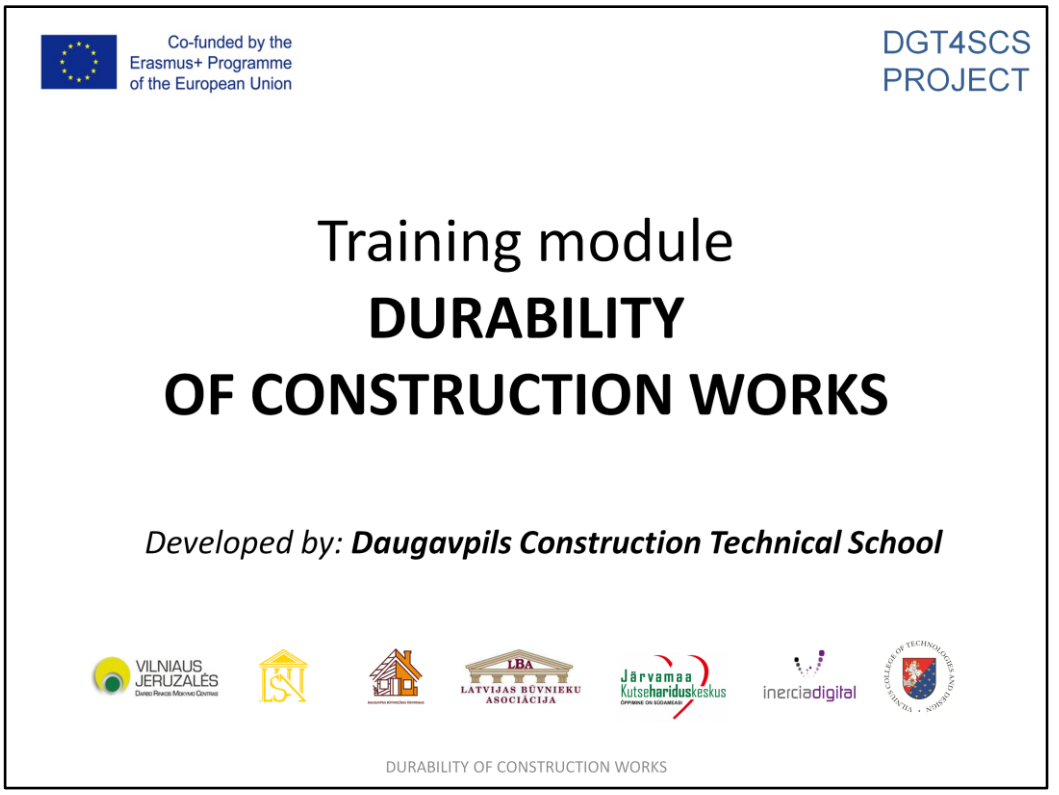
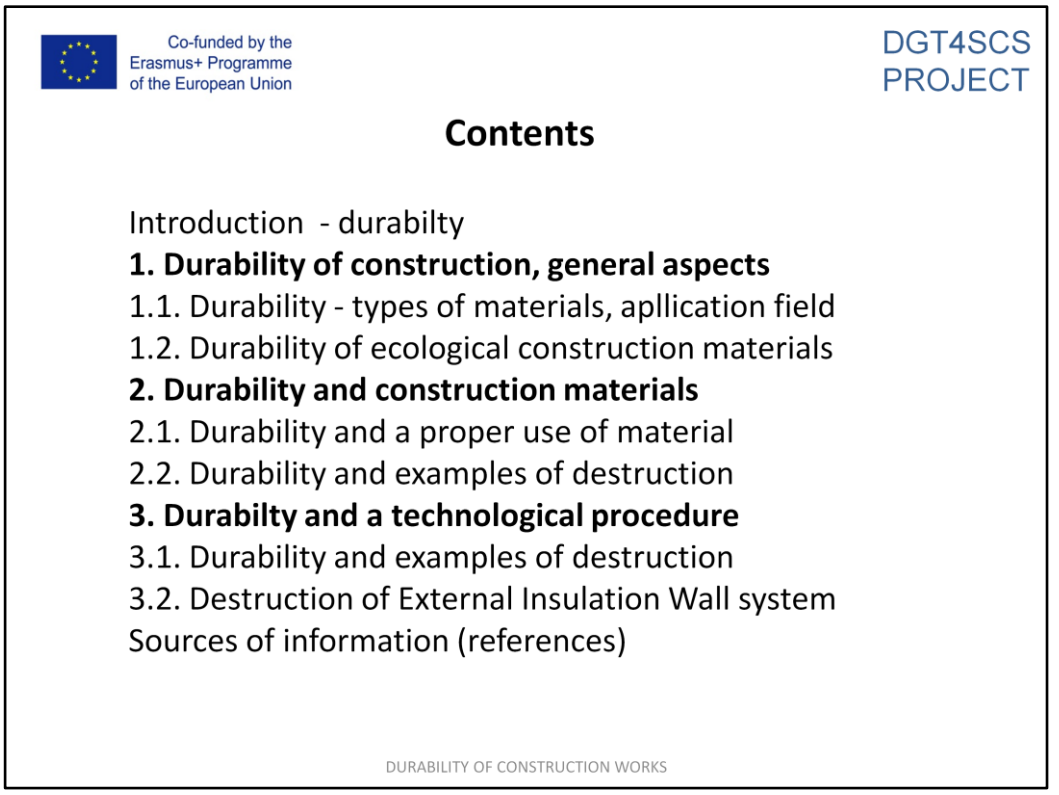


Notes for the trainer and additional information:

The information on the topic “Durability of construction works” should be adapted according to the level of education and knowledge of the trainees who will be trained within this module.



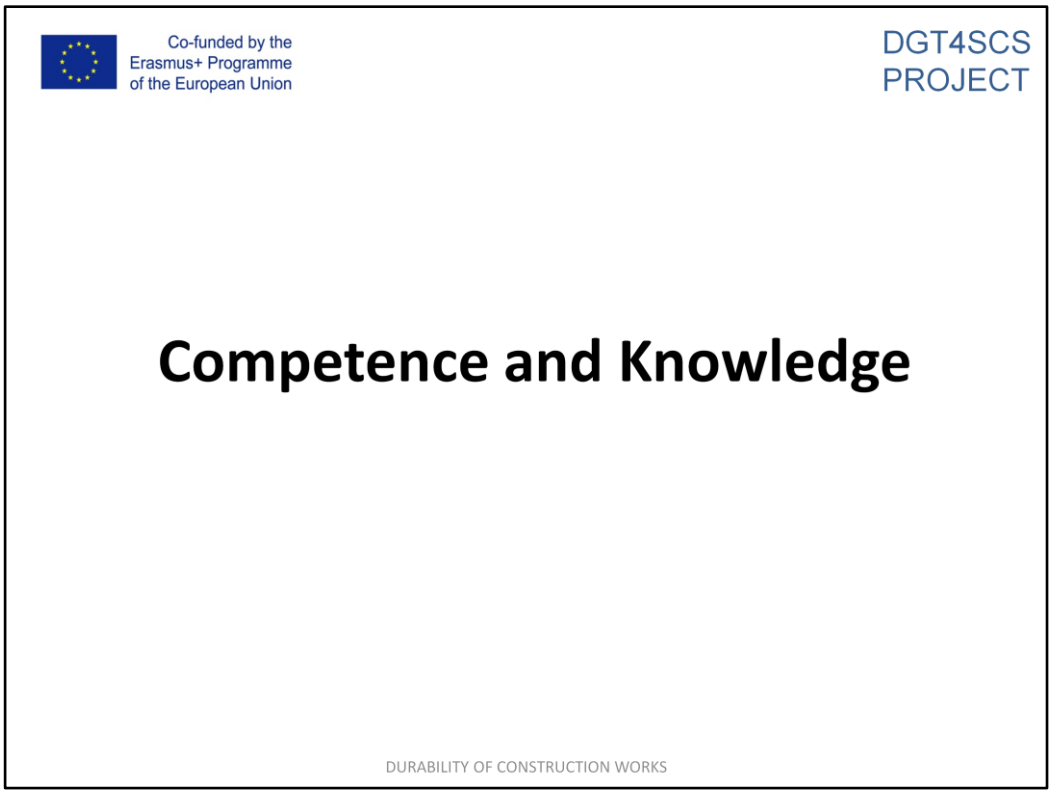
Notes for the trainer and additional information:

In this chapter or part of the training module

- trainees gain the information and general insights into durability of different construction materials depending on their type and application field (in the particular construction element or during construction works).
- highlighted importance of understanding and using proper construction techniques for different construction works (insulation, plastering, tilling etc.), because the right technique prolongs the lifespan of completed construction works and building elements (only following the procedure ensures durability of materials and works)
- trainees gain general information and knowledge on importance to install construction material following the producer's recommendation of a proper use (construction materials should be used according to purpose of construction/building elements which ensure durability of materials and works)
- trainees gain general information about the importance of using proper protective measures in order to prolong lifespan of construction materials (protection against destruction - improve durability)

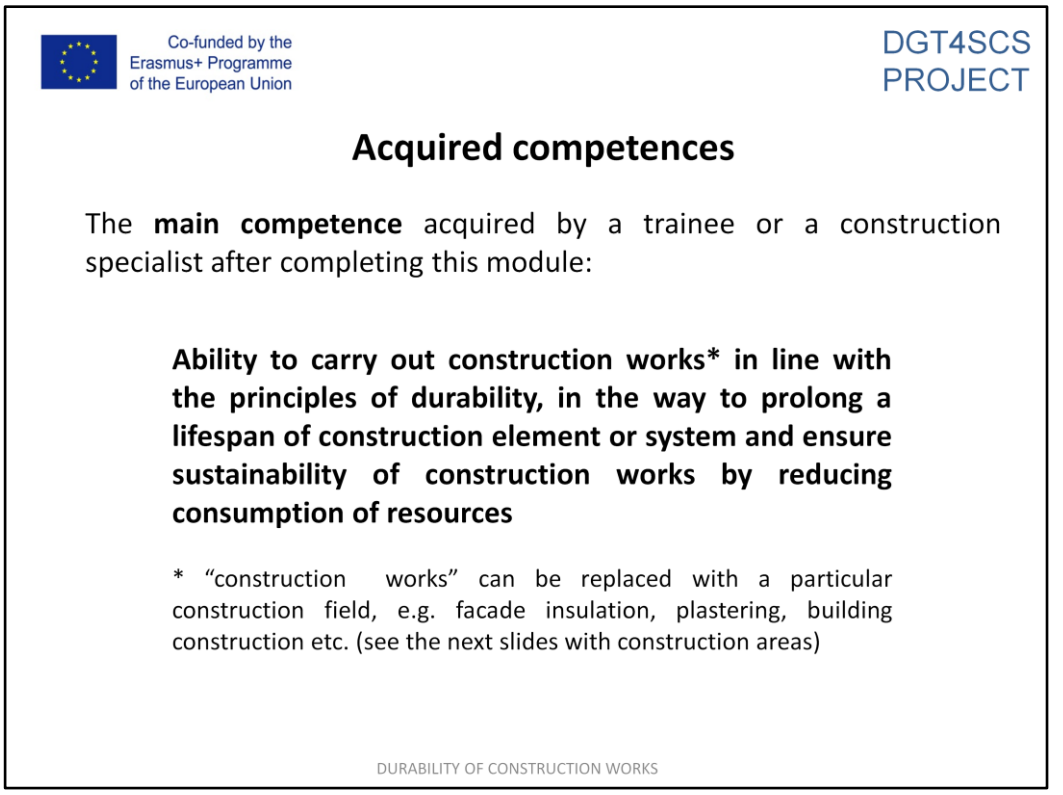
More detailed information about using a proper construction material and technique depending on type of works (insulation, tilling, masonry, painting, plastering, flooring etc) trainees get during specific professional training modules within the framework of a particular qualification.

