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**Robust Internal Thermal Insulation of Historic Buildings**

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**Project Acronym:** RIBuild

**Deliverable no.:** -

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**Abstract:**

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# Table of Contents

<b>ABBREVIATIONS</b> .....	<b>3</b>
<b>1 INTRODUCTION</b> .....	<b>4</b>
1.1 TARGET GROUP .....	4
1.2 PURPOSE .....	4
<b>2 THE SURVEY AND ITS PARTICIPANTS</b> .....	<b>5</b>
2.1 APPROACH AND SIZE OF SURVEY .....	5
2.2 GEOGRAPHICAL DISTRIBUTION OF REPLIES.....	5
2.3 EDUCATIONAL BACKGROUND .....	6
2.4 FIELD OF WORK.....	6
<b>3 SUMMARY OF REPLIES</b> .....	<b>7</b>
3.1 EXPERIENCES WITH RETROFITTING WITH INTERNAL INSULATION .....	7
3.1.1 <i>Follow up</i> .....	8
3.2 CHALLENGES WHEN RETROFITTING WITH INTERNAL INSULATION .....	9
3.2.1 <i>Moisture safety</i> .....	10
3.3 ARGUMENTS FOR AND AGAINST RETROFITTING WITH INTERNAL INSULATION .....	10
3.4 GUIDELINES .....	12
3.4.1 <i>Existing guidelines</i> .....	12
3.4.2 <i>Contents of a new guideline for retrofitting with internal insulation</i> .....	13
<b>4 MAIN TAKEAWAYS AND PERSPECTIVES</b> .....	<b>15</b>
4.1 MAIN TAKEAWAYS FROM THE SURVEY .....	15
4.1.1 <i>Experiences</i> .....	15
4.1.2 <i>Challenges</i> .....	15
4.1.3 <i>Arguments</i> .....	15
4.1.4 <i>Guidelines</i> .....	15
4.2 PERSPECTIVES AND FURTHER WORK .....	15
<b>APPENDIX 1</b> .....	<b>17</b>

## Abbreviations

BBRI/WTCB/CSTC – Belgian Building Research Institute (BE)

BRE – Building Research Establishment (UK)

DTU – Technical University of Denmark (DK)

EnEV – Energieausweis und Energieeinsparverordnung für Gebäude (DE)

LCA – Life cycle assessment

LCC – Life cycle costing

PUR - Polyurethane

SBi – Danish Building Research Institute (DK)

STBA/SPAB – Sustainable Traditional Buildings Alliance/Society for the Protection of Ancient Buildings (UK)

TI – Technical Institute (DK)

WP – Work package

WTA – Wissenschaftlich-Technische Arbeitsgemeinschaft für Bauwerkserhaltung und Denkmalpflege (DE, NL, AT, CZ)

# 1 Introduction

This document describes an online survey carried out among stakeholders in the building industry to gain insight to their experiences with retrofitting with internal insulation and their wishes for a guideline on the subject.

The survey was conducted after the first public seminar, held in January 2016, inspired by comments from the participants, to get further insight into their experiences with retrofitting with internal insulation.

## 1.1 Target group

The primary target group was practitioners in the building industry with experience with internal insulation. Craftsmen, entrepreneurs, building owners and managers were encouraged to participate.

## 1.2 Purpose

The purpose of the survey was to gain knowledge about practical experiences with internal thermal insulation, identify what practitioners experience as the challenges and hear about their ideas for the new set of guidelines, e.g. features, focus points and output.

The survey has provided the project with knowledge of the primary target group for the guidelines: practitioners. It gives a sense of what is important when it comes to relevance for the target group. It will serve as input in the development of user-friendly guidelines.

## 2 The survey and its participants

### 2.1 Approach and size of survey

The survey has been available online since May 6<sup>th</sup> 2016. The survey was first available in Danish and English and distributed to the RIBuild partners, the RIBuild newsletter and the communication network of RIBuild. The network consists of approx. 55 organisations and media from the partner countries, approx. half of these are Danish organisations. Survey was distributed through LinkedIn and to some extent via communication partners.

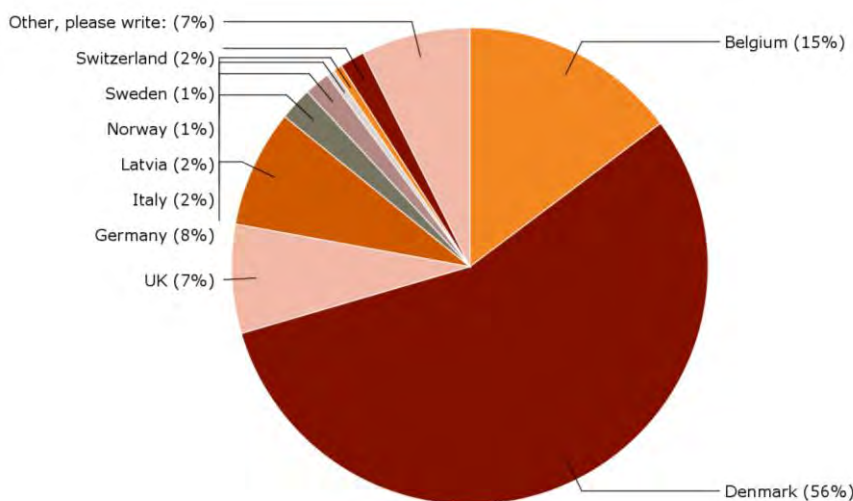
Response came mostly from Denmark, in a smaller degree from Belgium and a few responses from England as well. Only very few or no responses were received from the other partner countries. Shortly after the survey was translated into German and distributed to German contacts with assistance from TU Dresden – this resulted in a few German responses.

To obtain broader response from across Europe the survey deadline was extended until the midst of November and during September 2016 it was translated into Dutch, French, Italian and Swedish. It was not possible to get a Latvian translation within the given timeframe. The survey was once again distributed to all partners, to the communication network, via LinkedIn. The effort did not have a significant effect, only very few additional responses were achieved.

The replies were collected for analysis on November 17<sup>th</sup> 2016. In that period 158 complete replies were received along with 152 partial replies, which are also included in this report.

### 2.2 Geographical distribution of replies

176 participants answered which country they work in, the answers are shown below:



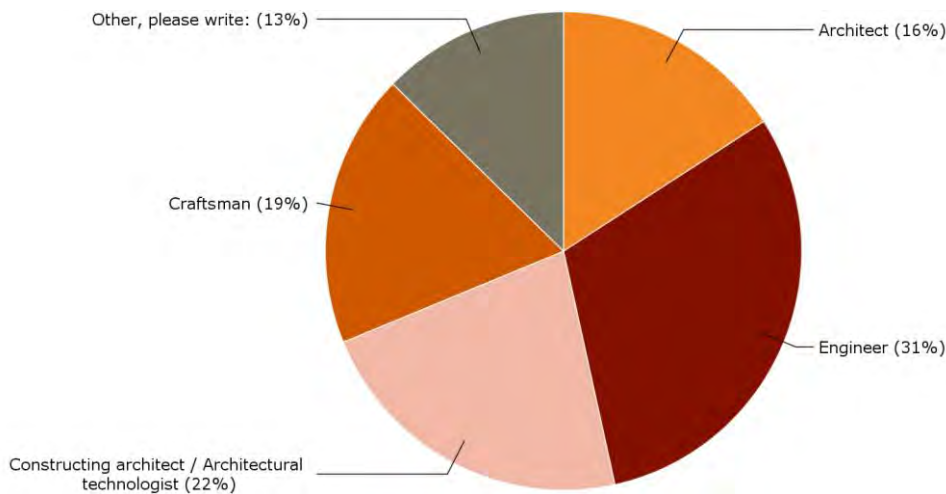
*In the category “other” the following were mentioned:*

- *Scotland*
- *U.S.A.*
- *Wales*
- *Canada*
- *Netherlands*
- *France*
- *Luxembourg*
- *Austria*
- *Spain*

We acknowledge that the distribution is not as even as we had hoped, with a majority being from Denmark, where we had more luck activating the local networks.

## 2.3 Educational background

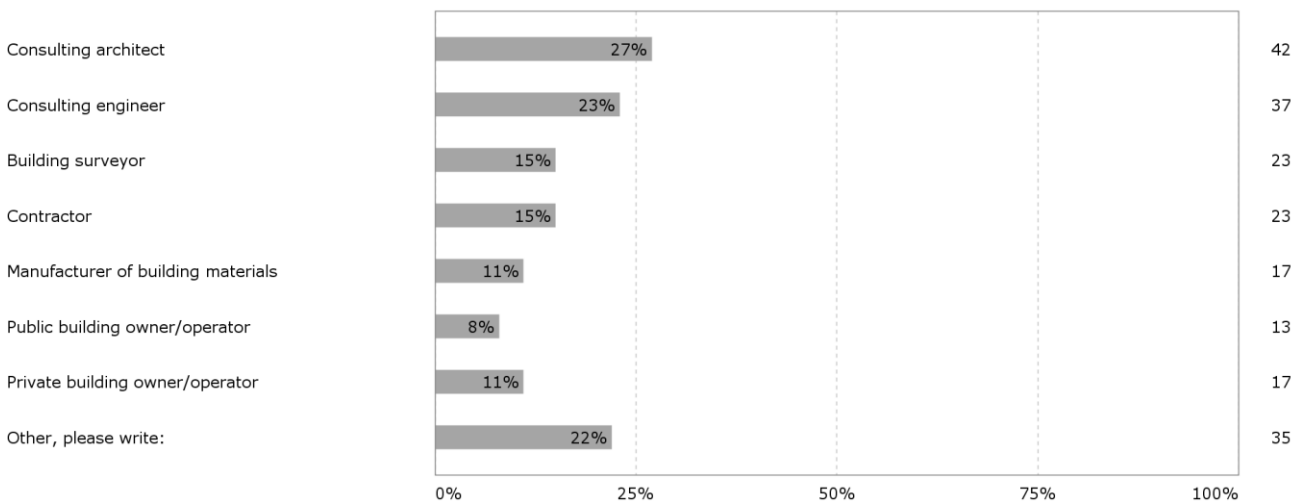
The educational background of the participants is quite evenly distributed in four main groups: architects, engineers, constructing architects and craftsmen.



The category “other” contains answers such as: energy consultant, operations manager, assessor, building surveyor, M.Sc. in Biology and M.Sc. Silv. Some additional answers were specifications within the main categories in the pie chart.

## 2.4 Field of work

The participants of the survey come from a variety of different occupations or fields of work. Half of the participants are either architects or engineers, but many other fields are represented as shown below.



More than 20% of the participants answered “other”, the fields of work mentioned more than once are as follows:

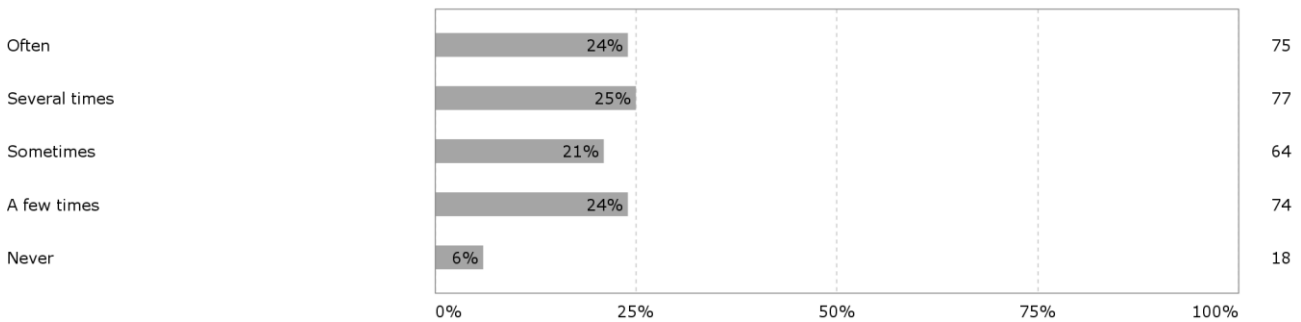
- Energy consultant: 7
- Research and education: 7
- Local government: 5
- Retail/distribution: 3
- Social housing: 3
- Insurance: 2
- Heritage protection: 2

### 3 Summary of replies

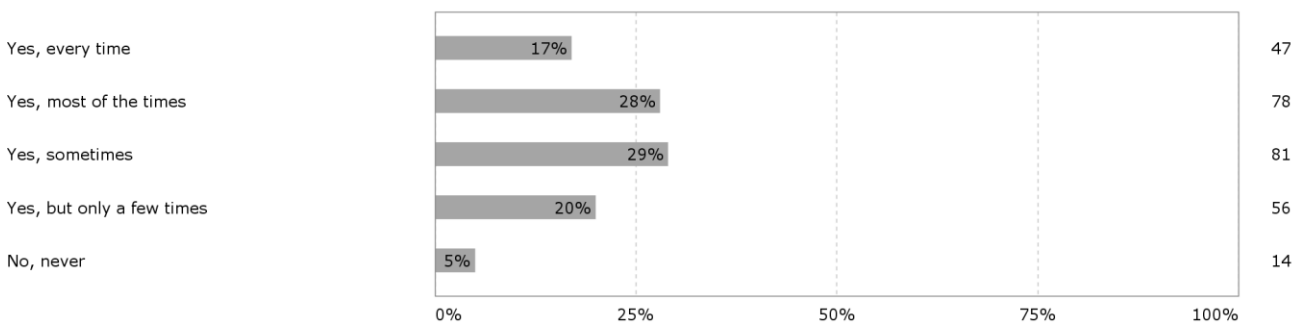
In this section we summarise the replies. Since many of the questions allowed for the participants to write in their own answers, the full answers have been included in this report as appendix 1. The appendix also includes indications of whether each question allowed for one or several answers.

