with Delphin
- Simulation of 5 years

Probabilistic approach:

- Not all situations simulated but chosen by Sobol method (quasi - Monte Carlo)

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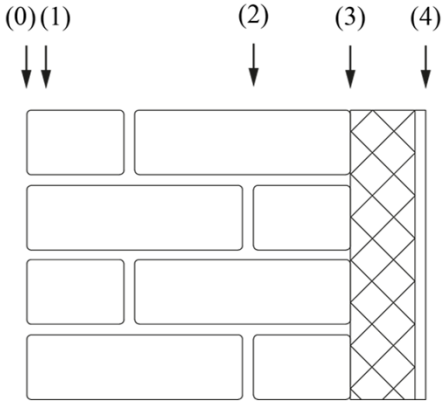
Output of simulations

Temperature and moisture conditions at

- (0): Algae growth (0.5 mm from outer surface)
- (1): Frost (50 mm from outer surface)
- (2): Wood Rot (50 mm from interface)
- (3) Mould growth (in interface)
- (4): Interior Surface (0.5 mm from interior surface)
- Heat Loss



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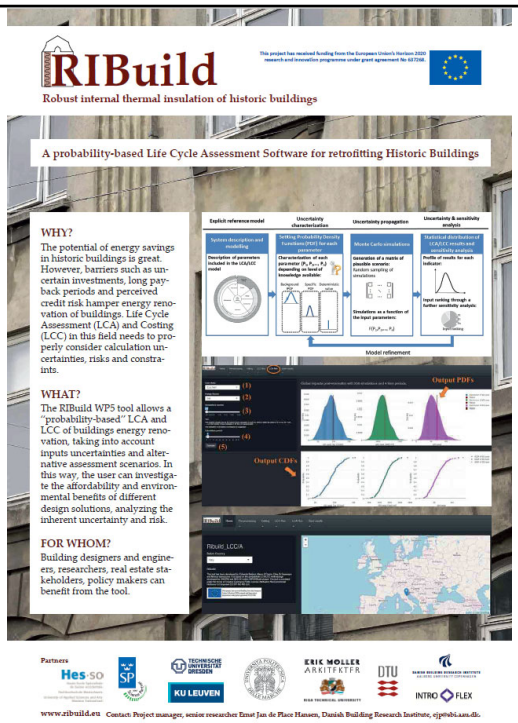
Probability based LCA/LCC tool



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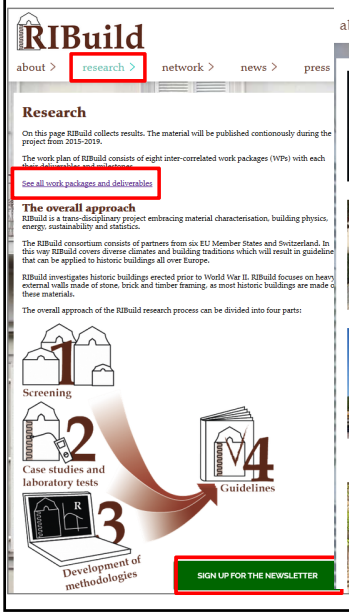
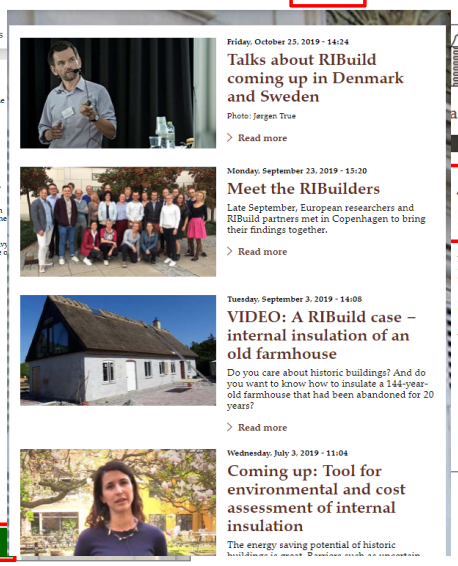
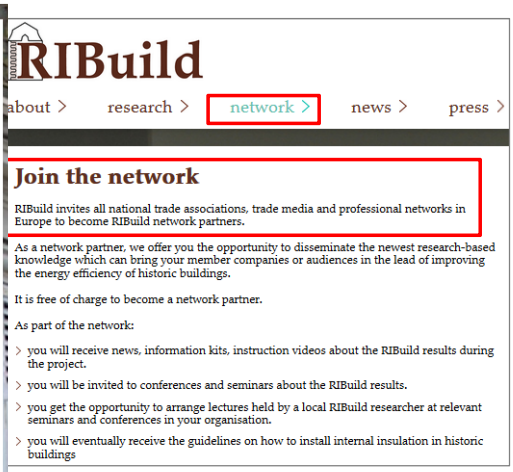
Project website – www.ribuild.eu







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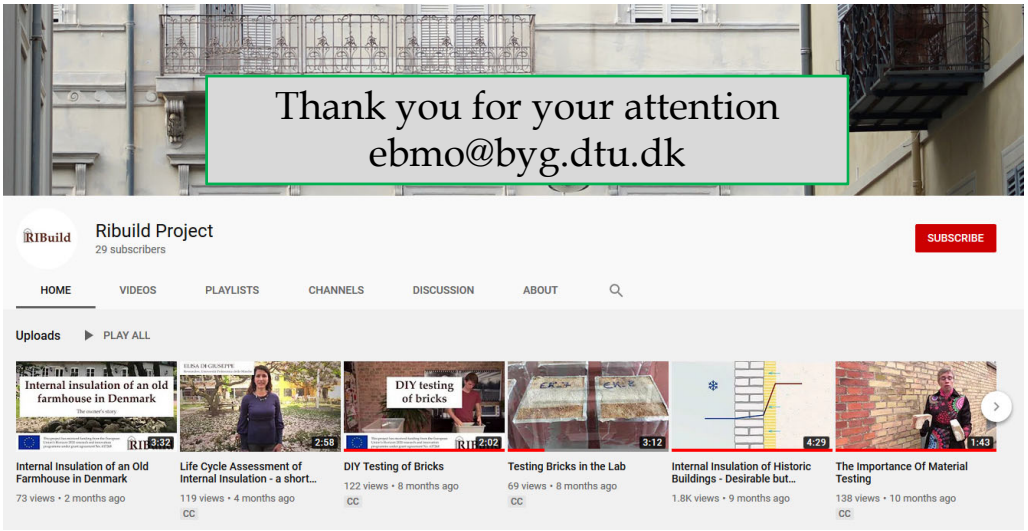
Videos on Youtube
(search for 'Youtube RIBuild')



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