Lifespan and durability of building construction are not covered by this part of module, because durability of building construction is an issue of civil engineers (EQF level 6-7) not construction technicians and construction workers (EQF level 4)



Notes for the trainer and additional information:

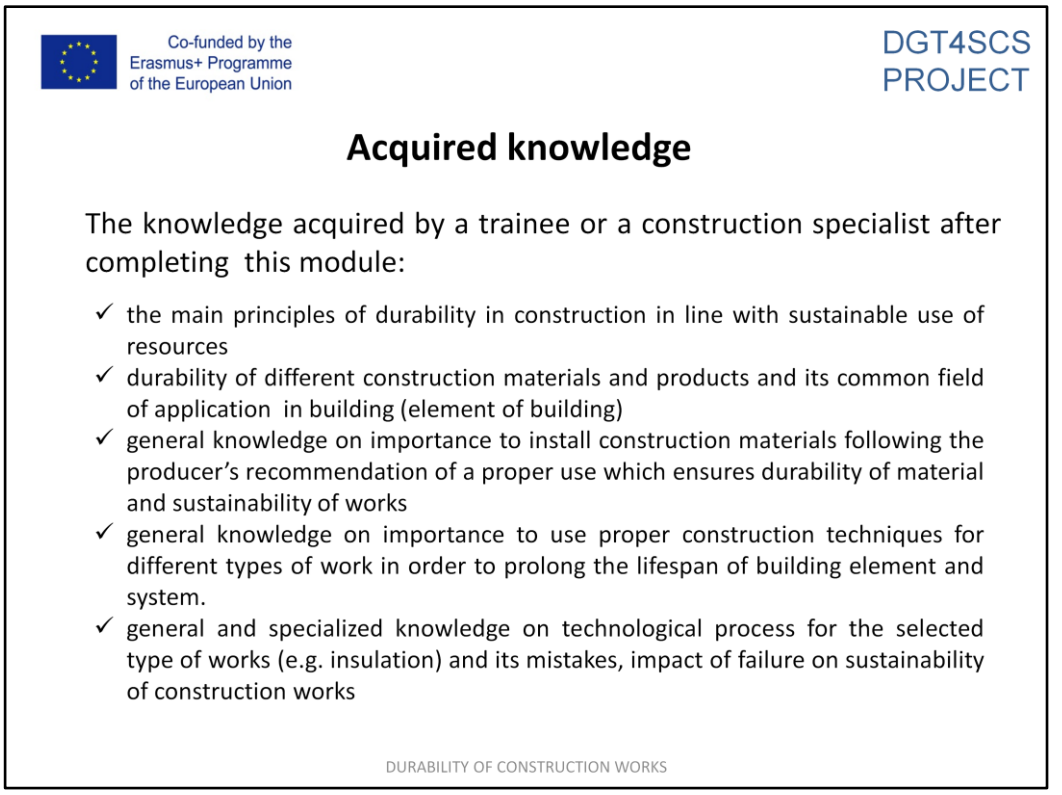
See the next slides.



Notes for the trainer and additional information:

Competence – the combination (selection) of knowledge, skills and attitudes which allow to perform a particular activity

The main competence and the construction areas in which it can be used are formulated.



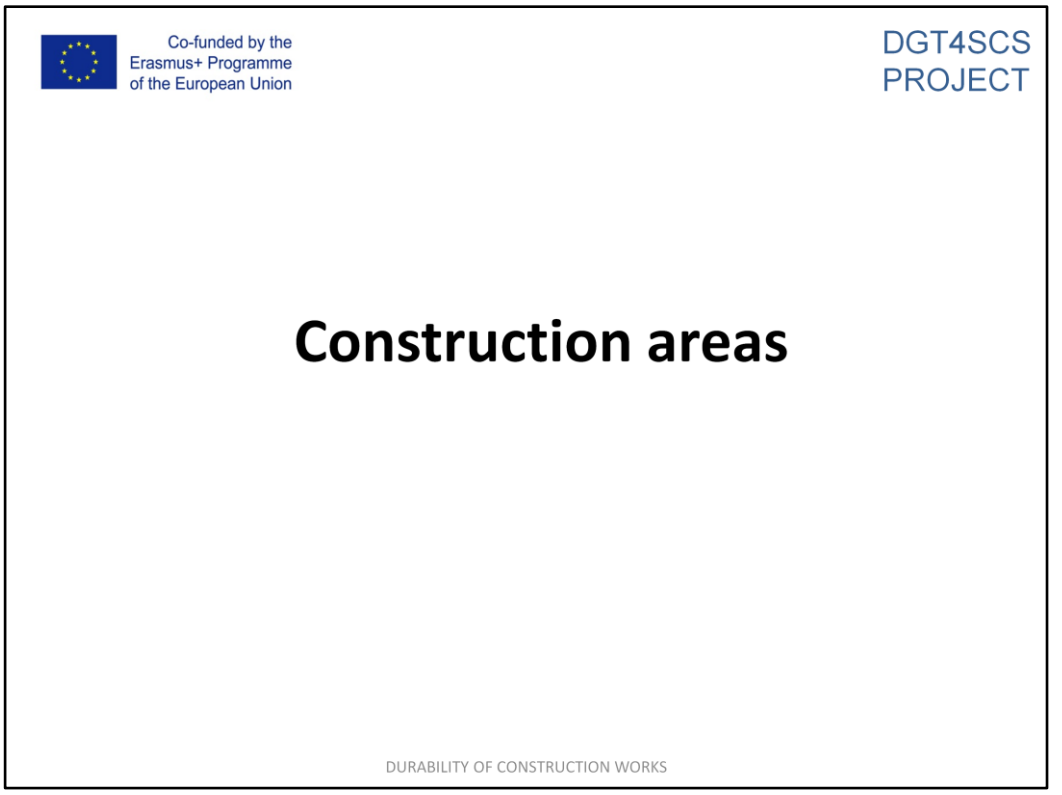
Notes for the trainer and additional information:

Here is a list of qualifications which can be gained at Daugavpils Construction Technical School within implemented vocational training programs and which can use the training module topics on Sustainable construction in order to gain competences and knowledge mentioned above:

- Building Technician
- Finishing Work Technician
- Dry Construction Technician

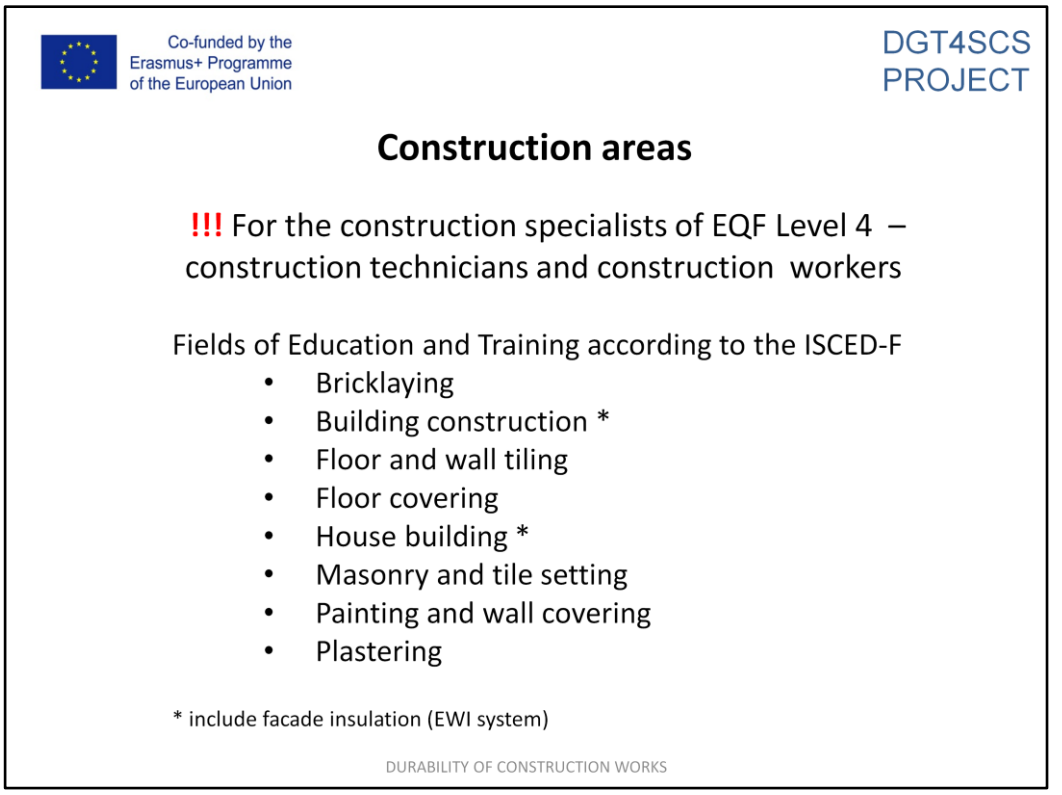
Description of qualifications and their general competences, knowledge and skills can be found here:

Finishing Work Technician
https://www.latvijaskvalifikacijas.lv/qualification/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-apdares-darbu-tehnikis/
Building Technician
https://www.latvijaskvalifikacijas.lv/qualification/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-eku-buvtehnikis/?doing_wp_cron=1592856313.2323319911956787109375
Dry Construction Technician
https://www.latvijaskvalifikacijas.lv/kvalifikacija/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-sausas-buves-tehnikis/



Notes for the trainer and additional information:

The construction areas in which the main competence of the topic “Durability of construction works” can be used.