#### 3.1 Experiences with retrofitting with internal insulation

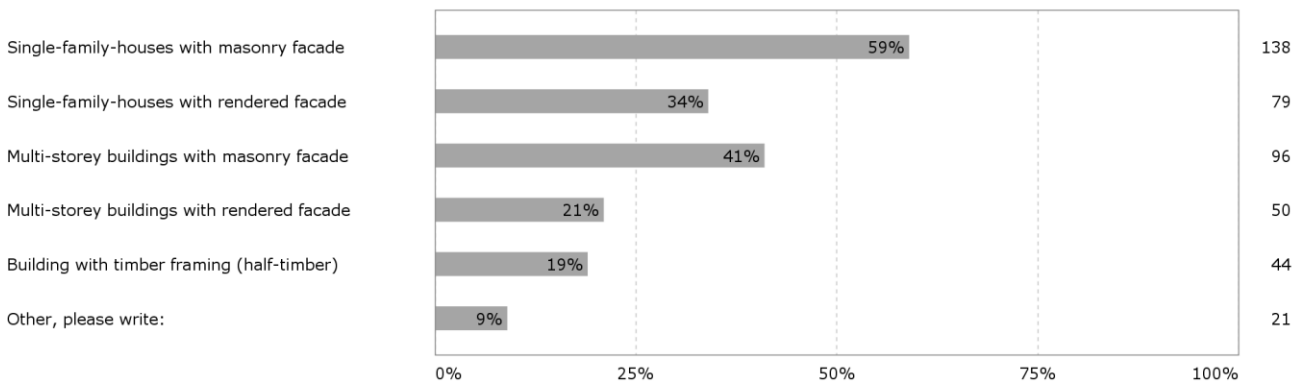
The first four questions treat the participants’ experiences with retrofitting with internal insulation. When asked if they have been involved in projects, where retrofitting with internal insulation was considered as a solution the answers were distributed quite evenly as shown below.



We then asked if the retrofitting with internal insulation was realised the majority answered “most of the time” or “sometimes” while only 5% answered “never”.

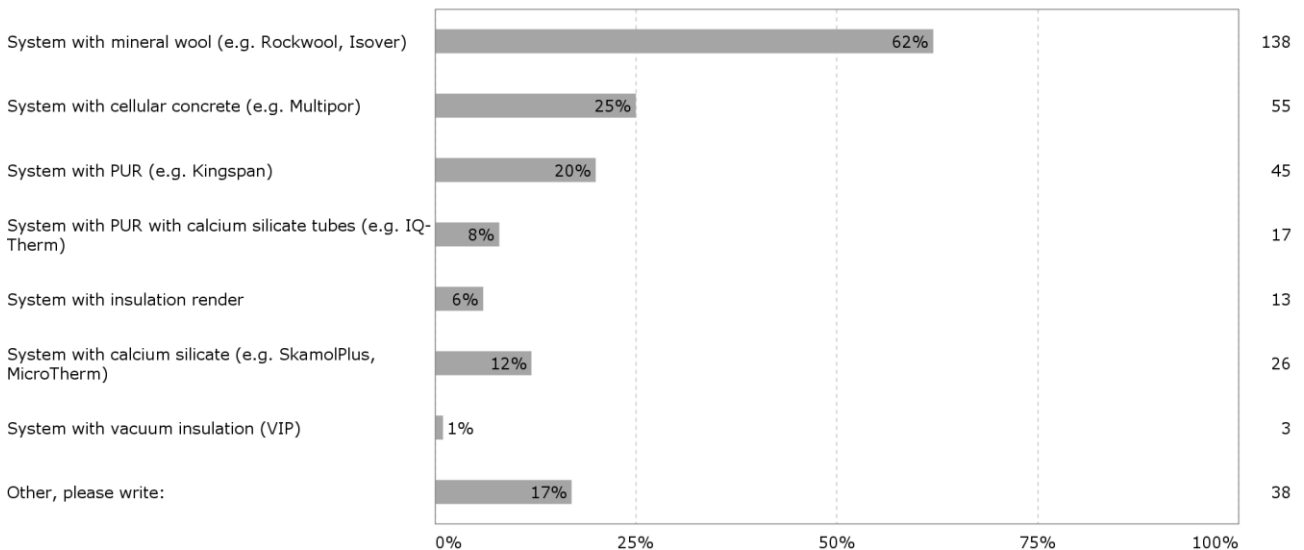


To examine in which types of buildings the retrofitting with internal insulation was realised we asked the participants to indicate which of 5 categories below they had worked with. We see a clear picture of buildings with masonry façade, both single-family and multi-story, being in majority.



Other types mentioned: Houses built of boulders, workshop/barn, basements, terraced houses in different materials (brick faced walls, concrete with wood facing, roof renovation) and tower blocks in concrete and tower blocks with lime washed façade.

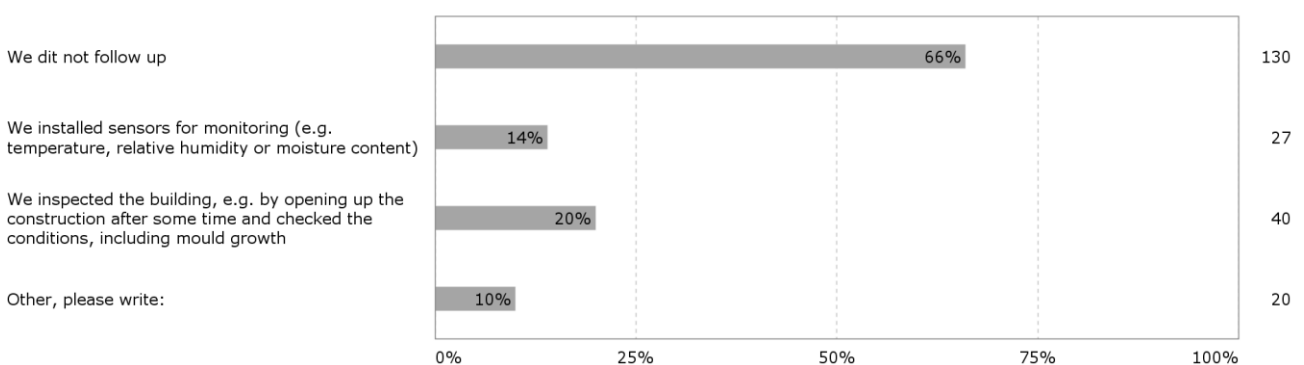
We also asked the participants which insulation systems were used in the buildings they had worked with. A clear majority answered the traditional solution with mineral wool, but several additional methods than the mentioned showed up among the 17% answering “other”.



In the “other” category 16 participants answered paper wool, cellulose or wood fibre as bats or boards. 6 answered polystyrene as boards or granules. 3 answered a hemp-lime mixture and 3 answered insulation clay.

### 3.1.1 Follow up

When asked how they followed up on the performance of the applied internal insulation, a large majority answered that no follow up procedure was performed.



Other answers: 6 answered visual inspection, 3 answered subjective evaluation by client/inhabitant, 3 answered that they have not reached far enough in the process to perform follow up yet.



## 3.2 Challenges when retrofitting with internal insulation

Many different challenges are mentioned by the survey participants. The survey initially mentions these examples: challenges of technical character, challenges in the cooperation, missing information, lacking knowledge. Below is a table of the challenges most commonly mentioned by the participants:

Challenges	No. of replies
Vapour barrier, humidity or mould	46
Lack of knowledge	38
Difficult details, fittings, joints	23
Problems with collaboration or the working relationship with other stakeholders	19
Technical or constructional issues	18
Lack of preparation or survey of existing conditions	17
Lack of experience (in particular among the craftspeople)	14
Timber frame ends	7

Examples of challenges described in the survey:

“Adhesion for different systems on different substrates without creating any thermal bridges”

“Missing understanding among the craftsmen as to the important and critical element, that there has to be a homogenous connection (adhesive coverage) between the base and the insulation.”

“Avoid vapour barrier, know the moisture characteristics of the materials, especially the moisture equilibrium. Avoid high insulation thickness (listed buildings)”

“A lack of knowledge about moisture migration, mould growth and mounting techniques.”

“There is a lack of knowledge in regard to not overly insulate the walls and that they need to be diffusion-open.”

“Knowledge & understanding of traditional building retrofit principles (e.g. moisture, ventilation, airtightness etc.) & application details”

“Internal insulation of existing buildings is a very difficult and challenging discipline. There are many circumstances in evidence during planning and execution. Even after occupancy. The wrong paint can “destroy” the construction. It can also be difficult to assign a particular product and the contractor exchanges it for a cheaper alternative. This can also cause a future unhealthy construction.”

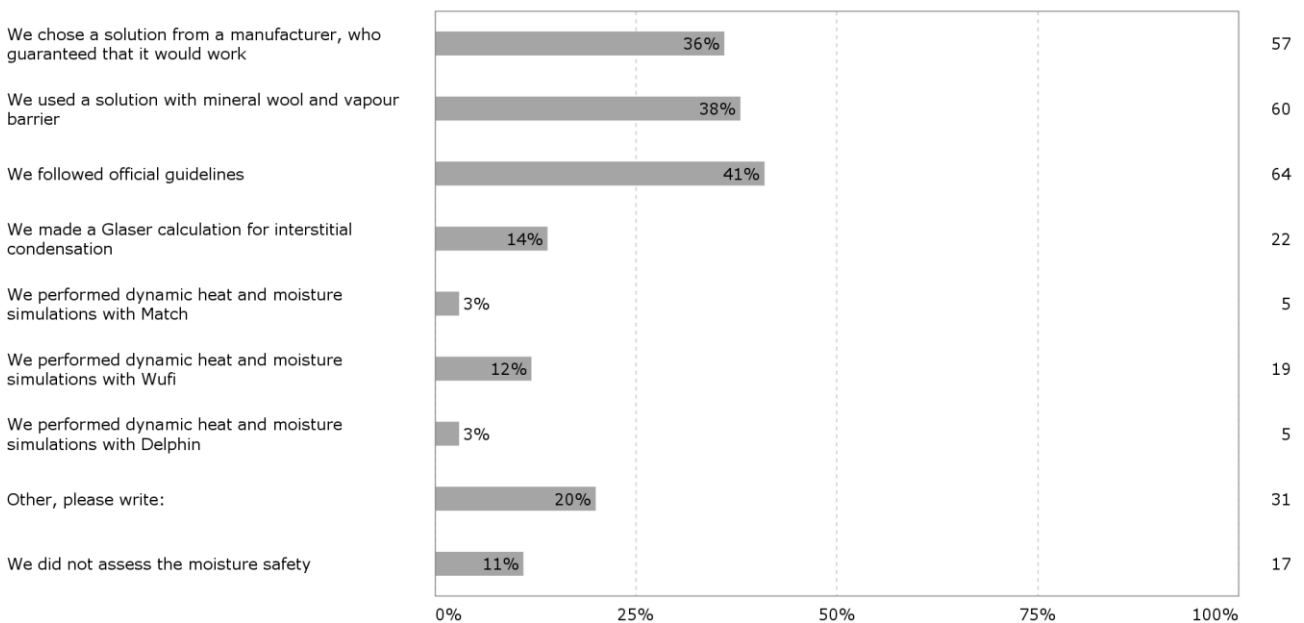
“Lack of information and warranty. Finding any meaningful systems is difficult. And if one is found, the manufacturer is not ready or able to make concrete statements or even give function guarantees. You are on your own”.

“Complex thermal bridge calculations. Material characteristics of existing masonry not known. Water absorption of visible brickwork. Software for two-dimensional hygrothermal

simulations is complex and not sufficiently user-friendly, need for improvement in material databases”

### 3.2.1 Moisture safety

Since moisture for many researchers is the main concern when working with retrofitting with internal insulation, we asked in particular how it was assessed in the design phase if a given solution for internal insulation was moisture safe.



Among the 20 % answering “other” these were the most common answers:

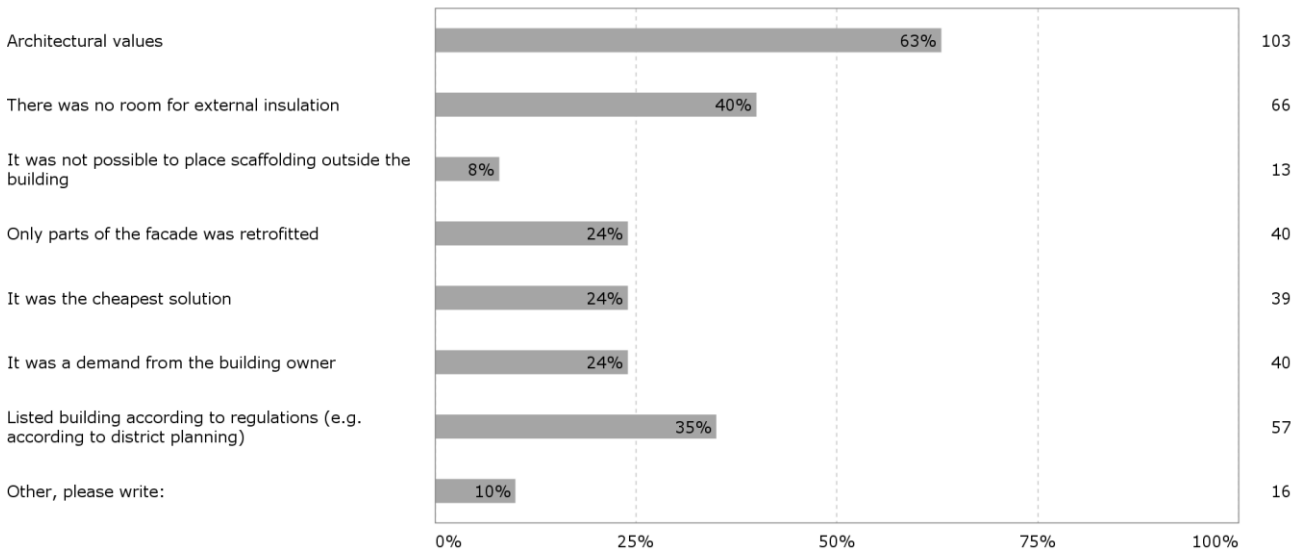
- Experience: 6
- Calculations/simulations/measurements: 8
- Inherent material properties: 6

The participants were asked if they had further comments regarding the moisture safety of internal insulation, recurrent themes were:

- The construction needs to be able to “breathe”: 8
- Internal insulation is not recommendable: 8
- Remember ventilation: 3
- Be aware of the impact of driving rain: 3

### 3.3 Arguments for and against retrofitting with internal insulation

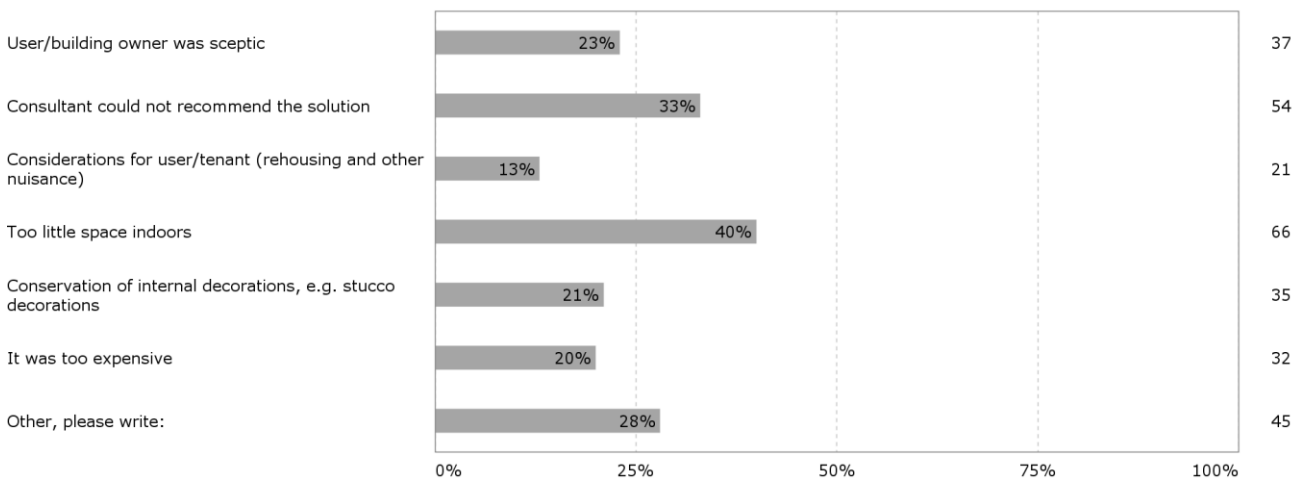
To get a better understanding of why a solution with internal insulation was chosen or rejected the participants were asked to indicate arguments for and against internal insulation. The majority answered that architectural values was a main argument for choosing internal insulation or that the building was listed and external insulation therefor was prohibited, but lack of space for external insulation was also indicated as a common argument for internal insulation.