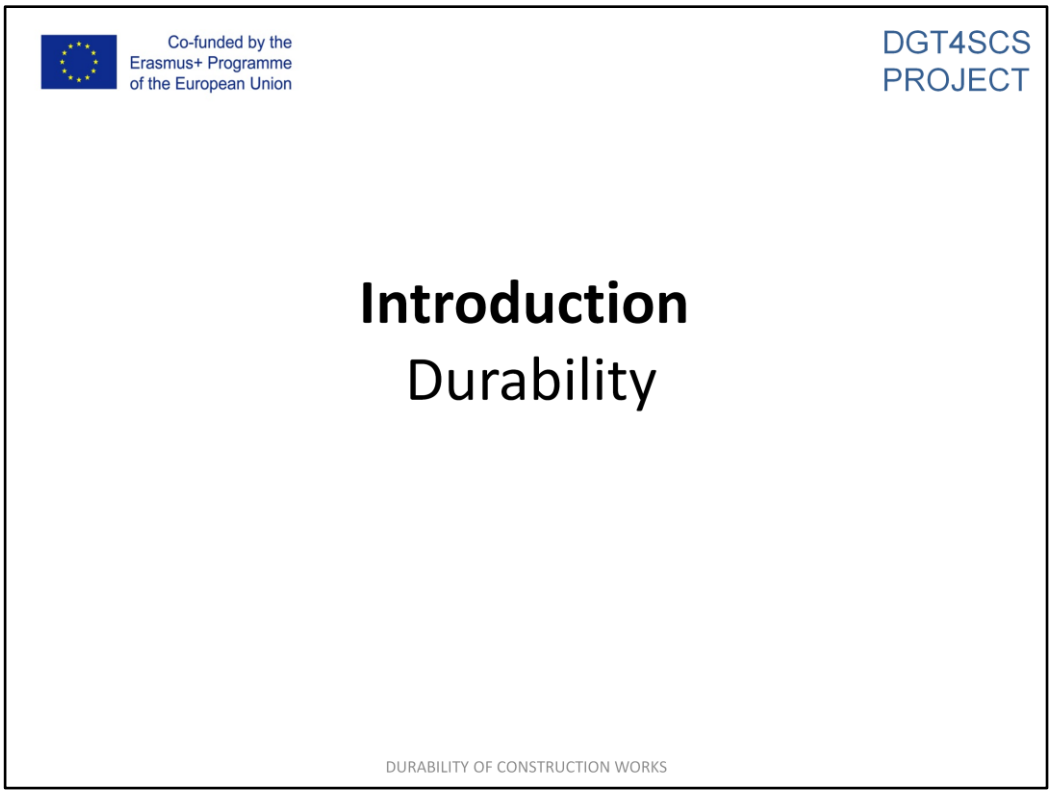


Notes for the trainer and additional information:

The construction areas in which the main competence of the topic "Durability of construction works" can be used.

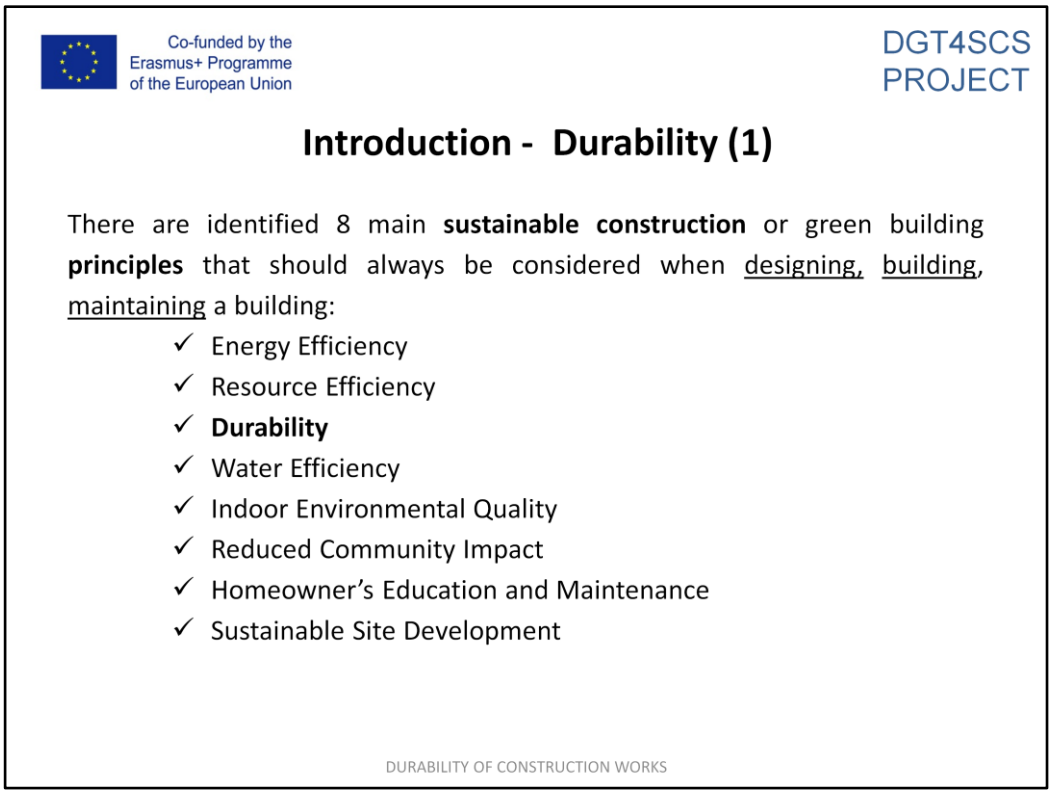
Fields of Education and Training.
Programmes and qualifications with the main content classified under 0732 Building and civil engineering according to the ISCED-F (2013)

Due to a fact that the training module is designed with possibility to adapt it to specific qualification, to make it more general or more specific, according to trainee's experience, background and level of knowledge as well as in line with a particular qualifications – areas to use competences and knowledge acquired from this topic may be significantly varied.



Notes for the trainer and additional information:

See the next slides.



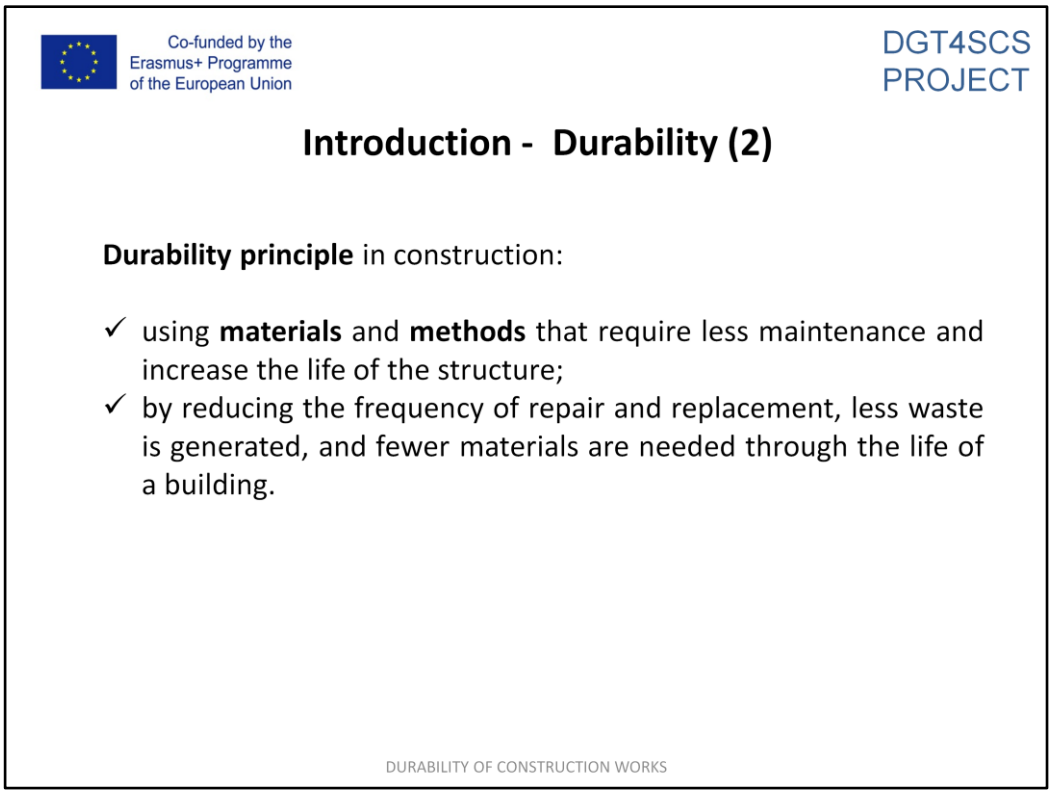
Source:

Kruger A., C. Seville. *Green Building: Principles and Practices in Residential Construction*. Delmar Cengage Learning: 2013. 21 p.

Notes for the trainer and additional information:

These principles are similar to the approach defined by LEED, BREEAM and other green building rating systems.