Other arguments for internal insulation were:

- Price: 3
- Regulations/demands/legislation: 4
- Elimination of cold walls: 2

When asked which arguments against internal insulation were used lack of space was mentioned as a common reason. Scepticism from both building owners and consultants is also mentioned as a common argument against.



Of other arguments against internal insulation the following were mentioned:

- Moisture/mould: 9
- Lack of experience with or trust in the method: 6
- Too difficult, especially the detailing: 6
- Risk of thermal bridges: 3

Furthermore 13 participants mentioned that there were no arguments against internal insulation.

## 3.4 Guidelines

In order to get a better view of what is needed in the new guidelines that the RIBuild project wishes to produce, the participants were asked both which guidelines they already use and which preferences they have in regard to the content and form of the new guidelines.

### 3.4.1 Existing guidelines

When asked if they knew any guidelines regarding retrofitting with internal insulation 46% of the participants answered no, 54 % answered yes, and the following were mentioned:

- BYG-ERFA (technical leaflets): 30 (DK)
- SBi: 27 (DK)
- Guidelines from manufacturers: 17
- BBRI/WTCB/CSTC: 5 (BE)
- WTA Merkblätter: 10 (DE, AT, NL, CZ)
- STBA/SPAB: 4 (UK)
- BRE: 2 (UK)

Other sources of guidelines mentioned are: TI and DTU from Denmark, Fraunhofer, Dresden University and Passipedia from Germany, UCL, British Standard, Retrofit Academy from United Kingdom and ANIT from Italy.

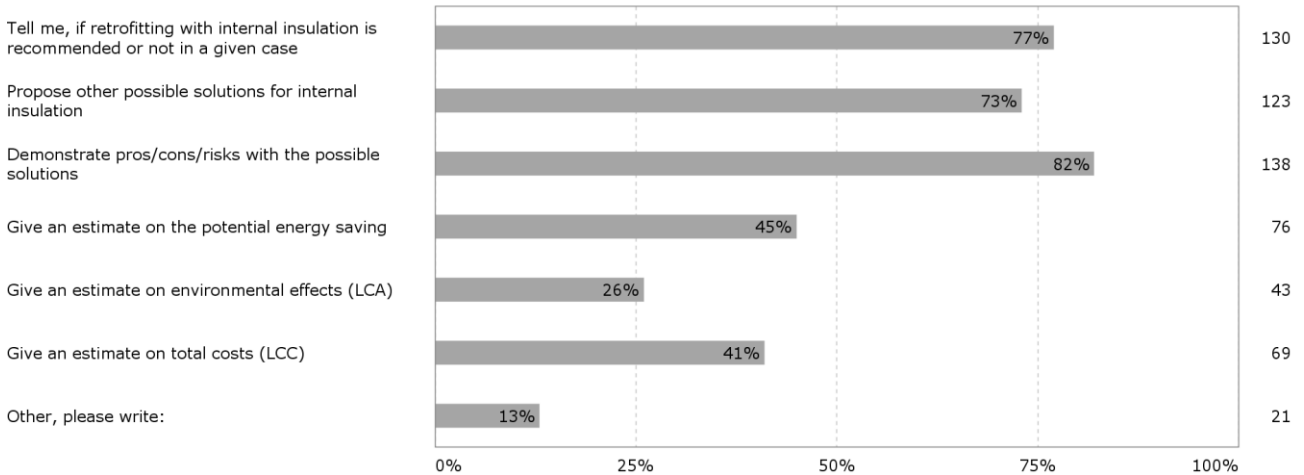
When asked if they knew any guidelines regarding improving energy efficiency of historic buildings 70 % answered no, the 30 % who answered yes mentioned the following:

- [www.historicengland.org.uk](http://www.historicengland.org.uk) and [www.historicscotland.org.uk](http://www.historicscotland.org.uk) : 4
- EnEV: 3
- STBA/SPAB: 3
- Kulturstyrelsen: 3
- [www.bygningskultur.dk](http://www.bygningskultur.dk): 2
- [www.bygningsbevaring.dk](http://www.bygningsbevaring.dk) : 2
- [www.byggeriogenergi.dk](http://www.byggeriogenergi.dk) : 2
- Guidelines from manufacturers: 2
- Own experience: 2

To read the total list of answers please see appendix 1.

### 3.4.2 Contents of a new guideline for retrofitting with internal insulation

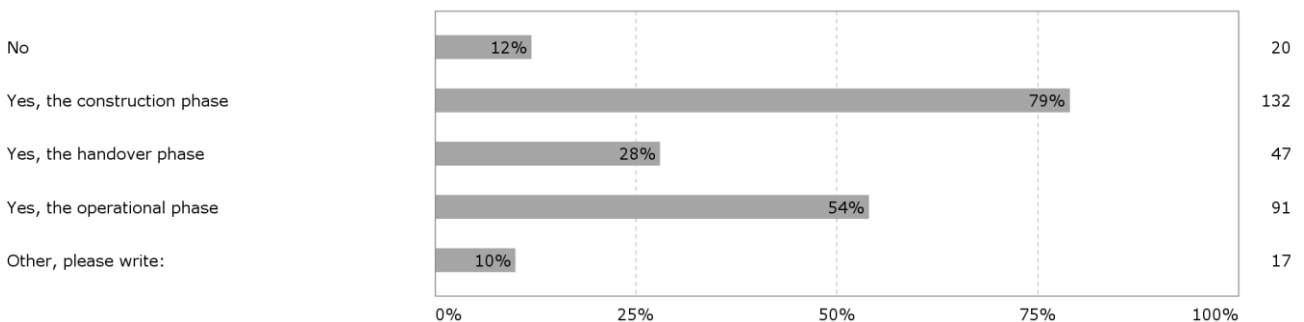
To gain input as to what content the participants prefer in a guideline/tool for retrofitting with internal insulation, they were asked to prioritise the content types below.



Most of the participants wish for the content to focus on choosing which if any solution is preferable and listing pros and cons, while the environmental factors (LCA and LCC) are deemed less important. Other content areas mentioned were:

- Be certain/legally binding: 3
- Describe the execution: 3
- Describe particular measurements or technical issues: 4
- Be holistic: 2
- Contain not only the conservative solutions: 2

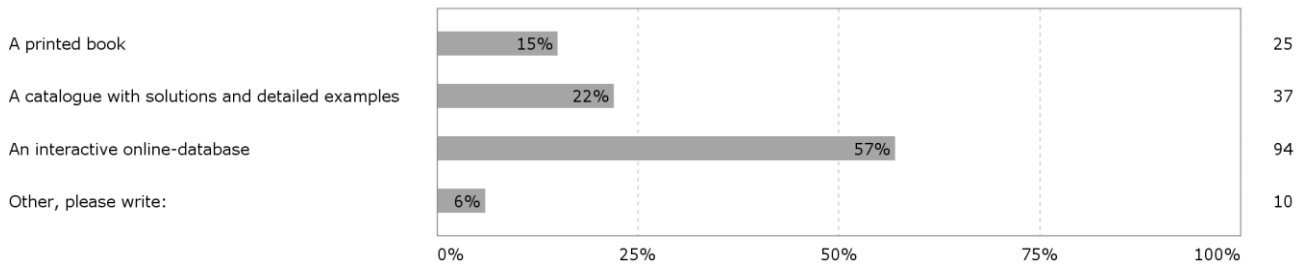
To find out whether the tool should include guidelines to other phases of building process than design, the participants were asked to indicate which, if any, as shown below.



A large majority wish for the construction phase to be included and more than half also mention that the operational phase should be included. Other phases mentioned were:

- Inspection and preparation of existing conditions.
- The quality assurance process.
- The operational phase and post-occupancy inspection.

The participants were also asked in which form they would prefer the guidelines. A majority indicated that an online database was preferable, as seen on the following page.



The answers in the “other” category mostly express the wish that the guidelines should be a book combined with an online database or an app.

Some recurring themes, when the participants were asked to write ideas and suggestions to the content or functionality of the future RIBuild guideline/tool for retrofitting with internal insulation, were:

- The guideline should have step by step (preferably interactive) recommendations and guides for choosing and performing the right solution in practice.
- Practical examples, lab tests and showcases would improve the guidelines as would connections to other guidelines (asbestos, radon, mould etc.).
- The guideline should include new and unconventional materials and solutions, and be prepared for new solutions emerging.
- Take climate and driving rain into consideration
- Be short and concise
- Include calculators and simulations in regard to U-values, moisture etc.

## **4 Main takeaways and perspectives**

### **4.1 Main takeaways from the survey**

#### **4.1.1 Experiences**

A similar number of participants had been involved with projects where internal re-insulation was considered either often, several times, sometimes or a few times. The participants stated that the internal re-insulation was realised most of the time or sometimes. The majority of the buildings where it was realised had masonry facades. The chosen solution was primarily mineral wool (62%) while cellular concrete or PUR solutions were used in 25% and 20% of the cases. In general many participants (66%) did not perform any follow-up.

#### **4.1.2 Challenges**

The main challenges mentioned were vapour barriers and humidity, lack of knowledge, difficulties collaborating and the solutions being difficult to execute in particular the details. It was anticipated that moisture safety would be a prominent challenge; when asked how this was handled most participants answered either through manufacturer guarantees, by using traditional systems with mineral wool and vapour barrier or by using official guidelines.

#### **4.1.3 Arguments**

Main arguments for choosing internal re-insulation were architectural values, lack of room for external insulation or that the building was listed.

Main arguments against were: lack of room for internal insulation, the consultants advising against it or scepticism among users or building owners.

#### **4.1.4 Guidelines**

46% of the participants had no knowledge of guidelines regarding retrofitting with internal insulation while 70 % had no knowledge of guidelines regarding energy efficiency of historic buildings.

Most participants wanted guidelines describing pros and cons and helping to choose if and how an internal insulation should be performed. Besides the design phase the participants would like the guideline to also describe construction and operation/maintenance.

The guidelines should have an interactive online tool, with step by step advice and practical examples.

## **4.2 Perspectives and further work**

The survey shows a lack of knowledge about and scepticism towards retrofitting with internal insulation – this underlines the necessity of the coming guidelines. But it also points to a need to

spread knowledge about internal insulation and the final guidelines. Many rely on manufacturers and/or existing official guidelines – this should be taken into consideration in the dissemination strategy. Not only trade organisations and media, but indeed manufacturers could also play a considerable part in the dissemination.

The survey suggest that a major part of practitioners do not perform follow-up despite many participants also mention how difficult proper execution is – this should maybe considered in the guidelines.

When asked about the challenges the respondents point to, besides technical issues and lack of knowledge, problems with collaboration with stakeholders. Maybe process, collaboration and roles should be considered as part of the guidelines. A parallel can be drawn from this need for collaboration between stakeholders to the many participants mentioning that the operational phase is very important to include.

A large majority wish for the construction phase to be included – this calls for a need for instruction guidelines on how to install internal insulation This should be considered, while it might not be the purpose of RIBuild, it should still be a further perspective of the project.

In regards to the form of the guidelines the survey points towards that the target group prefers a digital tool – this supports the choice of making an interactive online tool.

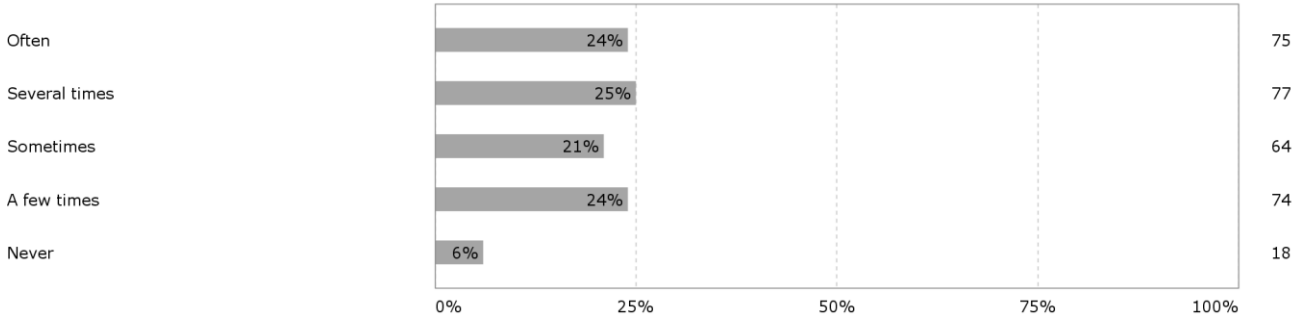
We have obtained a lot of contacts to respondents who will be happy to provide us with further insights from the practitioners' side. We could bear these in mind and consider including these contacts in tests of the online tool.