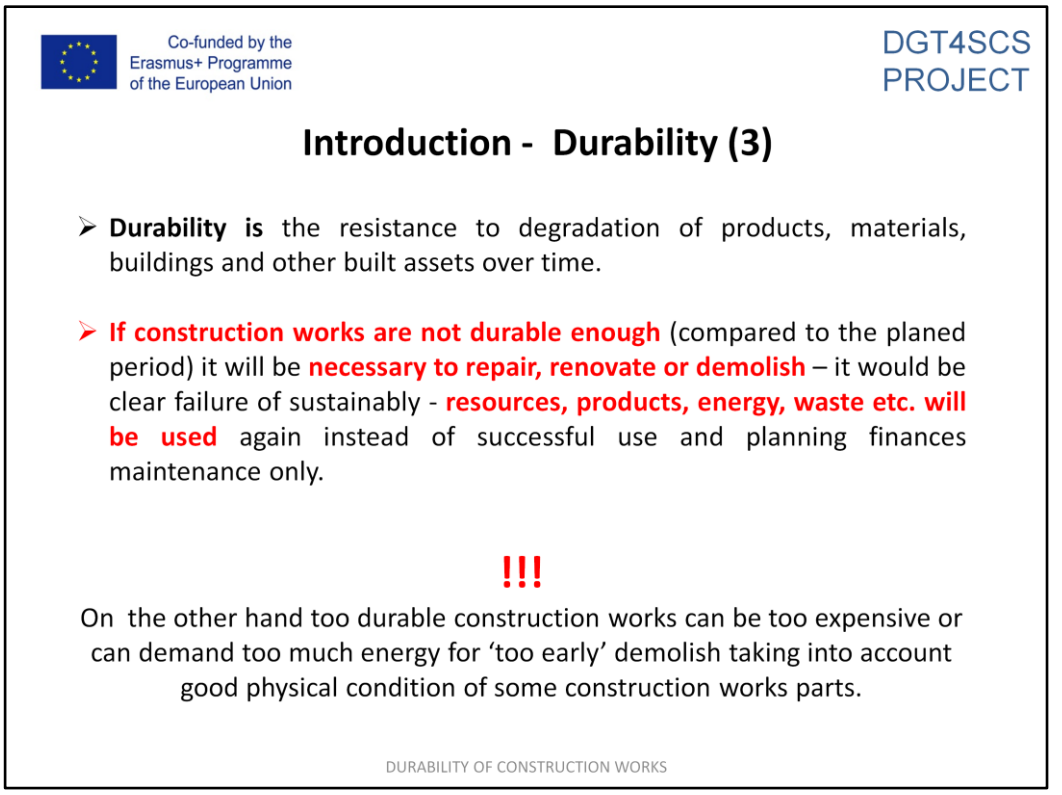
The principle "Durability" is considered within this module.



Source:

Kruger A., C. Seville. *Green Building: Principles and Practices in Residential Construction*. Delmar Cengage Learning: 2013. 21 p.

Notes for the trainer and additional information:



Source:

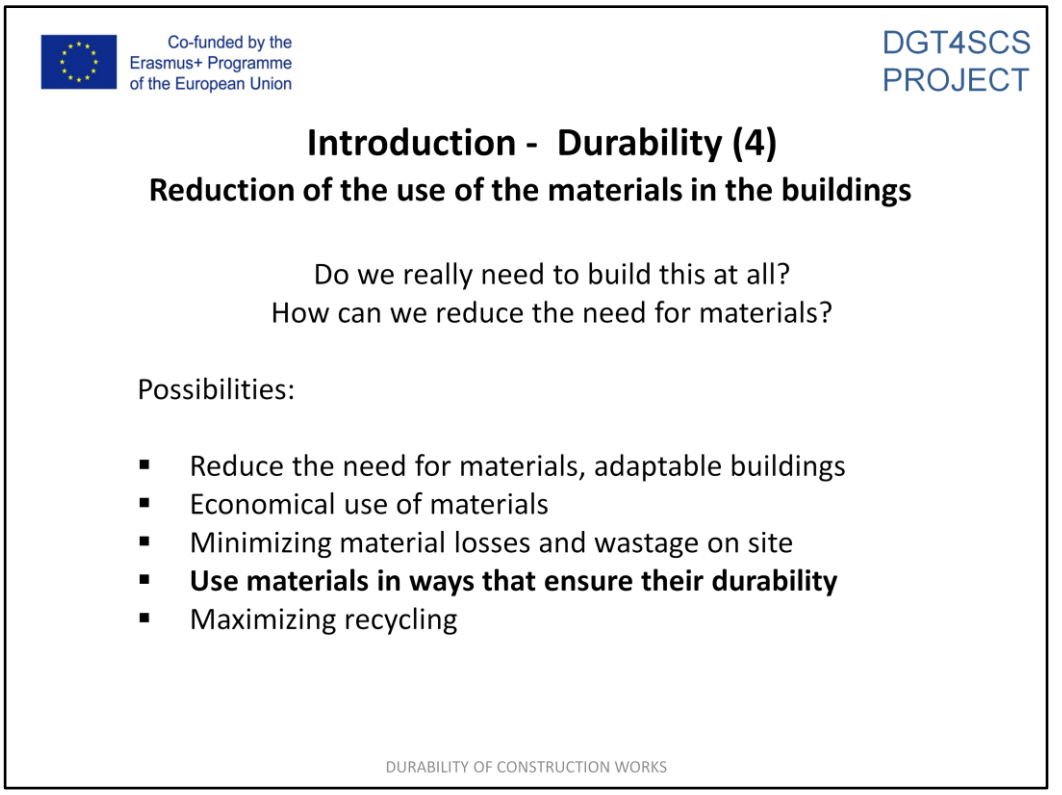
Expert guidelines for Construction Specialists' Training on Sustainability. 2020. 10 p.
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 8-18 p.

Notes for the trainer and additional information:

The **construction works designed to be used for a specific time period taking into account certain maintenance actions and measures** under 'normal' exploitation conditions within allowable degradation.

It is still a general rule that **by producing more durable products** (construction materials, construction works, buildings) **the use of raw materials is reduced.**

On the other hand, there is a point **where long-lasting buildings become an economic or environmental burden**; it becomes difficult to upgrade or adapt them any further, and their replacement would save resources due to technological advances and efficiency gains.
The resources saved by continuing to use an old, energy consuming building have to be weighed against the new materials needed to build a replacement building that can save much energy over the following 50 or 100 years. Comparative lifecycle assessments can be made to inform such decisions.
!!! The key question is thus optimum rather than maximum durability.



Source:

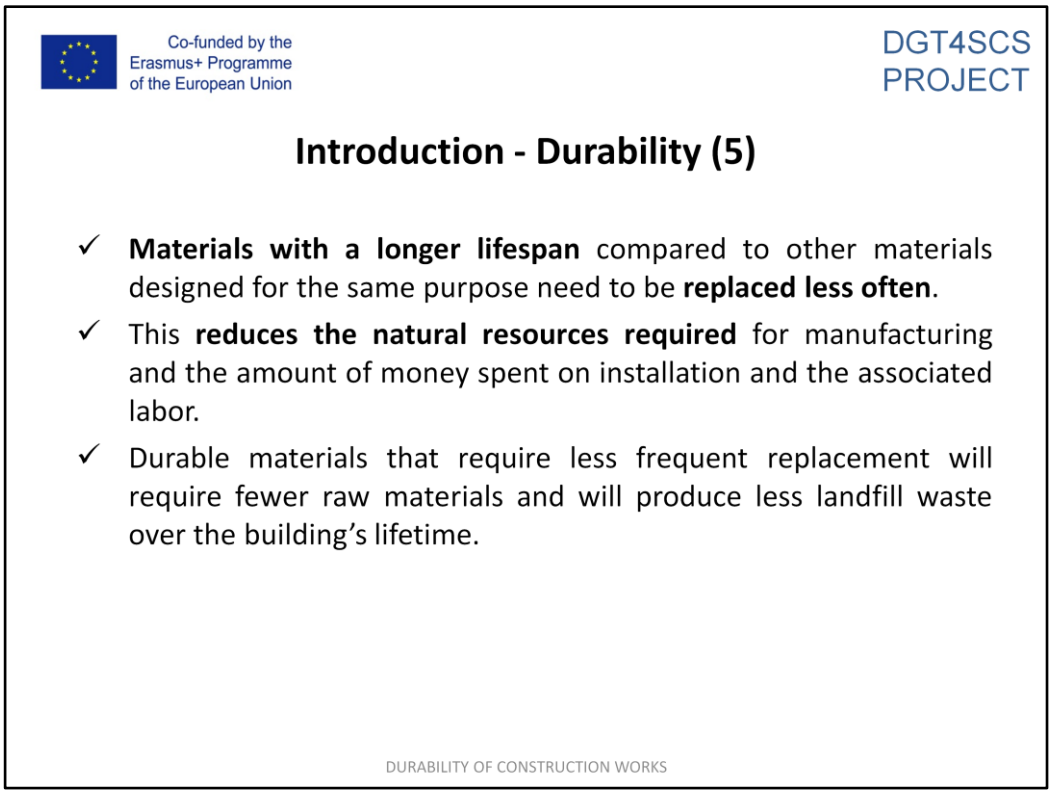
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 8-18 p.

Notes for the trainer and additional information:

For "Economical/efficient use of materials" and "Minimizing materials losses" see Training Module topic "Use of other resources in construction, use, repair and construction works"

Connection to other topic within the training material

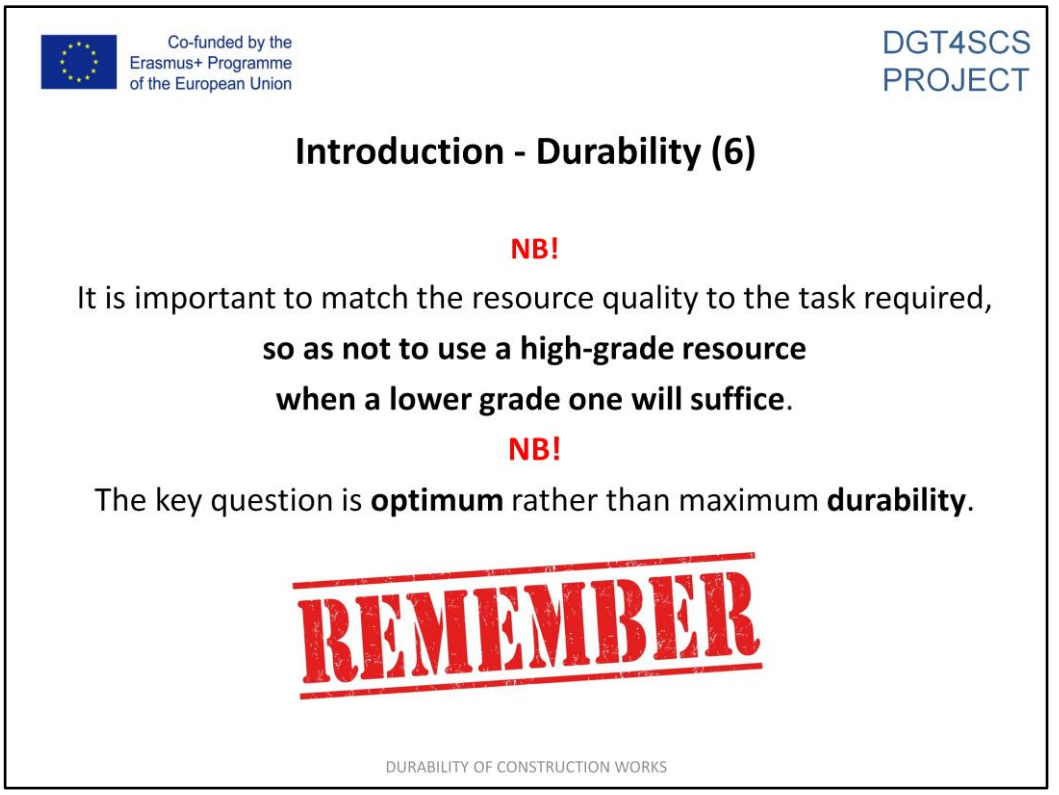
"Use of other resources in construction, use, repair and construction works"



Source:
Kim J., Rigdon B., *Qualities, Use, and Examples of Sustainable Building Materials***.** College of Architecture and Urban Planning The University of Michigan.

Notes for the trainer and additional information:

The durability of materials is an important factor in analyzing a building's life-cycle costs.
Materials that last longer will, over a building's useful life, be more cost-effective than materials that need to be replaced more often.
By looking at durability issues, the selection of initially expensive materials like slate or tile can often be justified by their longer lifespans.



Source:

Berge B., *The Ecology of Building Materials*. Routledge: 2009. 8-18 p.
Expert guidelines for Construction Specialists' Training on Sustainability. 2020. 10 p.

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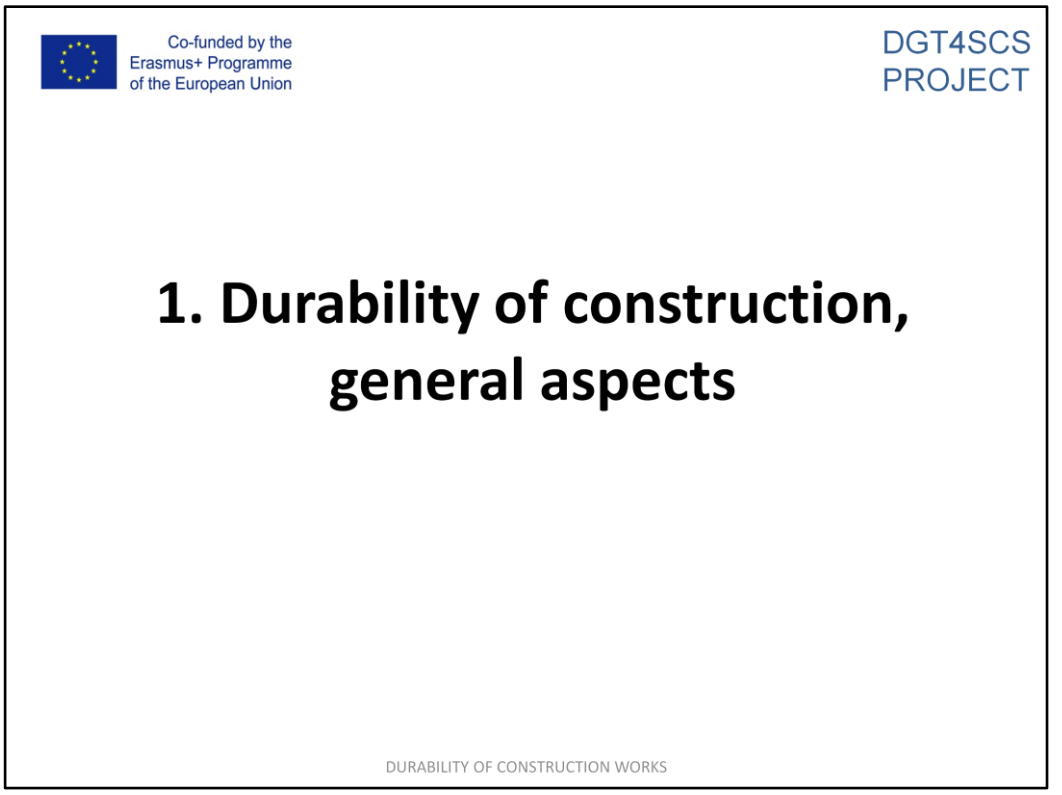

Notes for the trainer and additional information:

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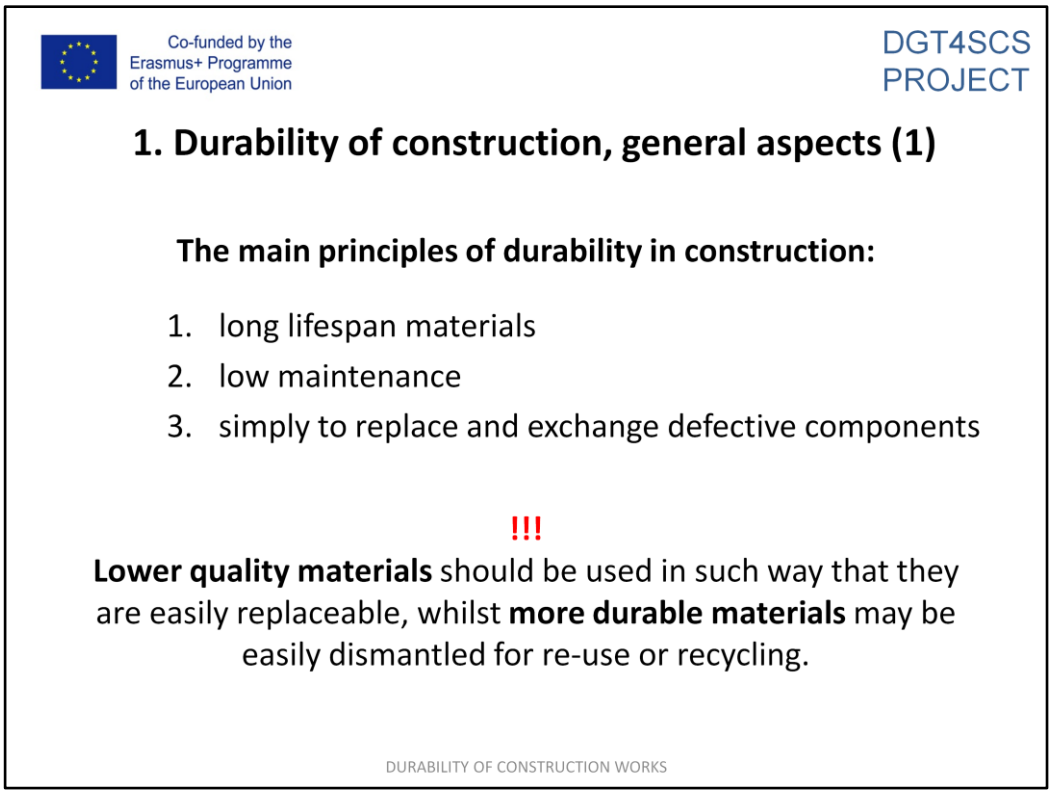


Source:

Using ecological construction materials in the Baltic States, p.8., In " *Ecology of construction materials*. A handbook. Baltic Environment Forum"
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 10-13 p.

Notes for the trainer and additional information:

- ✓ The durability of many products depend on regular maintenance. Material may have a short life span if not maintained or may have a very long life if properly maintained (e.g. wood products, which require repainting or refinishing at regular intervals to prevent moisture or ultraviolet damage)
- ✓ The exchanging and replacing of must be simplified in order to extend the building`s life cycle (**screwed or inserted joints prior to glued joints if possible).**

The **durability** of a material is dependent on building type, design, use, installation, and maintenance.

It is not possible to simply list the products that have been found to be durable in some projects and expect them to be the best choice for every project. There is no standard or widely accepted methodology for evaluating the durability of building materials.

But there are criteria to be considered for evaluating durability: disposal frequency indicated by e.g., manufacturers warranty period; durability based on appropriate maintenance, durability based on compatibility & interdependency* of materials in the construction unit.

*Compatibility and interdependency describe the relationship between the various parts of a system to make the whole system function as designed and ensuring a long life span of the construction unit.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

1. Durability of construction, general aspects (2)

The **lifespan of materials** depends on the following **factors**

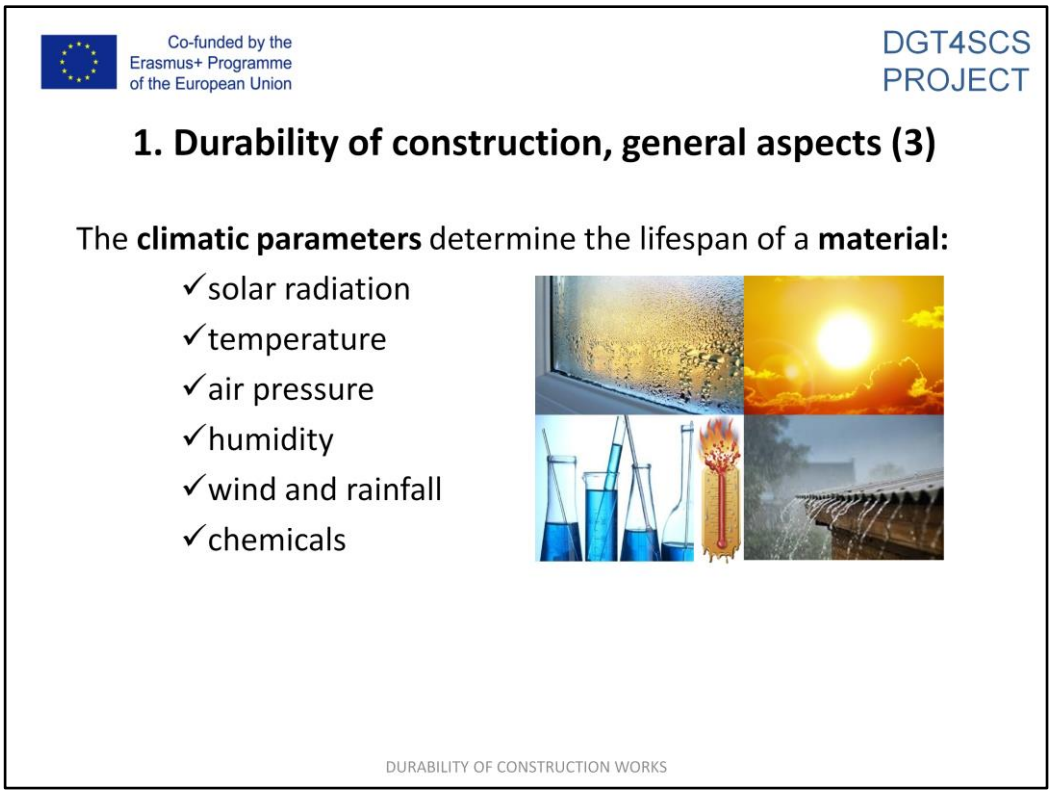
1. the material itself, its physical structure and chemical composition.
2. the local environment, climatic and other chemical or physical conditions.
3. the construction and its execution, where and how the material is fitted into the building.
4. maintenance and management.