We also received many useful comments in regards to important areas to examine and other tools to look into e.g. the STBA guidance wheel <http://responsible-retrofit.org/wheel/>.

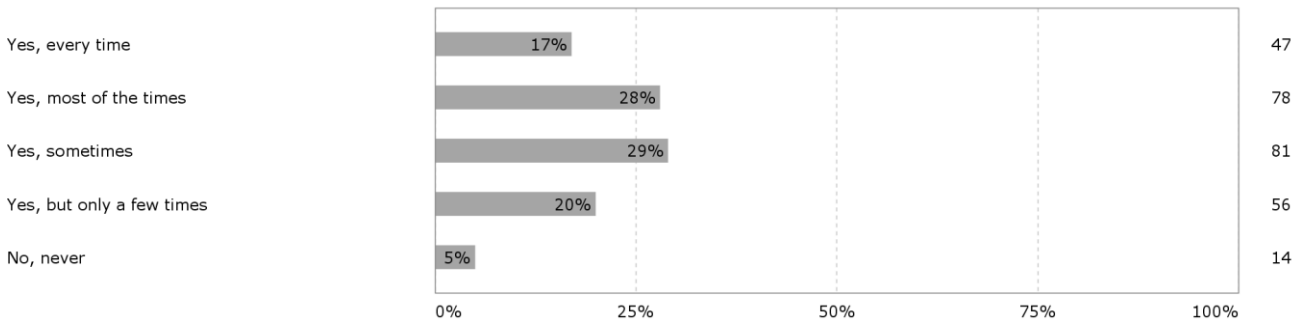


# Appendix 1

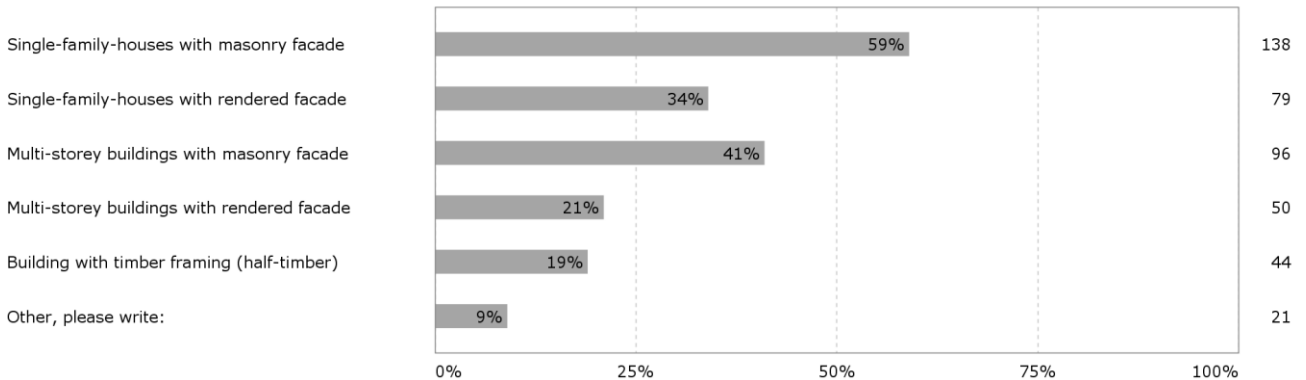
## Have you been involved in projects, where retrofitting with internal insulation was considered as a solution? (one answer)



## Was the retrofitting with internal insulation realised? (one answer)



## In which type(s) of building(s) was the retrofitting with internal insulation realised? (multiple answers)

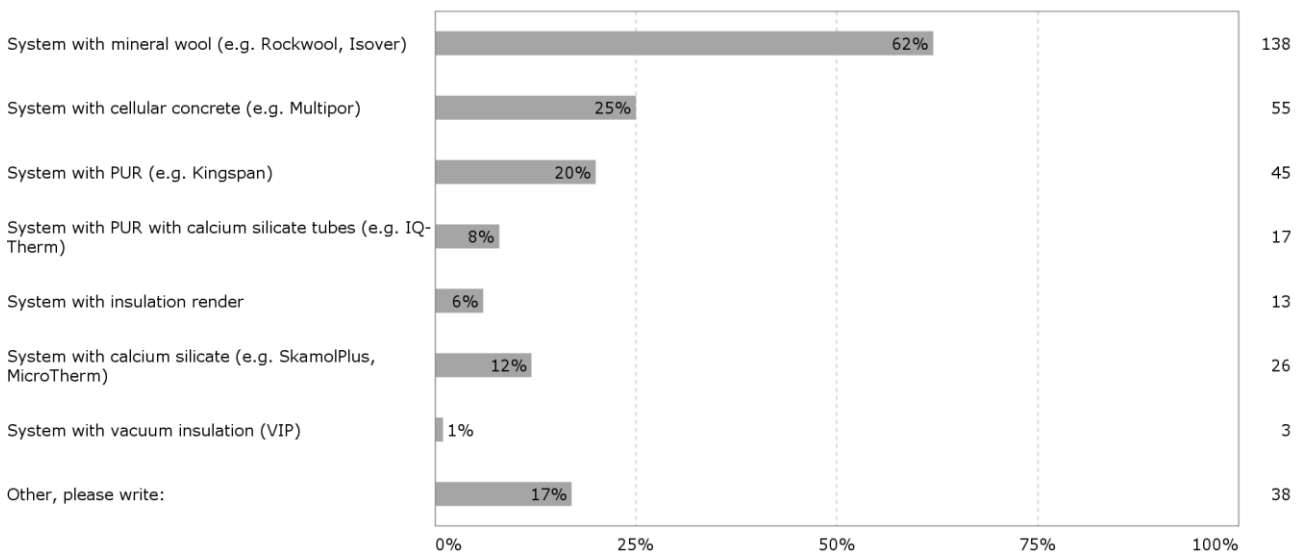


## In which type(s) of building(s) was the retrofitting with internal insulation realised? - Other, please write:

- Property built of boulders
- Country properties with plaster and boulders
- Workshop/barn
- Concrete elements
- Semi-detached house with brick face wall
- terraced house in concrete with wood facing
- Basement

- Roof renovation of detached houses
- Public and commercial buildings
- Houses in aerated concrete
- Exterior basement walls made of concrete
- Tower block, precast construction, concrete
- Tower block with lime washed facade
- Terraced houses made from light concrete
- Basement with both visible and covered façade
- Moulded basement walls
- Hospital
- refurbishment of single family house
- public offices with masonry facade
- Cast solid concrete
- hospital

### Which system(s) was/were used? (multiple answer)

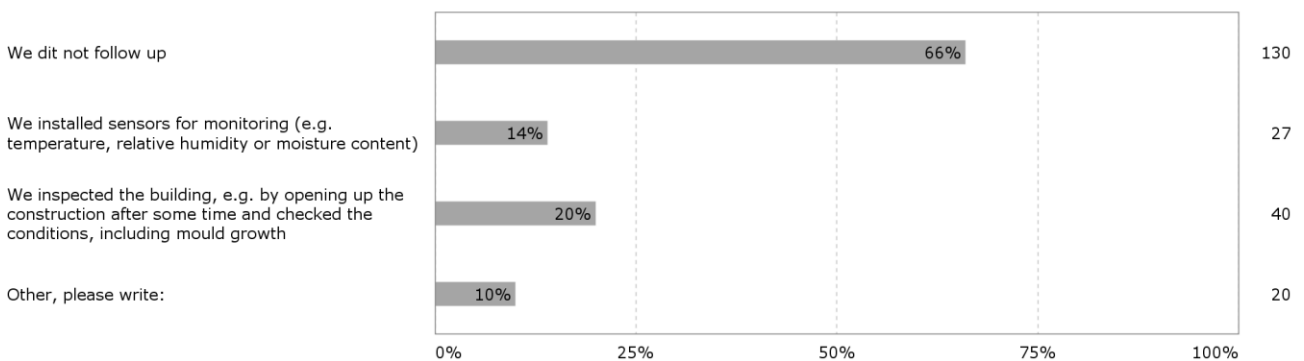


### Which system(s) was/were used? - Other, please write:

- Paper wool insulation
- Hemp and lime plaster from Hemp Eco Systems
- Steico wood fibre boards and lime plaster (Lime Green Warmshell)
- Gypsum wall with Rockwool
- Thermofloc boron-free paper insulation
- Cavity wall, interior gypsum/light concrete and insulation granulate and bats
- Is Multipor not a calcium silicate board?
- Fermacell thermal wall with InotanPUR
- internal secondary wall with insulation
- cellular glass
- Gypsum, wood panelling
- aerogel, cellulose, perlite beads
- pre-cast, pre-dried hemp lime tongued and grooved internal wall panels
- Isoperl/ polystyrene

- Hemp insulation mats on laths
- wood fibre insulation
- Polystyrene granules with wall ties.
- Erfurt KlimaTec cellular glass granules and special interfacing
- Gypsum board with PUR-foam by Danogips
- Hemp concrete
- EPS pearls
- Cellulose
- cellulose, wood fibre, ...
- EPS XPS
- thermofloc
- mix of wool and PUR
- Hemp-lime mixture or paper wool insulation.
- New
- Wood fibre insulation
- Heat insulation clay, Wood fibre boards
- Wood fibre
- Heat insulation clay
- EPS
- soft wood fibres
- Insulation clay, wood fibre insulation
- Spray-on cellulose
- cellulose
- wood fibre insulation, with lime moisture buffer layer

### How did you follow up on the performance of the applied internal insulation? (multiple answers)



### How did you follow up on the performance of the applied internal insulation? - Other, please write:

- Calculations
- Positive statement from private contractor in regards to the result
- Was dismantled after water damage
- Self-monitoring etc.
- External inspection at 1-year review
- We have not reached that point yet
- A follow-up did not indicate a need for destructive inspection
- Visual follow-up

- Have not performed, only observed
- On-going
- Visual inspection of surfaces later on
- Our method cannot cause mould!!!
- Interim moisture measurement
- No registered problems
- Inhabitants subjective evaluation of air quality, odour etc.
- visual and smelling
- buildings are in construction, inspection will be done in the future
- Control at 1-year review
- IR-thermography
- user survey

**What challenges did you experience in the process? For example: challenges of technical character, challenges in the cooperation, missing information, lacking knowledge? Please write:**

- Consultant paradox... the client asks the consultant, the consultant answers and the client does whatever he pleases
- there was a need for extra supervision, since there was no experience with this building technique
- It was difficult to seal correctly when using ex. Rockwool and a vapour barrier. Especially sealing between vapour barrier and external wall
- It has to be insured that moisture never gets in behind the wall
- There seems to be an attitude that RH is not allowed to exceed 75 % and if it does so it is tantamount to risk of mould growth etc. We believe that this is heavily historically influenced by this main rule that has been in force for several years when performing internal insulation with shuttering , laths, mineral wool, vapour barrier, gypsum boards. This rule is not in force when using capillary active internal insulation like IQ-Therm, since RH in the beginning (year 1) of 95 % is not a risk provided that the façade is relatively dry, that is a saturation below 30 %. This condition should be addressed since it is a general attitude that RH is not allowed to exceed 75 %.
- Insulation was not fully glued so the work had to be redone.  
Craftsmen did not perform quality control in regard to adhesive coverage etc. in spite of underlining in basic contract.  
Construction management team disregarded supervision of adhesive coverage etc. in spite of it being highlighted at start-up meeting.  
Craftsmen were not instructed in the suppliers' specifications in regard to mounting internal insulation products.
- Insufficient knowledge – e.g. "mould growth phobia" when RH is high in brickwork, which is not critical when air pockets and organic material isn't present
- some minor technical issues
- Moisture technical challenges, implementation challenges and problems handling the amount of material soundly.
- We did not really have any "challenges"
- Difficulties joining the vapour barriers
- We received a refusal from the Copenhagen municipality in one case in a multi-storey building owing to fire technical issues. We regard it as being grounded in lack of knowledge.

- Protection of the facades against rain, abutment protection
- Mould growth behind a secondary wall ?
- lack of knowledge and strong doubts of construction workers because of Glaser-procedure results which were negative  
doubts of building owners because of high material costs
- missing information
- None in particular.
- Cost of monitoring
- Moisture
- Have not experienced any
- none
- The product was improbably poor to work with, incredibly expensive and the requirements for execution were impossible to live up to.
- Renovation performed in 1975. Massive mould growth behind a secondary wall. Cause: no stripping of old wallpapers and paints. Furthermore an older layer of asphalt directly on the wall behind the plaster. Secondary wall built with timber framing, mineral wool and gypsum.
- Technical inspection of execution
- Constructional challenges
- In alterations we have experienced that organic material often has not been removed from inner walls (wood, wallpaper etc.) before internal insulation. This have caused mould growth, rot, and fungi occurrences.
- Conservative attitudes towards re-insulation in general  
Public authorities and institutes are NOT open towards other choices than mineral wool inc. SBi in particular. Does not wish to exchange experiences with other products – sad, but true.
- Too lopsided walls for Multipor when full adhesion is required
- Some uncertainty in regards to dew point in the basement where the work was taking place.
- To secure that the insulation is placed properly
- None
- One has to remember to take installations into account likewise fittings and flashings
- In the project it was decided earlier to mount beads on the original wall and attach gypsum boards to these. I suggested to the client that we mounted 75 mm porous concrete for regulating the wall. It gave a very nice result and I do not believe in mould problems. All things being equal the indoor climate of the house did improve compared to what it was earlier.
- Supplier-neutral data, instead of it mainly being the individual supplier who only highlights their own qualities
- Technical knowledge. Such as simple dew point calculators for constructions. The physical placement of the building – urban/rural. Detail solutions for other building elements. Other possible solutions than gypsum/mineral wool – and which challenges these pose – e.g. Simple mounting/fastening on these materials (the users' expectations for application)
- we have performed the works following the instructions we could find, but always as the final resort, since it is an unsafe solution
- There is a lack of knowledge in regard to not overly insulate the walls and that they need to be diffusion-open. I know of architects who renovate listed buildings without knowing what a calcium silicate board is!
- It was several years ago

- I only recommend internal re-insulation on walls that are not damp. Maximum recommended insulation thickness is normally 50 mm, in some cases maximally 100 mm.
- Bad pipe flanges. Protests against loss of carpet area.
- Execution of a tight vapour barrier
- One problem has been my focus on operation of ventilation system in relation to re-insulation of both facade and roof
- Problems with vapour barrier/venting
- Tight vapour barrier, Small cracks in corners and joints (dry cracks)
- Thermal bridges along the edges of the work. Drastical praises from salespersons.
- Constructional challenges
- None
- Removal of mould if necessary and remains of organic material (typically wallpaper) is time consuming. The supervisor must have great attention on the tightness of connections, electrical and heating installations! A lack of knowledge among the contractors. The working relationship with the owner, and the measurer of internal dimensions.
- A lack of knowledge among the project supervisors, economy is more important than the right solution.
- Missing understanding among the craftspersons as to the important and critical element, that there has to be a homogenous connection (adhesive coverage) between the base and the insulation. That is no cavities where mould growth can occur.
- Very difficult to carry out the right solutions, where the exterior walls have uneven thickness, e.g. Due to previous renovations.
- Multi-storey building: moisture impact on floor joists resting in the brickwork. Tar layer on the inside of roughcast brickwork what has been covered in plaster. When removing windows and the building was cooled it resulted in blown plaster that fell off when processing. Maximum insulation in regards to the risk of external frost erosions.
- None
- None. We just carried out the work as best as we could using our experiences
- I am often called to inspect older houses with mould problems. If there is internal re-insulation that is always the first place I look.
- Avoid vapour barrier, know the moisture characteristics of the materials, especially the moisture equilibrium. Avoid high insulation thickness (listed buildings)
- In basement: moisture and mould  
Half-timbering: moisture and mould  
Brickwork above terrain: none
- None as yet
- . Problems with suspended floors with timber joists, rot in timber joists set in brickwork – External insulation is not possible for listed or preservation-worthy buildings.
- Internal and external detailing.  
room dimensions  
access,  
aesthetics  
determining the condition of the existing structure
- All challenges could be handled smoothly. To verify the layers that were chosen, we used WUFI. The results have been shared with all the participants, so everybody could understand what we were doing to the building.
- A lack of understanding that internal insulation might trigger mould inside the construction.

- Knowledge & understanding of traditional building retrofit principles (e.g. moisture, ventilation, airtightness etc.) & application details. Affordability. Timescales. Value for money. Replicability.
- Resistance from conservation officers and requirements for insulation from building control officers. Two departments of the same local government organisation working in different directions.
- n/a
- Dealing with potential dampness and ventilation of existing structure.
- None
- On one project we wanted to use a wood fibre vapour open system of IWI, however the guarantee provider would not accept this option and so we had to use an independent liner with an air gap
- To establish an air-tight vapour barrier
- None
- How easy it is to perform internal re-insulation and how difficult it is to obtain a vapour-proof construction.
- It is often problematic to convince the client that it is not a relevant solution even when your explanation is based on "erfa-blad" and SBi guidelines argue against it. The client is often focused on the economic advantage compared to external re-insulation and attempts to calculate the risk of internal insulation
- Three walls have been tested with destructive measures; one had light mould growth and was removed.
- There is a general lack of knowledge and people attempt to moisture-proof (keep the moisture away) Just use materials that can actually handle the moisture.
- Taping the membrane to the ceiling etc.
- Costs always challenges as no life cycle costing on the UK. Space challenges at window reveals etc.
- Have experienced mould problems caused by improper cleaning of the surfaces.
- Certification of the constructing craftsmen.
- Keeping the internal side tight has posed some problems
- Lack of knowledge
- Mortar piled up in the cavity wall, through-going wall ties etc.
- The challenge has mostly been finding a diffusion-open system
- Detailing reveals
- The building authorities do not understand the use of breathable insulation in construction. Several technical parameters are misunderstood which does not benefit the dissemination of these solutions
- Thermal bridge issues when attaching to existing windows. Inflow of light is improved by slanting window reveals
- My own house done by myself. Have not observed any problems, even where the theories have not been followed. Only 50mm primarily to eliminate mould growth on thermal bridges.
- The big problem for us was moisture; we gained positive experiences with a ventilated layer between the insulation and the existing wall. This was also meant to avoid frost bursts/crumbling of the brickwork
- The insulation has been effective and have posed no nuisance for the residents
- m

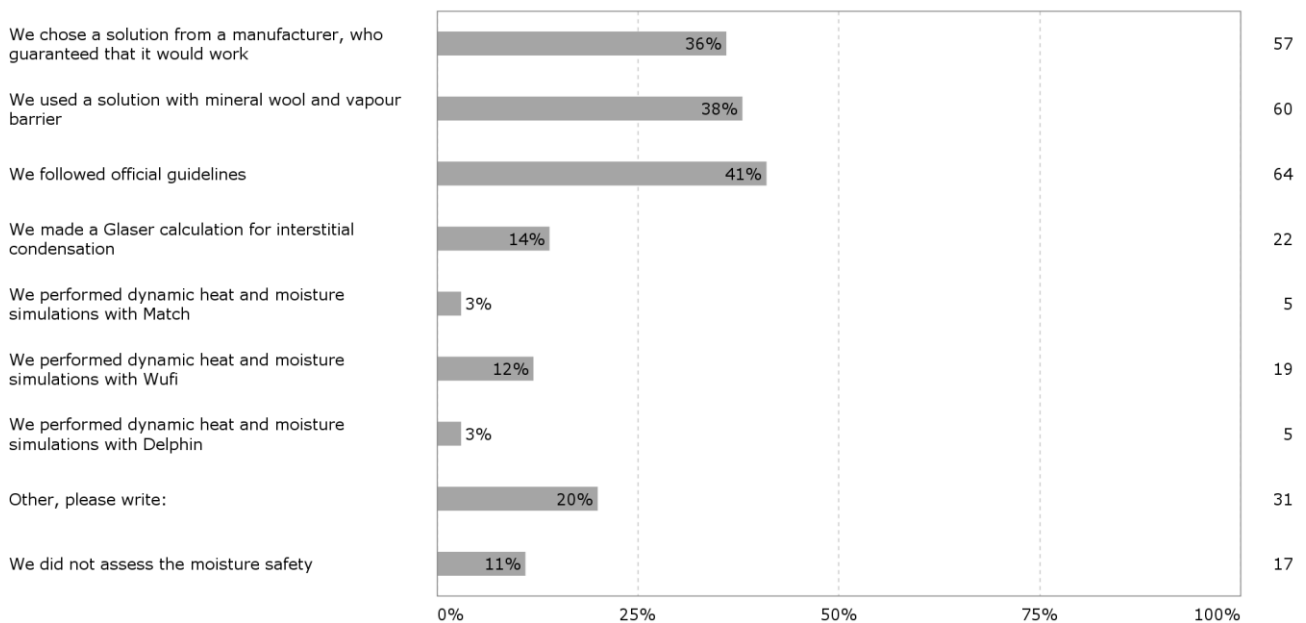
- Internal insulation of existing buildings is a very difficult and challenging discipline. There are many circumstances in evidence during planning and execution. Even after occupancy. The wrong paint can “destroy” the construction. It can also be difficult to assign a particular product and the contractor exchanges it for a cheaper alternative. This can also cause a future unhealthy construction
- Insecurity among the executing craftsmen – working methods based on the craftsmen’s experience.
- Accurate analysis beforehand because lacking information from suppliers
- The client and the architect are often uncomprehending towards the problem and wish a cheap solution. Often the carpenters will pretend that they easily can make it without it causing problems.
- Installations
  - The clients are lacking the will to invest the final 30-40% for a good solution
- lacking knowledge
- The main challenge is the details. They never are according to the drawings
- Internal insulation is a very complex topic. Every building is different and affords a separate approach. The biggest challenge is to get all the details right.
- Lacking knowledge of contractors, difficulties of good execution, particularly for important technical details.
- None
- Making the structure air tight
- Predicting humidity problems
- do not know
- A tremendous lack of hygroscopic data for natural materials which are more often chosen instead of mineral wool, PUR, etc.
  - Dynamic simulations software such as DELPHIN or WUFI comes with products in their database. Unfortunately, materials on Belgian market are not reflected in these databases.
- Adhesion for different systems on different substrates without creating any cold bridges
- connecting the insulation to the existing windows
- technical
- challenges in the cooperation
- Careful implementation of the vapour barrier function in a proper density to prevent internal condensation
- Problems with the verticality and planeness of the masonry when using rigid panel of insulation+gypsum
- Correct application of the air tightness screen to avoid internal condensation
- Lack of knowledge of installers. Difficulties of having continuous insulation
  - Lacking knowledge from contractor
  - challenges of technical character in relation with calculation (WUFI, etc.)
- We manufacture those systems ourselves and give total information to our customers.
- maximal insulation , and the follow up/knowledge by contractors
- Challenges with self-made builder (auto-constructeur)
- no challenges experienced
- The tests have not been running for long enough time to evaluate yet.
- Moisture technical questions are always the most challenging in such a process
- No challenges – Only insulating the gables of the top floor of five multi-storey buildings in connection with establishment of penthouse flats – no moisture problems.



- Difficult to hang Pictures in the given areas - restrictive.  
Not always possible to have long term monitoring installed due to economy.  
Installer not always experienced.
- Lacking knowledge of the importance of internal heating for the outer wall. Can paper wool as insulation without a vapour barrier be performed without moisture problems. Egen Vinding og Datter in Ringsted have built a house in this way. TI is performing continuous moisture measurements.
- A lack of knowledge about moisture migration, mould growth and mounting techniques.
- Lack of knowledge. Irregularities in the surface. The transitions to a lightweight facade on the same floor had to be done without a visible joint
- Tech character
- technical
- Scepticism caused by a lack of knowledge/information about the use of internal insulation in Denmark. A relatively high price because the products/solutions are unknown by the craftsmen, and because there have not been developed rational procedures for mounting internal insulation + consequential work.
- Managing the transmission of humidity across several materials
- Don't know
- We have been met by a lack of knowledge, different opinions of good building practice but have arrived at the best solution being in most cases the diffusion-open insulation, since it does not demand a tight vapour barrier – and does not cause condensation problems in timber constructions e.g. Suspended timber floors.
- Constructional problems, challenging working relationships or lack of knowledge.
- No special problems
- Development of the component connections, further training expenses to insure the participating architects' knowledge of building physics (often hindering and impeding))
- Determination, weighing and assessment of the decision criteria for the respective type of interior insulation. Compromise between the different interests of the participants (sound, fire, heat, humidity, impact protection, use, etc.). Deciding when to combine with components such as ventilation technology. Planning of the component connections and clarification of the question as to when flank insulation is necessary. Protection of the beam heads for wooden beam ceilings and interior insulation.
- Lack of information and warranty. Finding any meaningful systems is difficult. And if one is found, the manufacturer is not ready or able to make concrete statements or even give function guarantees. You are on your own.
- Weather protection & checking the condition of the façade
- Complex thermal bridge calculations. Material characteristics of existing masonry not known. Water absorption of visible brickwork. Software for two-dimensional hygrothermal simulations is complex and not sufficiently user-friendly, need for improvement in material databases
- Problems in coordination with other stakeholders
- Stock materials and properties not exactly known (water-based plaster / clinker?) Special difficulty: timber beam ends
- Lack of knowledge at the coordinating contractor. Among other things the existing "old materials" were not examined including their condition. Furthermore the coordinating contractor recommended to plaster internally with cement-lime mortar
- missing material characteristics of the existing design
- Performance information lacking

- none
- none
- Difficulties with technical characteristics.
- Installation of an intelligent vapour check - passage to the supports of the slabs.
- Thickness and lack of interior space
- The vapour tight membrane is difficult to carry out and seal. Too much craftsmanship, no simple infallible mounting of a good solution. It ought to be a mounting assignment not a fundamental assignment where everything is supplied by the metre.
- Addressing the cold bridging at intermediate floors is technically challenging, and the how to detail bay windows to ensure that the Tf and mould index do not cause a change in state of the structure.
- All
- Used to isolate vertical brick walls so that the insulation in the attic floors may be integral with the walls.
- execution OK
- Dust, debris, access
- A major challenge lies in resolving appropriate details where timber joists in the first floor void go into the wall, and where the linings in the rooms above and below are vapour sealed, either through design or by over painting.  
Usually this area is not insulated, creating major risks for the timber of interstitial condensation and decay, especially with wind driven rain.
- Preparation of the wall that is to be re-insulated. Expenses for moving installations are considerable.
- The biggest problems are: maintaining continuity of insulation in inaccessible locations; maintaining air and vapour barrier continuity and recreating architectural features - especially plaster mouldings

## In the design phase, how did you assess if a given solution for internal insulation was moisture safe? (multiple answers)



## In the design phase, how did you assess if a given solution for internal insulation was moisture safe? - Other, please write:

- Choices based on experience
- See comment
- iQ-Lator
- HEAT-calculation
- See comment
- WTA leaflets 6-4 and 8-5
- used other software for moisture analysis and linear thermal bridging
- We used vapour open materials
- Consultant came with solutions
- Assessing the assignment as such
- Experiences from other assignments. Moisture simulations from the supplier
- In general I very rarely recommend internal re-insulation
- Using standard proposal from energy10
- Following principles of moisture-open insulation in traditional buildings, & learning from other projects
- moisture movement testing of the hemp lime internal wall panels
- My own moisture analysis/assessment
- Made a diffusion-open solution with a cavity of 30-50mm
- We incorporate hygroscopic materials
- Experience shows limited risks, but prospective long-term damages on e.g. Joist system are not known
- Experiences from many buildings with these materials
- No internal insulation planned in the design phase
- Karsten tests

- We adapted systems based on official literature
- Vapour barrier + verification of dew point position
- See comments
- Experience
- (Therm) Calculation of the thermal bridges
- Using Praxishandbuch Innendämmung des FVID e.V.
- Cond
- we used our experience