The best way to determine **the real lifespan** of a material is through long experience and concrete documentation.

Source:

Berge B., *The Ecology of Building Materials*. Routledge: 2009. 10-13 p.

Notes for the trainer and additional information:



Source:
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 10-13 p.

Notes for the trainer and additional information:
Solar radiation. Ultraviolet solar radiation deteriorates organic materials by initiating chemical reactions within the material and causing oxidation. This effect is stronger at high altitudes where the ultraviolet radiation is more intense, and it also increases toward the equator.

Temperature. The speed of a chemical reaction doubles for every 10C increase in temperature. Higher temperatures therefore increase the deterioration of organic materials. Heat also stimulates deterioration processes in combination with solar radiation, oxygen and moisture.
At low temperatures, materials such as plastic and rubber freeze and crumble. Aporous low-fired brick only lasts a couple of winters in northern Europe - whereas in the Forum in Rome the same brick has lasted 2000 years. Above all the cycle of freezing and thawing is a deciding factor for most porous mineral materials. The coastal climate of the North is also very deleterious. Wide changes in temperature strain materials, even without frost, and will cause deterioration.

Air pressure. Air pressure affects the volume of and tensions within materials that have a closed pore structure, such as foam glass and various plastic insulation materials. Sealed windows will also react. Changes in size that occur have the same effect as temperature changes.

Humidity. Increased humidity can increase deterioration both physically, and by creating an environment for harmful fungus and microbial growth as well as insect attack. Changes of humidity also cause deterioration through changes in volume and stresses within the material. The stable air conditions (rooms with a very stable air moisture content) should ideally also be applied to building interiors in order to reduce the deterioration of surface materials and to facilitate cleaning.

Wind and rainfall. Conditions are at their worst when wind and rain come simultaneously. Then dampness can be driven into the material and start the deterioration process. Strong winds cause pressure on materials that may even lead to fracture or collapse. Wind combined with sand or sea salt can have a devastating effect on certain materials.

Chemicals. Along the coast the salt content of air can corrode plastics, metals and certain minerals. In industrial areas and in the vicinity of heavy traffic, aggressive gases such as sulphur dioxide can break down a variety of different materials. Concrete suffers from so-called 'concrete sickness' where the calcium content is broken down in aggressive environments. This also occurs with certain types of natural stone - as witnessed in the deterioration of many ancient monuments due to modern pollution.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

1. Durability of construction, general aspects (4)

Problem

During construction, many materials are exposed to rain or humidity. Sealing damp materials into buildings is a principal cause of subsequent defects.

Solutions

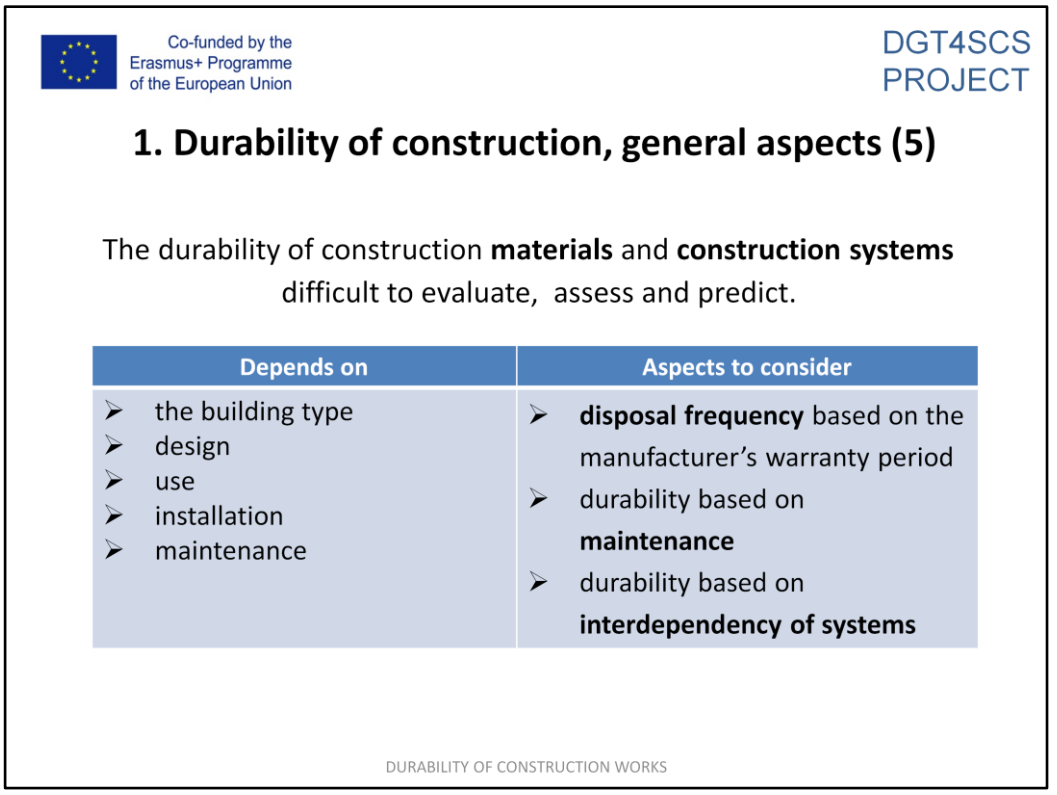
1. Careful site management routines and storage
2. Construction systems where the load bearing structure and roof covering are assembled first
3. Construction canopy systems, called Weather Protection Systems

DURABILITY OF CONSTRUCTION WORKS

Source:

Berge B., *The Ecology of Building Materials*. Routledge: 2009. 10-13 p.
Krag. Weather protection. Available from: https://www.krag.lv/weather-protection.html [Accessed 1 November 2020].

Notes for the trainer and additional information:



Source:
Using ecological construction materials in the Baltic States, p.10, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

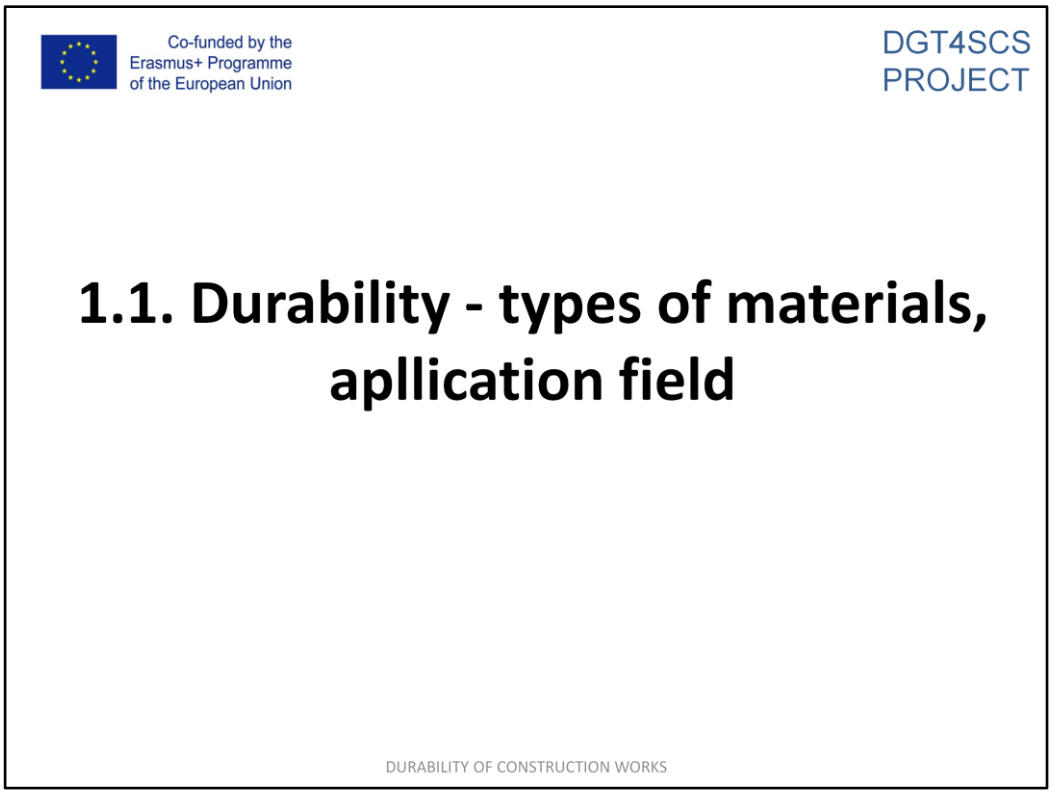
There are a number of aspects that have commonly been used in **evaluating building materials** and considered when selecting materials if the goal in mind is "sustainability" – one of them **is durability:**

- ✓ How durable is the material?
- ✓ How much and what kind of maintenance does it require over its life time?
- ✓ How well does the material perform in a relationship with other parts of a system to make the whole building function as designed in the given e.g., climatic conditions?

Selecting durable materials besides cost savings to the building owners also reduces waste going to landfill, and reduces the raw materials and energy consumption needed for production of materials.

It is not possible to simply list the products that have been found to be durable in some projects and expect them to be the best choice for every project. There is no standard or widely accepted methodology for evaluating the durability of building materials. But there are criteria to be considered for evaluating durability: disposal frequency indicated by e.g., manufacturers warranty period; durability based on appropriate maintenance, durability based on compatibility & interdependency of materials in the construction unit.

- ✓ Disposal frequency – the anticipated shelf life of a system or product before it must be removed and replaced – estimation can be based on the manufacturer's warranty period;
- ✓ Durability based on maintenance – some products may have a short life span if not maintained or may have a very long life if properly maintained (e.g. wood products);
- ✓ Durability based on interdependency of systems – depends on the relationship between the various parts of a system to make the whole system function as designed.



Notes for the trainer and additional information:

The following slides give information of the **durability aspects** to consider for several selected types **of materials and products** – conventional and ecological – common used for the construction of **(1) basements, (2) walls, (3) roofs, (4) windows and doors, (5) insulation and (6) finishing**.

NB! The information at this subtopic should be adapted according to the level of education and knowledge of the trainees who will be trained within this module.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (1)

Aspects to consider

Construction element	Material	Durability and inderdependency
Basement/ Walls 	Concrete	✓ Hard wearing and long lasting, but once it has started cracking or becoming uneven, needs to be replaced or covered with further layers of new concrete. ✓ Non-biodegradable.

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.11-13, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Concrete is the most widely used material for the construction of basements. Most often it consists of ~12M% cement, ~6M% water and aggregates (gravel sand, rock cuttings, recycled brick gravel). Additives or additional substances are added when required. There is a large variety of products (massive, light-weight, reinforced with steel, etc.) for multiple application is available.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (2)

Aspects to consider

Construction element	Material	Durability and inderdependency
Walls 	Timber	✓ Well suited for pre-fabricated constructions (carcass, panel houses). ✓ Durability depends on proper installation, maintenance, treatment and type of wood.
Walls 	Straw	✓ Biodegradable product. ✓ No standardisation in material supply thus making durability estimates difficult, but there are examples of 100 year old straw bale buildings (e.g. Nebraska, USA).

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States , p.11-13, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Timber is a renewable source widely available in all three Baltic States. Thus, there is a good variety of timber products available on the market. Timber products show a good balance between the strength and weight of the material. Most commonly timber is used for single family or low storey (2-3 storey) buildings.

Straw

A lot of agriculture waste – straw still remains unexploited. Straw in buildings can be applied in load-bearing constructions (mounted straw bales) and in non-load bearing constructions where bales of straw are used as an infill in the framework of the basic structure of a building e.g. timber frame. Examples and experiences usually reflect small, single family buildings. These are individual pilot projects.

- In Latvia the building code "Fire protection of buildings" LBN 201-07 **allows timber frame constructions of up to 4 floors.**
- If a building is higher than 2 floors, it is mandatory to design fire protection systems (i.e. fire separation zones in exterior building finishing) and sprinkler systems. These systems raise the costs of building.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (3)

Aspects to consider

Construction element	Material	Durability and inderdependency
Windows	PVC frame 	✓ Moderately durable, low maintenance, does not require painting, however if problems with window frames occur while in use, refurbishment might be complicated. At high temperatures may expand and warp; at extremely low temperatures may crack. Good moisture resistance. ✓ It is important that PVC windows have a good micro-ventilation system built-in in order to reduce water condensation on glass.
	Aluminium frame 	✓ Very durable, requires low maintenance. ✓ Contacts between different metals should be avoided in order to prevent materials from corroding.

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.13-15, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Aluminium frame windows

These windows are lightweight, but conduct heat very rapidly, thus in order to improve the energy efficiency they should have an insulating plastic strip placed between the inside and outside of the frame and sash.

PVC frame windows

Polyvinyl chloride (PVC) is a synthetic material, made up of alternating units of vinyl chloride. PVC frame windows are widely used, mostly due to their good thermal and sound insulation properties as well as the lower price in comparison to other e.g., wooden frame windows.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (4)

Aspects to consider

Construction element	Material	Durability and inderdependency
Windows 	Wooden frames	✓ Expand and contract according to weather conditions. Frames are less affected by temperature; but can be affected by moisture and thus require the most maintenance (repainting is usually required every 5 years). Composite frames have better moisture and decay resistance. ✓ Easy to repair. ✓ Aluminium-clad timber frames are expected to have lifetimes of in excess of 40 years. PVC by comparison is around 25 years.

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.15, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Wooden frames in general give an attractive appearance to a building, but can be heavier and thicker than other frames. In recent years, high quality wooden windows with very good insulation properties can be found on the market. When choosing wooden frame windows the economic aspect starts to play a role, because of the relatively high costs of good quality timber. For example, in Latvia prices for wooden frame windows are 25-40% higher than PVC frame windows.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (5)

Aspects to consider

Construction element	Material	Durability and inderdependency
Roof	Metal 	✓ Very durable (>60 years). Has very good ability to withstand a wide range of weather conditions. ✓ Low maintenance costs. ✓ Because it is lighter than e.g., tiles, puts less stress on walls and rafters . ✓ High fire resistance.
	Bitumen 	Durability >30 years ✓ Require relatively low maintenance, can be easily repaired if damaged. ✓ Compatible with various roof designs.

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.16-18, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Metal

Various types of metal roofs in various profiles and colours are available on the market. Most common are steel products. Most steel sheet products are produced through the basic oxygen furnace process, which uses 25 to 35 % old steel to make new steel.

Bitumen is a product of petroleum processing. Bitumen sealing sheets are available in a large variety and colours, typically cheaper than other roofing materials. Lightweight and suitable for most types of roofs.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (6)

Aspects to consider

Construction element	Material	Durability and inderdependency
Roof 	Clay tiles	✓ Very durable (>70 years). Can last even longer than the material on which the roofing rests. ✓ Very high fire resistance. ✓ Tiles are very heavy - extra roof support can be required. ✓ If colour is added and only on the surface of the tile, colour can fade over time. ✓ Tiles are fragile, so walking on them can break them which makes it more difficult to carry out maintenance. ✓ Initial installation can be more complicated than other roofing materials.

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.16-18, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Clay tiles

Widely used in the 19/20th centuries and earlier, currently clay tiles are applied much less. More frequently they are used on roofs of separate family houses. Like bricks, tiles can be hand-made or machine-made. Clay tiles are manufactured from kaolinite clay with various additives. The minerals are vitrified to bind the tiles at a high firing temperature in excess of 1100°C, the higher the temperature the longer the life of the tile.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (7)

Aspects to consider

Construction element	Material	Durability and inderdependency
Roof 	Reed	✓ Life period ~25-40 years, if applied properly can serve for more than 100 or even 600 years (depending on quality of construction works and material, roof angle, climatic conditions) ✓ Top layer periodically needs to be cleaned from moss. Areas of decay in a thatched roof can be removed and patch-repaired. Particular care is required to ensure the underneath of the thatch has adequate ventilation to prevent premature rotting. ✓ Construction quality is very important with respect to fire resistance and durability - high skilled experienced craftsmen are required. Nevertheless, sensible precautions should be taken to reduce the fire risk during the use of the house.

DURABILITY OF CONSTRUCTION WORKS

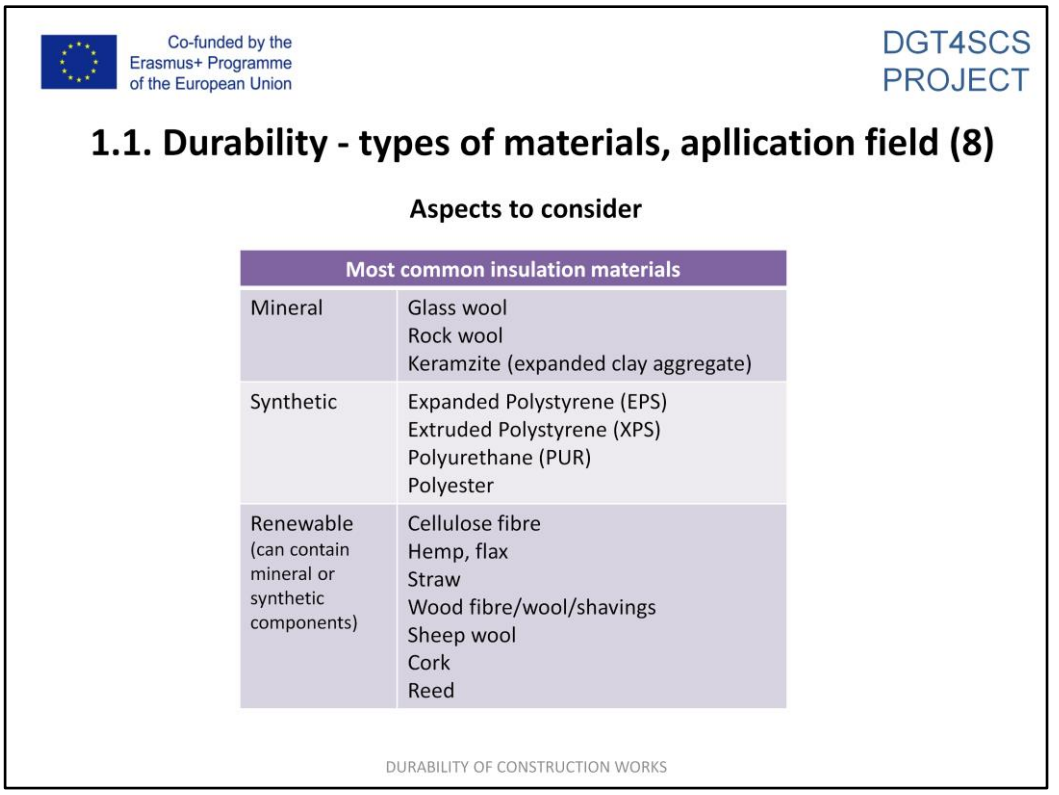
Source:

Using ecological construction materials in the Baltic States, p.16-18, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Reed

The reed roofs are most common for separate family houses located in the countryside, commercial buildings – old fashioned restaurants and small constructions e.g., pergolas, saunas. Reeds are flexible thus suitable even for very complicated architectural roof designs. For residential houses the roof thickness is ~25-45 cm thus having good sound and insulation properties, but combinations of insulation in different positions may still be necessary.