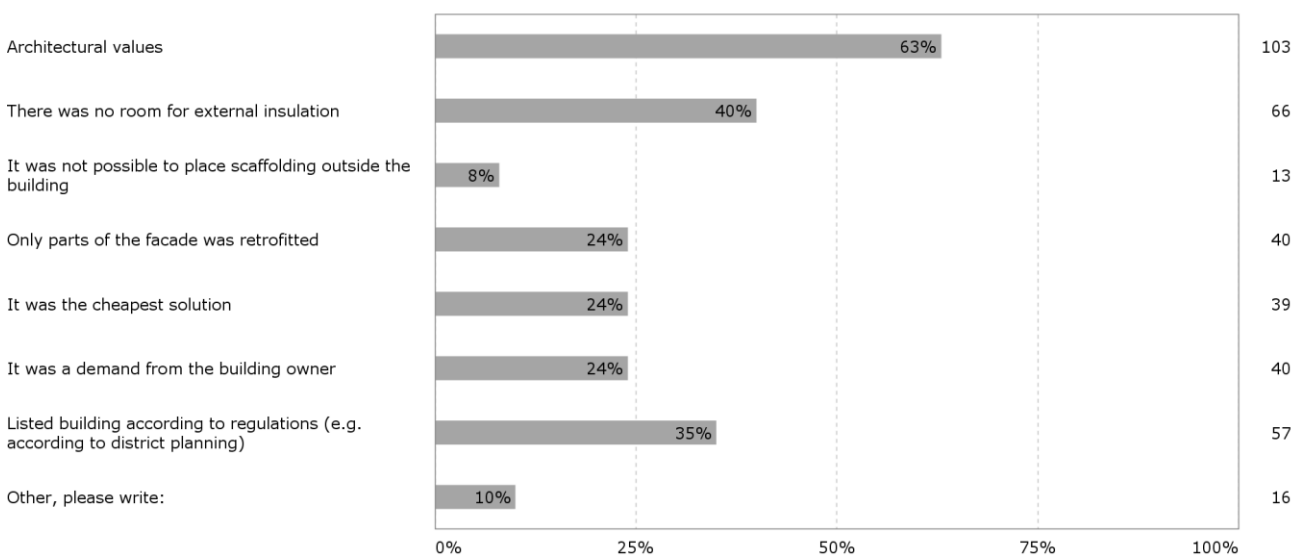
**If you have any further comments regarding the moisture safety of internal insulation, please write:**

- Capillary-active insulation like iQ-Therm is moisture absorbent why moisture is not a problem. You have to make sure in this case that the external façade is in order and maybe consider if a proofing of the façade is relevant/ a good idea.
- The project in which I have participated as the client, a case of internal re-insulation in Folehaven by the housing organization 3B, the buildings were from the end of the 1950s and have poured upper floors. Rambøll and SBi performed the moisture technical calculations, I do not know by which methods. They did however, in spite of the large consultant competency, manage to overlook the need for inspection of the joints in the external brickwork.
- In older buildings: we always secure against penetrative or rising damp with Remmers Kiesol system, used for more than 60 years. Brickwork: proofing is offered as an additional protection against driving rain. Brickwork: always inspect the condition of joints etc.
- Our material HES-mix from Hemp Eco Systems has been developed for more than 20 years into the present solution, we have got extensive experience. We have a long list of references and we have documentation of the moisture regulating qualities of the material
- x
- Since no institute wish to perform tests etc. with Thermofloc boron free paper insulation, in spite of good verifiable evaluations/ tests, it is difficult from instructions and “experience leaflets” to asses and use as a possible solution
- Generally one should not make these walls... but a German manufacturer has made a product that seems ”credible”. Should according to the manufacturer be a diffusion-open board that is stable in regards to dew point, fastening, mould inhibiting etc. Will use this next time such a solution is needed. However there are demands in regard to the subsequent processing of the board, which painters need to be aware of.
- None
- It would be interesting with more factual information on building materials that do not need a vapour barrier. Where natural uptake and release of moisture is considered.
- I never recommend anyone to perform internal insulation with mineral wool, last time I had a customer with such an assignment I gave an offer on building it with insulation boards from H+H
- I have in one case used porous concrete in a massive solution with a good internal vapor barrier.
- Will perform if it is demanded, but attempt to accomplish the projects with “hot roof” (i.e. roof where the bearing structure is on the inside (warm side) of the thermal insulation)
- Bad solution – re-insulate externally when possible
- I prefer to avoid internal moisture protection, since the most secure solution is external moisture protection. I.e. remove the cause instead of symptom treatment.

- Rarely recommend and often advise against homeowners' use of internal re-insulation. However I do have a more positive attitude towards solutions with porous concrete.
- none
- In the UK moisture-open insulation systems are essential for most solid masonry buildings, but most people still do not know or follow these principles and follow incomplete/incorrect industry-led risk assessment methods designed for other building types. Detailing is of the utmost importance, but given that general knowledge levels are so low, the principles are the most important thing to follow in the first instance - principles of traditional buildings and moisture movement, and principles of insulation detailing, and principles of airtightness and ventilation. We have recently written leading guidance on internal and external insulation in traditional buildings for Bristol City Council, available at <https://warmupbristol.co.uk/content/planning-guidance-your-home>. Much other guidance is available from UK conservation and technical research bodies - details available on request.
- The mineral wool insulation approach we used does not have a completely formed vapour barrier.
- Only bad experiences with internal insulation
- Difficult to solve constructionally, difficult to obtain ventilation without the risk of it affecting the wrong areas. The perfect internal re-insulation often demands large destructive measures in the adjacent constructions to obtain vapour tightness in correlation to the adjoining building elements.
- Moisture protection!! Why?
- Do not use organic materials and make sure the material in use can breathe so potential moisture can be ventilated away
- Most of the insulation assignments in single family houses are "planned" and performed by craftsman companies who does not have a theoretical approach – and therefore does not know of moisture calculations
- Ensure capillary stop from outside by having a vented cavity
- We have 15 years of experience with internal insulation.  
We decline jobs where we cannot influence all details
- nothing
- Internal insulation for masonry facade MUST come with an assessment of the brick performances. According to the value of the "A" coefficient, driving rain can become a major issue.
- extra ventilation in kitchen and bathroom
- none
- Yes – now we are having a stab at using ISOVER RetroWall System while making controlled measurements
- To be on the safe side we have chosen a porous concrete with a high lambda value, i.e. lower insulating power but more robust moisture technically
- We are following the measurements carried out and following the recommendations of DTU and TI based on these measurements among others avoiding insulation 20 cm above the floor and 10 cm below the ceiling.
- We assess experiences made in e.g. Germany while bearing the fire safety in mind
- The role of an energy consultant in the case of a continuing education in the field of monument protection is not (yet) anchored in the planning process.
- Condensation water must be avoided. This is why mineral wool actually fails.
- Be aware of the significant impact of driving rain

- Easy-to-use dimensioning aid / planning guide wanted. A not yet perfect example: [http://www.passipedia.de/planung/sanierung\\_mit\\_passivhaus\\_komponenten/loesungen\\_fuer\\_den\\_feuchteschutz](http://www.passipedia.de/planung/sanierung_mit_passivhaus_komponenten/loesungen_fuer_den_feuchteschutz)
- After 3 years, no mould growth
- No
- Moisture safety of internal insulation should be paramount and the provision of well installed and designed ventilation is crucial. Using steady state calculations will not demonstrate how the wall will perform should moisture either be present or penetrate the structure. using VCL in older breathable buildings will result inevitably in underperformance , premature decay and increased likelihood of mould growth.
- No
- Energy efficiency 'Cheerleaders' like the Energy Saving Trust have published guidance that substantially ignores issues of moisture.  
Due to funding cuts this guidance has often disappeared from online resources.  
The industry may or may not follow manufacturer's instructions, and provide no guarantees of future structural integrity when installing IWI.  
Building control does not seem to have ways to promote best practice, and may be approving buildings with defective solutions.
- ISOVER RetroWall system is a very robust and reliable solution..
- Interstitial condensation is not well understood or documented. Standard predictive algorithms have been shown to be incorrect and empirical work has verified this. We use our experience of where moisture forms and how it moves to determine if internal insulation is suitable. It mostly isn't.

### Which arguments in favour of internal insulation where used? (multiple answer)

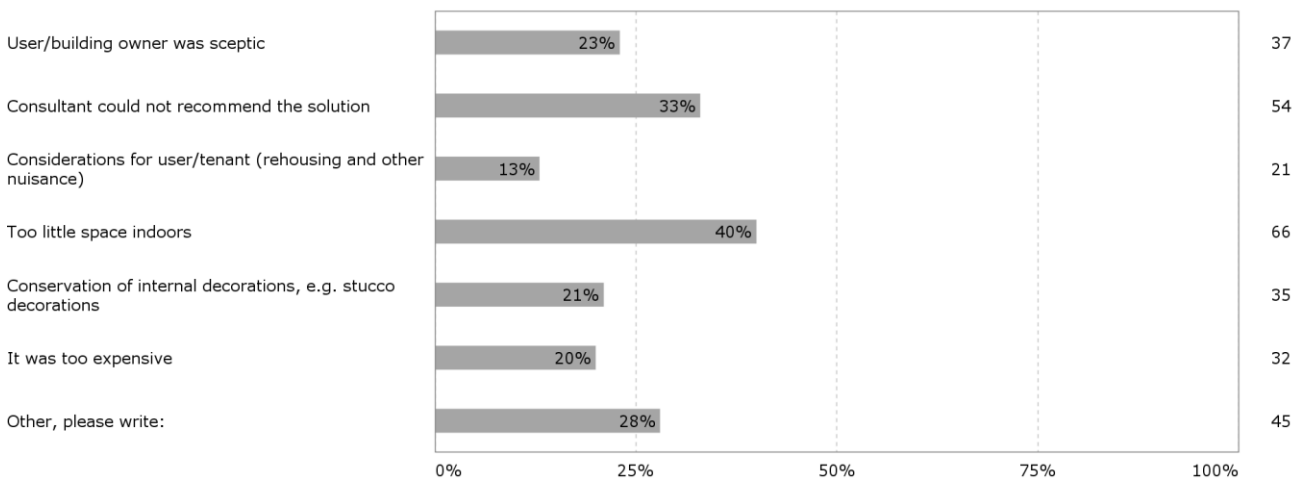


### Which arguments in favour of internal insulation where used? - Other, please write:

- Energy savings and elimination of cold walls
- Avoiding mould that cannot grow in HES-mix
- Basements
- Best solution for the price
- Lack of funds
- Normal regulations in district plan and from municipality

- Sound technical reasons.
- Listed building
- building connections
- insulating a carcass like a fridge
- A demand from the insurance company
- to propose solution for with internal surface temperature problem
- Because of building legislation (the outer wall was placed directly on the outer rim of the building site)
- Benefits (KfW)
- No other option - basement
- need to preserve the vapour open nature of the structure

### Which arguments against internal insulation where used? (multiple answers)

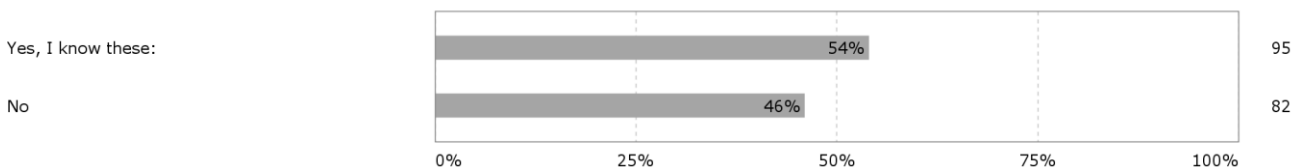


### Which arguments against internal insulation where used? - Other, please write:

- None
- fire technical issues
- No arguments against
- Demands from IQ-therm in regards to surface and mounting were unrealistic, They were impossible to work with
- No arguments against
- None
- We have been warned by Danish construction of a variety of scenarios
- Risk of mould growth
- None
- Constructionally difficult and poor
- Was against it myself because of uncertainty
- Moisture technical conditions
- Uncertainty in regard to mould growth
- None
- We advised against it in writing
- Risk of failure. Thermal bridges are not solved optimally
- internal is usually the optimal solution

- The solutions can turn out to be more expensive than external insulation because of pipework, niches, stucco, electrical installations etc.
- none
- it would have influenced the moisture behaviour of the wall in a bad way
- Risk of mould growth
- It is often necessary to move electrical and heating installations
- too difficult because of the details
- None
- Possible condensation problems, ... and all that follows
- safer out,
- Risk of thermal bridges
- insufficient insulation
- none
- Moisture technical challenges
- Lack of experience – established solutions
- Uncertainty in regard to the importance of cooling the outer wall and the risk of condensation that follows and a limited possibility of drying out caused by heat from the inside
- Fear of mould growth
- See previous comments in regard to e.g. prices
- Techniques with outer insulations have been tested and therefore trusted, but those with internal insulations - there is lack of experience
- Practical questions and scepticism also from advisors. Not from the client, just wants the work done.
- The non-specialists should have more faith in it
- Uncertainty of the parties involved, wrong expertise
- Risk of system failure
- Since there was not performed thorough examination of the existing construction
- None
- too technically challenging when the cold bridging could not be addressed
- None
- None
- it was too big a moisture risk

**Do you know any guidelines regarding retrofitting with internal insulation?** (one answer)



**Do you know any guidelines regarding retrofitting with internal insulation? - Yes, I know these:**

- SBI anvisnigner
- Byg erfa
- Byg Erfa
- Remmers iQ-Therm
- SBI, DTU m.fl.

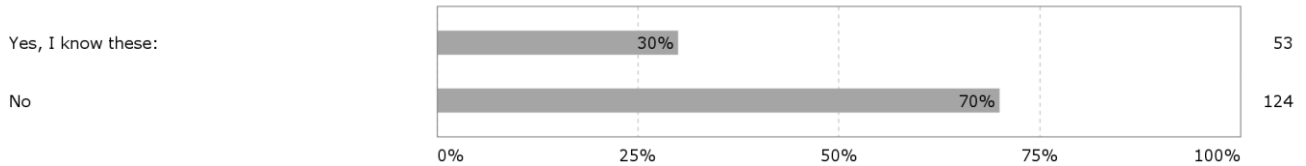


- SBI-anvisninger og BYG-ERFA-blade
- WTA leaflet 8-5 and 6-4 and 6-5
- Erfaringsblade og SBI-anvisninger
- WTA MB 6
- SBI-anvisning 221
- STBA Responsible Retrofit
- SBI nr ?
- BYG ERFA blad og produktvejledninger
- BygErfa
- jeg har travlt
- Byggeri og energirådvad
- Producentnvisninger
- SBI / ERFA -men ikke brugbare
- byggeri og energi -Ytong - Rockwool
- Div. Producenter.
- gasbeton har lavet en publikation som omhandler efterisolering af kælder vægge.
- SBI/BYGErfa
- Bygerfa.
- BYG-ERFA - Leverandøranvisninger
- bygerfa har et blad.
- BYG ERFA
- Byg Erfa
- Byggeerfa erfaringsblade.
- sbi, bygerfa, rockwool
- Byg erfa
- måske
- TOR
- sbi
- SBI, Erfablade
- SBI anvisninger, Byg-Erfa blade, leverandøranvisninger
- vil ikke bruge tid på at slå op
- SBI 224
- SBI 239 og 240, Bolius, RTS og så leverandørerne
- Byg-Erfa
- SBI-anvisninger og energi10
- Byg-Erfa
- STBA /SPAB/Historic Scotland
- "Leitfaden Innendämmung 2.0", WTA-Merkblätter
- Too many to mention in this survey; happy to provide details via email
- SPAB, BRE, etc
- SBI anvisninger og erfa blade
- efarblad SBI anvisniger
- Ja
- byg-erfa
- Byg-Erfa
- sbi

- Sbi
- SBi
- SBi vejledninger (fugt og efterisolering)
- erfaring og diverse litteratur
- flere sbi-anvisninger
- SBi-anvisning, leverandørmateriale
- Add 25% to the limit
- Sbi230
- Sbi
- Isover, Gyproc
- RAGE
- /
- air thide
- Fraunhofer, Dresden University, other international expert
- .
- UCL
- BBRI documents
- WTCB
- BBRI
- CSTC-Contact n° 36 (4-2012); CSTC-Contact n° 23 (3-2009); CSTC-Contact n° 38 (2-2013);<http://www.energieplus-lesite.be/index.php?id=10352>[http://www-climat.arch.ucl.ac.be/guide%20ISOLIN\\_avril2011\\_web.pdf](http://www-climat.arch.ucl.ac.be/guide%20ISOLIN_avril2011_web.pdf)
- VEA brochure
- WTCB+publications
- SBi og Byg-ERFA
- Teknologisk Instituts vejledninger
- Ytong
- ISOVER RetroWall System
- Byg-Erfa blade, SBi-anvisninger, forskningsprojekter om emnet
- Byg-erfa, SBI, beregningsprogrammer / fugtsimolering (udføres eksternt her)
- SBI og Byg-erfa
- WTA
- WTA-Blatt
- WTA-MB 6-4, 6-5, 8-1, 8-5
- WTA-Richtlinien
- WTA,  
[http://www.passipedia.de/planung/sanierung\\_mit\\_passivhaus\\_komponenten/loesungen\\_fuer\\_den\\_feuchteschutz](http://www.passipedia.de/planung/sanierung_mit_passivhaus_komponenten/loesungen_fuer_den_feuchteschutz)
- WTA Merkblätter
- BYG ERFA blad
- WTA
- <http://www.anit.it/pubblicazione/manuale-anit-riqualificazione-dallinterno/> ;  
<http://www.anit.it/pubblicazione/isolamento-termico-dallinterno-senza-barriera-al-vapore/> ;  
<http://www.edilteco.it/it/news/attachment/455/nuovo-manuale-anit>
- TI og BygErfa
- STBA Guide, and BRE publications, English heritage works and Historic Scotland
- BS5750

- Montageanvisninger fra producenter
- Manufacturers and the UK's Retrofit Accademy guidance

**Do you know about guidelines regarding improving energy efficiency of historic buildings?** (one answer)

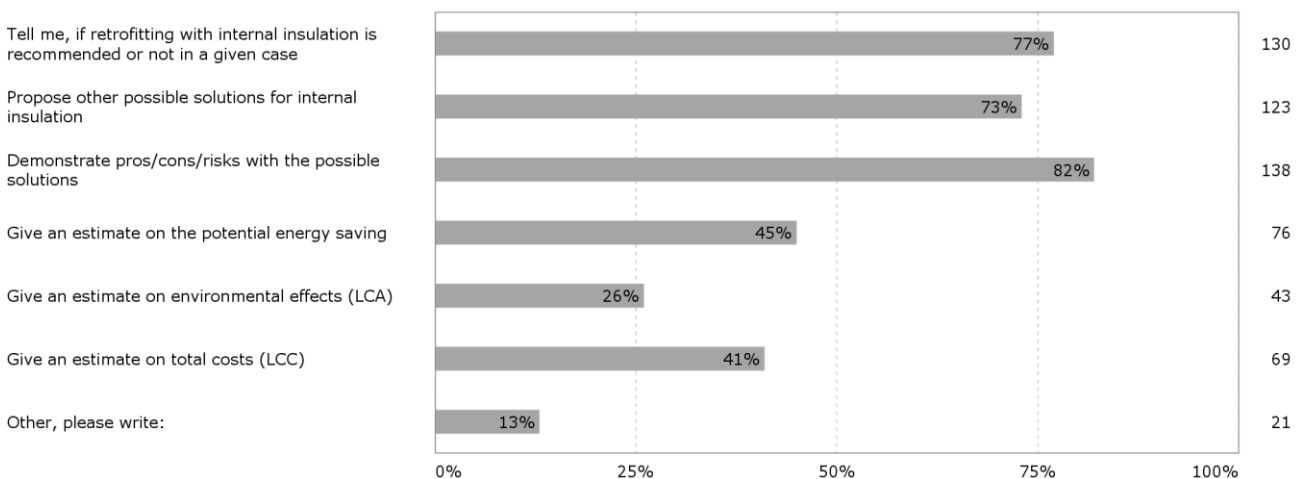


**Do you know about guidelines regarding improving energy efficiency of historic buildings? - Yes, I know these:**

- 3encult
- ASHRAE Guideline 34P
- 1940'erne og 1950'ernes murede boligbebyggelser renoveringsguide
- Remmers iQ-Therm
- WTA leaflets
- delvist SBI-anvisning 221
- SPAB Research Reports on U values and Building Performance
- BYG ERFA og god byggeskik
- stadig travlt
- Center for bygningsbevaring i Raadvad
- SBI / ERFA -men ikke brugbare
- bygningskultur 2015 - dtu
- SBI
- måske
- ditto
- Energiguident af bevaringsbygninger, Raadvad eller [www.bygningsbevaring.dk](http://www.bygningsbevaring.dk)
- Historic scotland
- Byg-Erfa
- STBA/SPAB/Historic Scotland
- Too many to mention in this survey; happy to provide details via email.
- BRE etc
- [www.historicengland.org.uk](http://www.historicengland.org.uk)
- Videncenter for energibesparelser i bygninger.
- Sbi
- Kulturstyrelsen
- Rapport BYG·DTU R-184 2008
- "Bindingsværkshuset" og erfaring
- Vejledning om energiforbedring af fredede og bevaringsværdige bygninger.
- Don't forget the line/spot heatloss
- Skamolplus
- WTCB
- BBRI, others
- see above
- VEA brochure
- [byggerienergi.dk](http://byggerienergi.dk)

- Teknologisk Instituts vejledninger
- Ytong
- Erfaringer fra et projekt på Politigården
- SBI, Bygningskultur DK, BYFO
- diverse, z.B. vom Bundesamt für Energie BFE, MINERGIE
- viele, das haus ist ein System, auch TGA ist wichtig
- prEN 16883
- Kfw Mindestanforderungen, EnEV
- OIB-Richtlinien
- EnEV, EEWärmeG, DIN ...
- EnEV
- [http://www.aicarr.org/Pages/Editoria/Pubblicazioni/III\\_Guida\\_Aicarr.aspx](http://www.aicarr.org/Pages/Editoria/Pubblicazioni/III_Guida_Aicarr.aspx)
- SPAM and EH documents in the UK
- TP15 Historic Scotland
- Kulturstyrelsen - energiforbedring af bevaringsværdige bygninger
- The UK's Retrofit Academy guidance and the UK's Association of Environment Conscious Builders guidance

#### A guideline/tool for retrofitting with internal insulation should: (multiple answers)

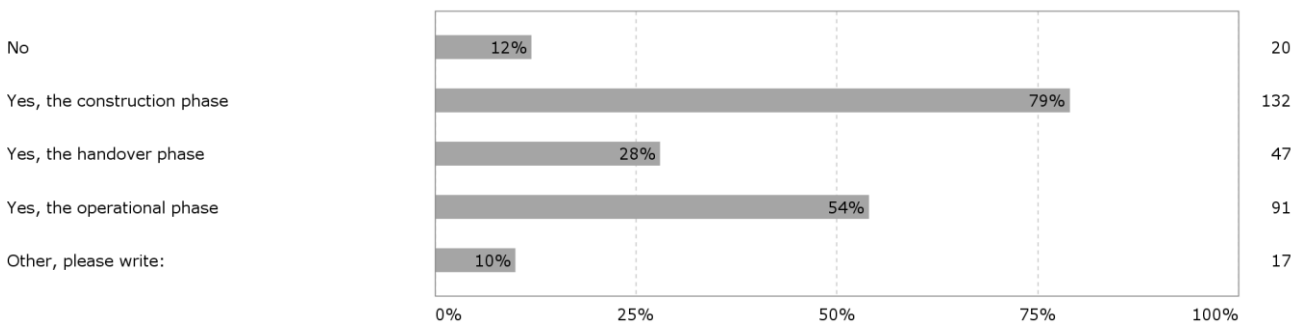


#### A guideline/tool for retrofitting with internal insulation should: - Other, please write:

- System ability of capillary transport, which is poor in eg. Porous concrete
- Fire issues
- Please see STBA GUIDANCE WHEEL
- Seeing other options than the conservative ones
- Give account of future ventilation
- Should list focal points in regard to where process control should be performed
- Be held responsible for the proposal
- Put it in the context of a whole-building approach to retrofit, i.e. make it clear that IWI is only part of the solution and should always be accompanied by other related measures (e.g. maintenance, drying, windows & reveals, floors, lofts, heating & power etc.)
- We have the solution
- Remember the architecture
- Describe advantages for health and comfort

- Internal insulation should be left to experts in their trade who do not depend on a guideline
- Provide more data for insulation material on the Belgian market (reliable sorption curve for hygroscopic material is already a big advantage for simulations)
- tell about risks considering healthy buildings
- The recommendations ought to have a defined certainty, like in statical calculation. I.e. one should prove that the system works even if there are inexpedient but through experience expected errors in use, maintenance etc.
- Overall economy is an important issue, but also which prerequisites are relevant in regard to execution should be mentioned
- Not only the risks but also show that internal measures practically never lead to any damage
- Obligation of manufacturers to provide appropriate data sheets (e.g., without beautified lambda values, suitable as input data for simulation tools)
- Bring legal certainty
- Contain measurement tools – i.e. possibility of a "sample" of e.g. one square meter of wall
- give detailed drawings and annotated pictorial instructions for how to do the work

**Should the tool include guidelines to other phases of building process than design?** (multiple answers)

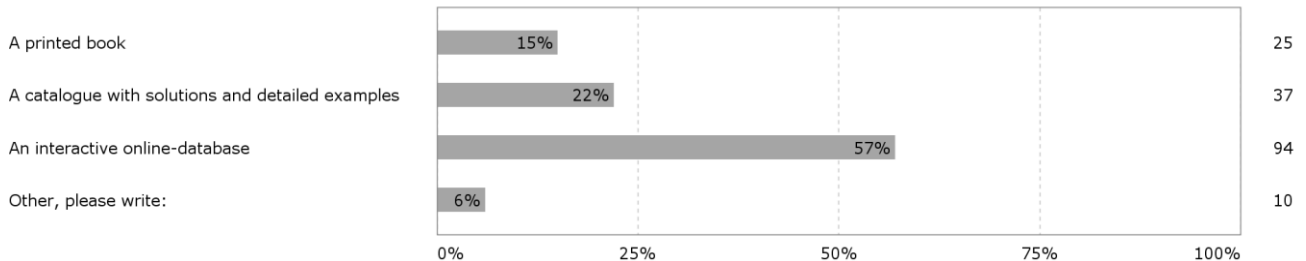


**Should the tool include guidelines to other phases of building process than design? - Other, please write:**

- Inspection of the conditions after the re-insulation has been performed e.g. measuring moisture conditions
- Learning to treat the internal surface correctly, which paints etc. can be used, how to repair holes etc.
- A matric for quality assurance demands – including a standard plan for control and reference samples for approving the inspection
- Measurements and monitoring
- proper description of what it takes in regard to execution
- Process control in both planning and execution
- recycling
- For user/client
- energy savings
- Guidelines for assessing whether the existing building (brickwork, half-timber, roof construction) is suitable for the change in temperature and moisture conditions
- What the costs are if it should go wrong regardless
- Reconstruction
- The reconstruction phase
- Control measurements e.g. Temperature- and humidity sensors that are built into the construction and can later be used for inspection

- Indeed, the operational phase, the use of the building e.g. proper paints
- Previous failures
- the design and project planning phases

**In which form do you prefer the guidelines?** (one answer)



**In which form do you prefer the guidelines? - Other, please write:**

- Don't know
- Online database supplemented with an app
- A physical guideline (like bygERFA) and in addition an online catalogue of reference projects and energy/economy examples
- SBI-anvisning with link to a calculation tool
- As a pdf for iPads
- Both a book and an interactive database
- I prefer printed book, but for most an online resource is essential, and is more easily updateable
- A combination of a book and an online database, it is necessary to differentiate the material meant for "the large architectural and engineering firms" from the material meant for smaller craftsman companies, constructing architects and small architectural firms.
- Catalogue with solutions and online database
- All mentioned above available online would be great - explaining background text, crucial details, catalogue of solutions implemented and interactive database.

**If you have any other ideas or suggestions to the content or functionality of the future RIBuild guideline/tool for retrofitting with internal insulation, please write:**

- Book/catalogue/leaflet AND an online tool
- A calculator for ROI for the actual building one is considering
- It is important that a leaflet (hard copy) in simple language is made for residents and maintenance staff which explain how to handle the interior surfaces (painting, mounting, cleaning etc.) This leaflet should also have recommendations for a frequency of inspection of the surfaces e.g. every 7-8 years (at the same time that the ventilation ducts are inspected).
- Practical showcases made in 1:1
- x
- x
- Again please see the STBA Guidance Wheel that already does what you suggest. Contact the STBA for more details.
- Digital photos that compare to a sharing of knowledge
- Easy for all products, not only for the conventional ones
- Have experienced that it is important that the moisture barrier is functional and how Ytong (aerated concrete) is finished, like you mentioned in the questions regarding follow-up maintenance

- That actual examples are made in practice followed by destructive measures to prove that it works – a series of pictures would be usable. One has to remember to try to categorise the different solutions, many says that internal insulation is a bad idea, NO that is not true, it might not be 100% the right solution, but it is still a doable solutions which in many cases improve the indoor climate. Often it is not the amount of insulation that is crucial for the client but a question of indoor climate and a warmer outer wall which can be accomplished by putting up a secondary wall made from ex. Aerated concrete and insulating it a bit.
- Remember that new materials/solutions will come that could be usable in the building industry
- No, not at present
- Choosing construction type through a step-by-step guide helping the user to choose material/construction, appearance with sub-folders for visualizing advantages in the possible solutions (U-values, maximal thickness in regard to frost bursts in the outer wall, energy savings etc.)
- I find the interactive solution by DTU very usable. Especially if it is made product specific as suggested. We need a tool like DUKO (guidelines for choosing roofing underlay)
- Are permissions and trained craftsmen needed? Can the building owner perform the work himself, if quality assurance is made e.g. image documentation.
- Especially in regard to preservation of architectural qualities externally and internally
- See online tools we have developed in the UK in recent years: a) Responsible Retrofit Guidance Wheel (<http://responsible-retrofit.org/wheel/>) and b) Bristol Council online video and survey tool, leading to full guidance referenced previously (<https://warmupbristol.co.uk/content/planning-guidance-your-home>).
- No
- Include basements and make it possible to combine with other things such as radon
- An interactive step-by-step guide for different scenarios outputting possible solutions, pros and cons, and costs would be an extremely useful tool. I feel a printed book or other type of solution would not be used as much by the industry.
- Calculations of U-values for each construction
- Showing solutions with sustainable/virgin materials
- Connections to other guidelines etc. e.g. asbestos, PCB, mould fungi and if possible the requirements of the rent act.
- Would be useful if there would be explanation on construction part - all the important details - sealing, air gaps, details around windows junctions to ceiling, basement, etc. To point out potential problems to avoid, or building details that has to be investigated closer.
- Possibility of moisture simulations of the different solutions, sharing of experience in relation to re-insulation (where does it go wrong) It would be nice if there was drawn from different areas of knowledge (SBI / Byg-erfa, BYFO or references to these)
- Many building site compatible graphics for connection details, Compilation of individually selected data in a PDF document as an attachment to the planning / design documentation
- Linking and coordinating the directive with the Praxishandbuch Inndämmung, published by the FVID e.V., Verlag Rudolf Müller, Cologne (Germany)
- A kind of decision-making tree would be a good way to determine the most appropriate system for a particular application in the exclusion procedure.
- Short and concise (no book), table form, PDF or online document with link to further information, application examples, vendors and as free as possible planning tools. Example for the suggestion: [http://www.alt-bau-neu.de/\\_database/\\_data/datainfopool/Saena\\_Gebaeuedaemmung.pdf](http://www.alt-bau-neu.de/_database/_data/datainfopool/Saena_Gebaeuedaemmung.pdf)

- it is important that any tool should quantify risk and exposure to wind driven rain, and the risks of internal vapour pressure and the need for proper ventilation
- x
- We need documented lab tests.  
E.g. Fixing a small square of calcium silicate between joists, surrounded by flexible foam sealant.  
Internal insulation with plasterboard, a services layer, a vapour check, and insulation sealed against the wall but with some provision for dissipating moisture across the wall area.
- By making the guideline interactive it will be possible to choose different systems based on the actual condition of the building at hand
- You need to take account of climate. Northern EU countries have continental winters which tend to be much drier with RH in the range 20-70% whilst the UK has RH 70-100% in the winter.

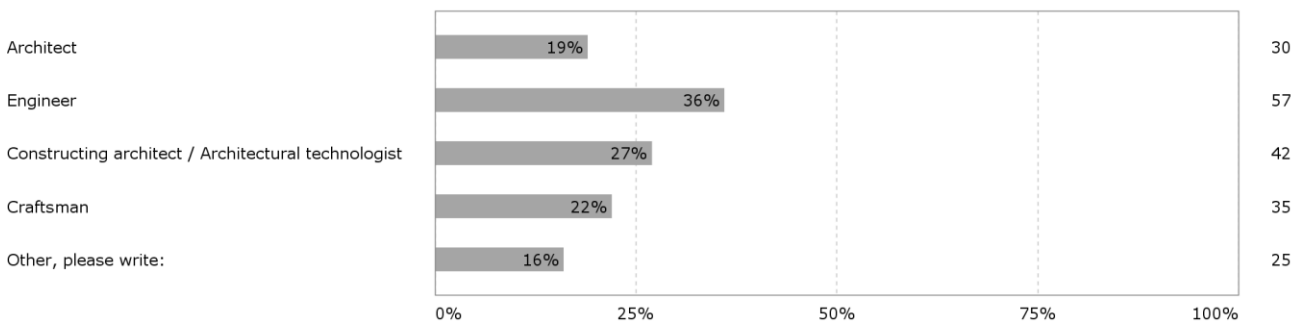
**If you have any comments on or recommendations for the RIBuild project in general, please write:**

- Show the advantages of combining internal insulation with external proofing of the facade
- RIBuild could gain massive insights by following the pilot project in Folehaven. The project is conducted in a inhabited context which is expected to subject the insulation method for a maximal pressure test. In spite of a difficult start, with a negative effort from the advisors and bad craftsmanship, it is expected to show initial results (moisture measurements and inhabitant interviews). Landsbyggefonden will depending on these initial results decide whether the project will be upscaled.
- Our solution for internal insulation using hemp and lime has existed for many years. Could you not focus on the solutions already on the market and work on having them exhibited in practice.
- x
- x
- Contact STBA - Nigel Griffiths or Neil May
- Very good idea. Belong in the carpentry/masonry business which needs a professional education in line with "GVS,VVS,EL og kloarkmestre"
- I would like people to be more open towards new products in Denmark. Sometimes old technical data for paper wool is used instead of current data on paper insulation. This makes it impossible to use these guidelines in practice.
- No
- I would like that Eva wrote a SBI-anvisning on the subject
- The end result should be door-to-door distributed to all homeowners
- We - the Sustainable Traditional Buildings Alliance, or STBA (<http://stbauk.org/>) - would be pleased to be involved in the project, given our considerable experience in this field. We have access to the vast majority of UK experts in traditional building retrofit, and work closely with the UK government on these issues. We have designed two major online tools for traditional building retrofit and specifically solid wall insulation, which the Government and local municipalities are keen to replicate on a wider scale.
- No
- Show sections of different types of buildings and allow for variable solutions depending on the circumstances
- Calculation of U-values for each construction. Descriptions of the pipework for technical installations, recommended materials. Moclay.



- Certain risks might be accepted if it alleviates bigger problems
- A very important project that there is great need for - the need rises, the further you get from the big buildings and companies and into the smaller cities, where small properties and companies are too dominant.
- Make a cost calculation including everything and compare to building new. Don't forget to include maintenance over the lifetime and changes in fixed expenses.
- Include as many manufacturers as possible  
Include as many manufacturers as possible. Example: In the first query, EPS was completely missing, although the system "Doublage" is available from Saint-Gobain.
- I participated in a seminar at AAU Copenhagen where you described the project
- Reference stories and descriptions of experiences
- X
- . The heritage sector is really waiting for the results of this project. Personally, I rarely dare use re-insulation because of potential problems.
- Eliminating the need for lateral insulation on party walls would have a high value, as it would cut the potential for condensation at the corner of the house next door. e.g. By using aluminium strips to conduct heat to the party wall, or perhaps by bringing vertical heating pipes to this point.  
You should investigate using closed cell insulation buried underground to cut cold bridging risks, at external corners of un-insulated ground floors in particular. E.g. Foam glass insulation. Standard details have a huge value. Phone or email me for more material on all this. Andrew.frew@nihe.gov.uk 02895982332; 0771 427 2833 Technical Innovation Manager for the Northern Ireland regional Housing Authority. 87,000 stock.
- I would recommend to include the ISOVER RetroWall system in the study

**Educational background**(multiple answers)

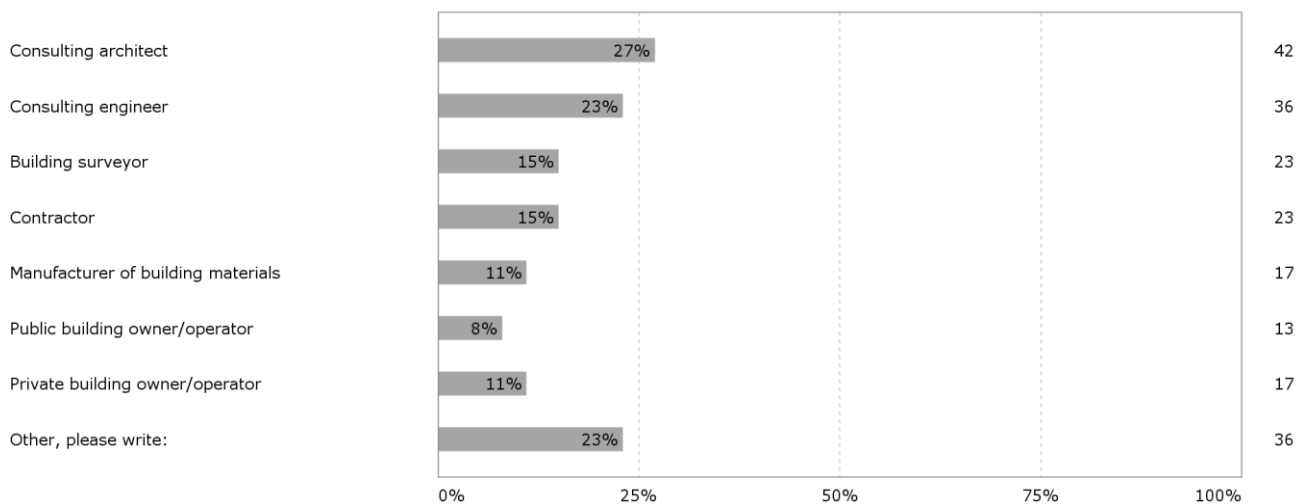


**Educational background - Other, please write:**

- Assessor
- Self-taught
- Chartered Architectural Technologist
- MSC in biology
- Labourer
- MSC.comm
- Owner
- Mason
- Building technician
- Carpenter/ building technician
- cand. silv.

- Sustainable Energy & Traditional Buildings Consultant
- Building surveyor
- Operations management
- architectural technologist
- energy consultant
- education
- Building assessor
- MBA F and HD informatics
- Energy auditor
- Carpenter, engineer HTL
- Energy consultant
- Building Physics Consultant
- bachelor

### I work as/for (multiple answers)

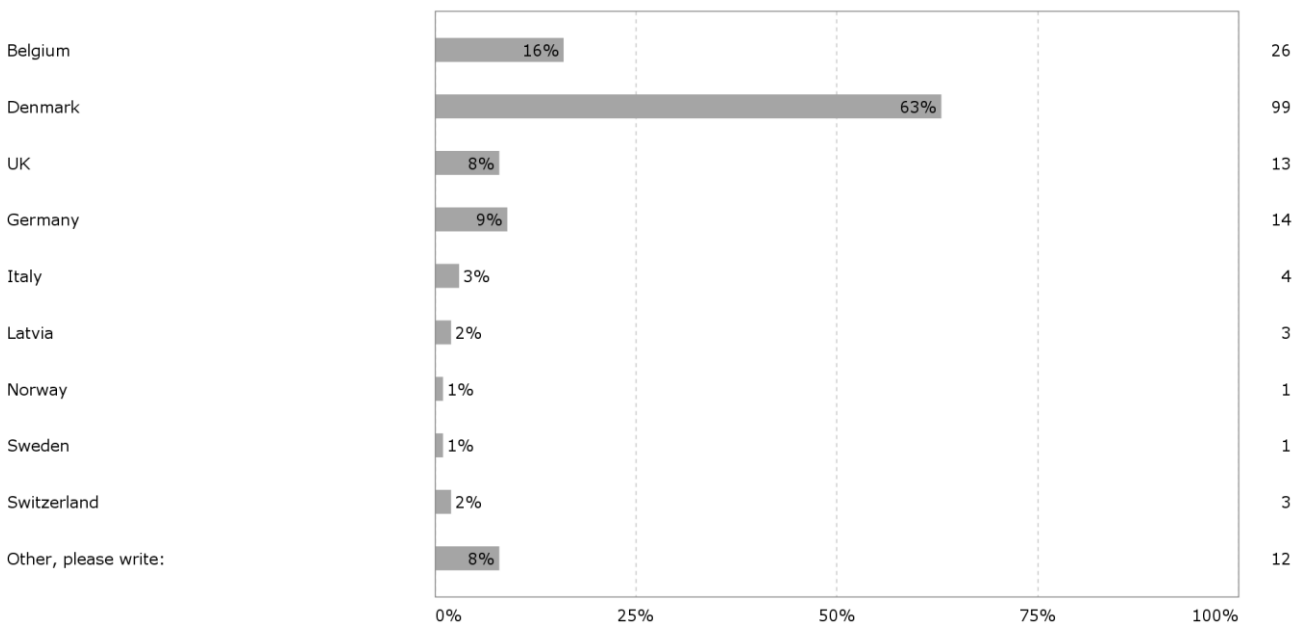


### I work as/for - Other, please write:

- Research
- Social housing
- Distributor of Remmers
- Chartered Architectural Technologist
- SPAB - Society for the Protection of Ancient Buildings
- Public project for energy savings
- Insurance
- Wholesale distributor of insulation products
- Building technology advisor at Dansk Håndværk - Syns og Skønsmand
- Retired
- Energy consultant
- Sustainable Energy & Traditional Buildings Consultant
- Educator / Researcher
- Operations manager within social housing
- local authority building procurement
- Social housing
- Building permit caseworker

- Material distributor
- Energy consultant
- Building authority and consultancy
- Construction institute
- BBRI
- education
- high energy efficiency building association (pmp asbl)
- local government
- Technical approval and certification
- building research centre
- Municipality
- Insurance
- Energy auditor
- Consulting architectural technician
- Energy consultant
- University
- Independent Consultancy
- Heritage expert

**I work in** (multiple answers)



**I work in - Other, please write:**

- Scotland
- USA
- Through European network/cooperation
- I have retired
- Scotland
- I have also worked on EU projects and worked in other countries for organisations including the UNDP and UNESCO.
- Wales, not England in fact!
- Canada

- Netherlands
- France Netherland Luxemburg
- Austria
- Spain