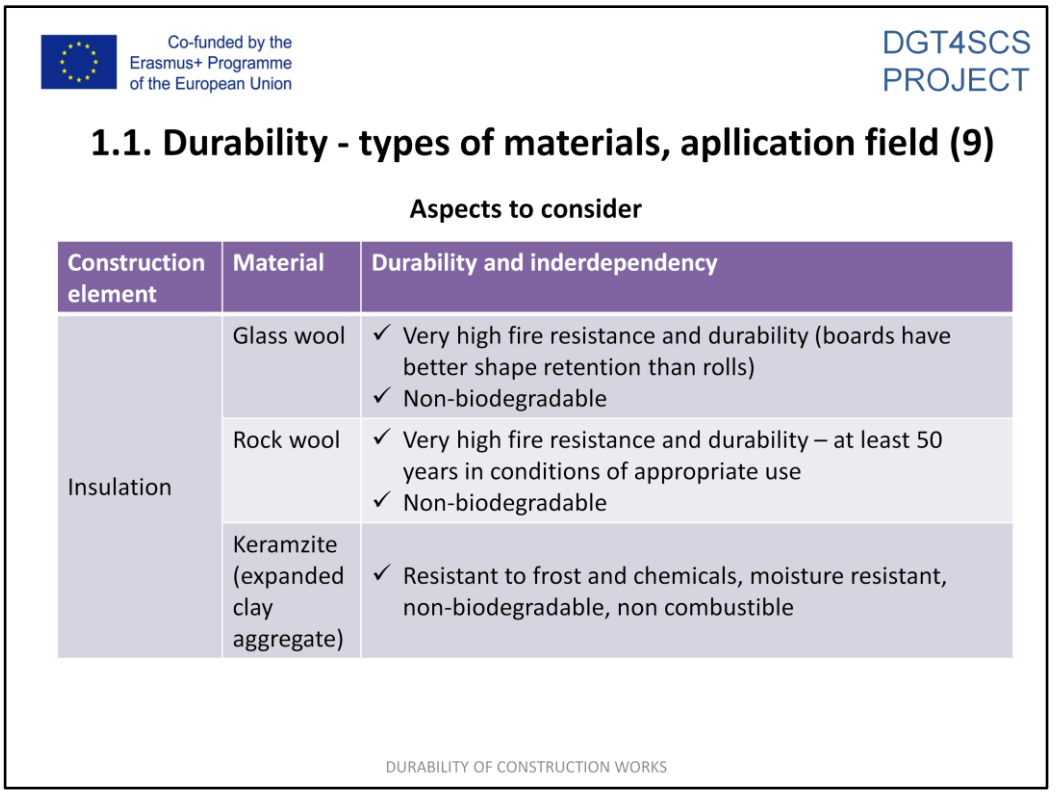


Source:

Using ecological construction materials in the Baltic States, p.19, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Insulation is a key component of sustainable building design. A well insulated home reduces energy bills by keeping warm in the winter and cool in the summer. This in turn cuts down carbon emissions linked to global climate changes. In terms of energy efficiency, investing in high levels of insulation materials for buildings is more cost-effective than investing in expensive heating technologies.



Source:

Using ecological construction materials in the Baltic States, p.19-20, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Glass wool

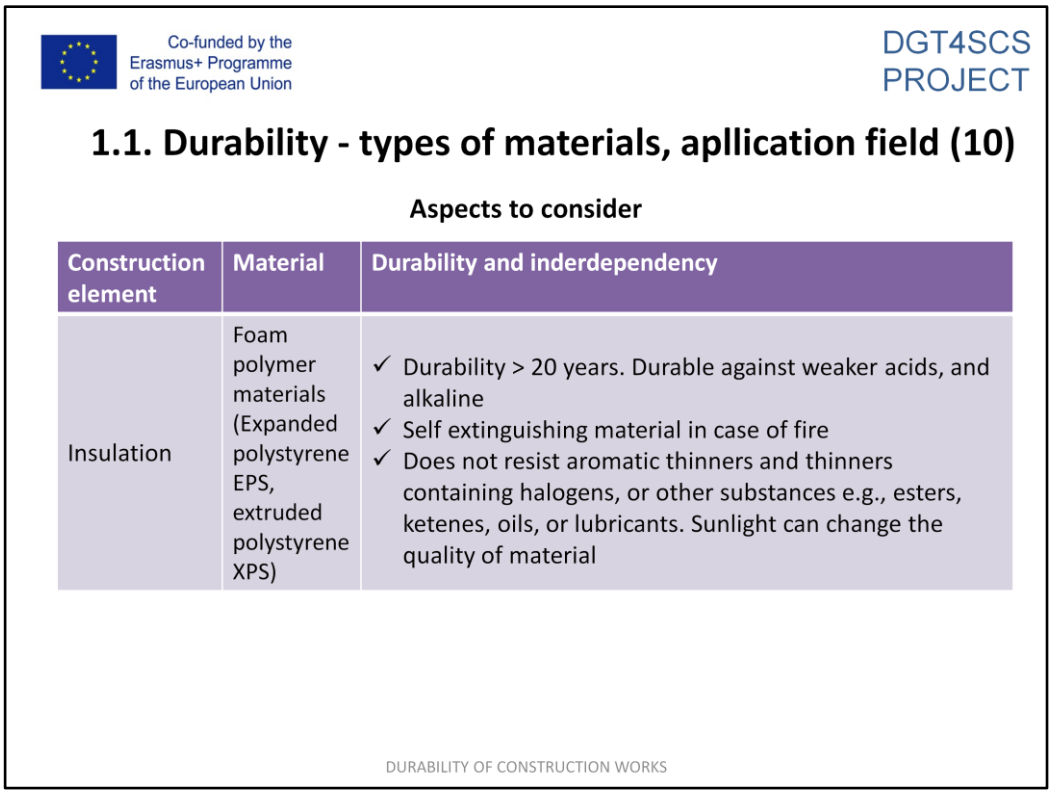
Produced from a mixture of sand and waste glass. The mixture is melted at a temperature >1300°C. The molten mass is pressed through small openings by centrifugal force, cooling on contact with the air. The bonding agent is sprayed on to the fibres. At a temperature of ~200°C the bonding agent polymerises. Afterwards, the wool is cut and packed in rolls or panels under very high pressure. Has good thermal and insulation properties. Wide range of application in constructions.

Rock wool

Consists of mineral raw materials (e.g., dolomite) that are processed into fibres. The mineral raw material is melted along with coke, recycled wool and small amounts of lime at ~1500 °C. The molten mass then flows over disks rotating at high speeds to create fibres while cooling at the same time. Mineral wool insulation materials should be built under the driest possible conditions and given long-term humidity protection.

Keramzite (expanded clay aggregate)

For production of this material clay is palletised and fired in a rotary kiln at a very high temperature. The organic compounds in the clay burn off forcing the pellets to expand. The resulting ceramic pellets are lightweight, porous and have a high crushing resistance. Used for insulation of walls, ceilings and floors. Has good sound and thermal insulation properties.



Source:

Using ecological construction materials in the Baltic States, p.21, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Foam polymer materials (Expanded polystyrene EPS, extruded polystyrene XPS)

Foamed polystyrene sheets are widely used for insulation due to very good insulation properties and price. EPS consists of ~94M% polystyrene, ~5M% pentane, ~1% hexabromcyclodododecane flame retardant and dicumyl peroxide, small amounts of PE waxes, paraffin, and metal salts from fatty acids. XPS is produced by extrusion using polystyrene granules containing a number of additives with the help of a foaming agent. EPS panels can be used for insulation and sound isolation in areas not affected by moisture, while XPS panels are non-moisture sensitive. Panels are lightweight thus easy to use without any additional mechanisms.

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DGT4SCS PROJECT

1.1. Durability - types of materials, apllication field (11)

Aspects to consider

Construction element	Material	Durability and inderdependency
Insulation	Cellulose	✓ Long life time ~100 years if applied as advised ✓ With regard to fire resistance belongs to the group of hard flammable materials.
	Wood fibre	✓ Dimensionally stable, high mechanical resistance, UV and moisture resistant, good fire resistance properties ✓ Not affected by rodents
	Sheep wool	✓ Sheep wool is naturally flame retardant, self extinguishing ✓ Producers state that insulation maintains its form and will continue to perform for the life of the building

DURABILITY OF CONSTRUCTION WORKS

Source:

Using ecological construction materials in the Baltic States, p.22-23, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Cellulose

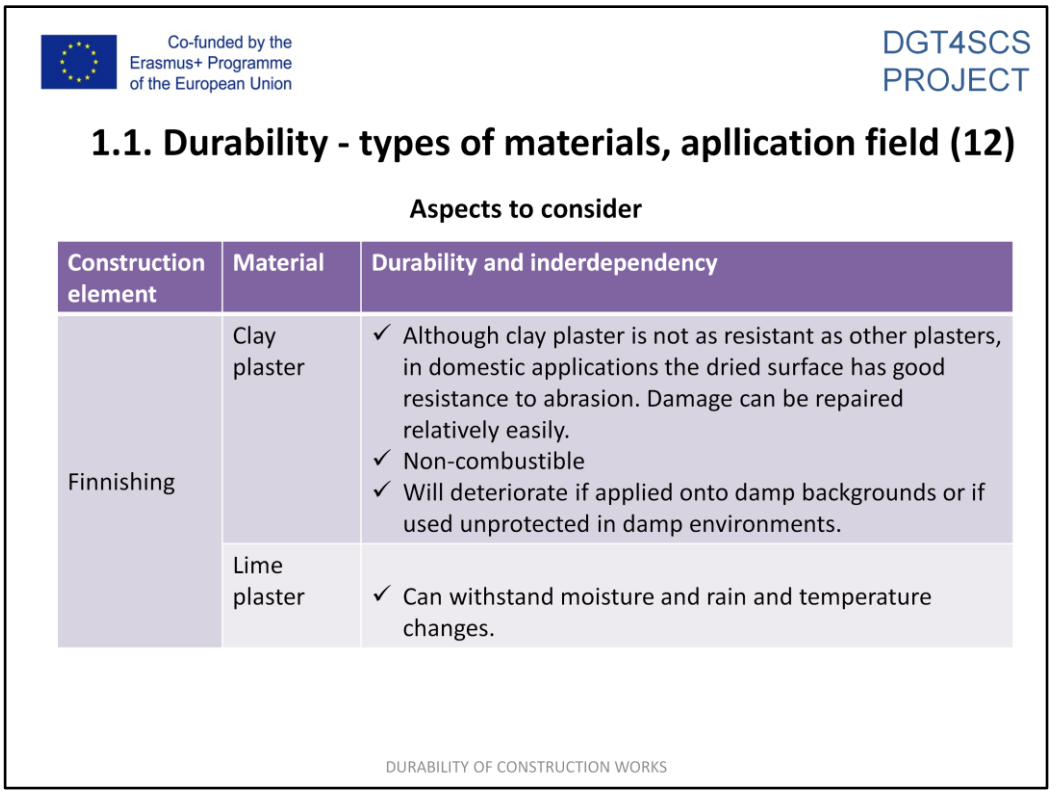
Cellulose insulation material can be produced from cellulose fibre e.g., recycled paper (~82%). It is one of the most favoured materials of eco-builders because it can be blown into cavity walls, floors and roofs; used as a loose fill; and is also available in quilts and boards that can be installed manually.

Wood fibre

The so called fibrolite is one of the materials used for insulation of basement, floors and ceilings etc. It is also used as a sound protection barrier. Fibrolite consists of wood wool (by-product from the forestry industry), cement and water.

Sheep wool

Sheep wool performs exceptionally well in thermal insulation as well as in sound insulating applications. Available in rolls and batts. Wool insulation can be used in the roof, walls and floors of any building type. Installing wool insulation is very similar to installing conventional insulation batts. Sheep wool insulation is attracting growing interest in Europe.



Source:

Using ecological construction materials in the Baltic States, p.24, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

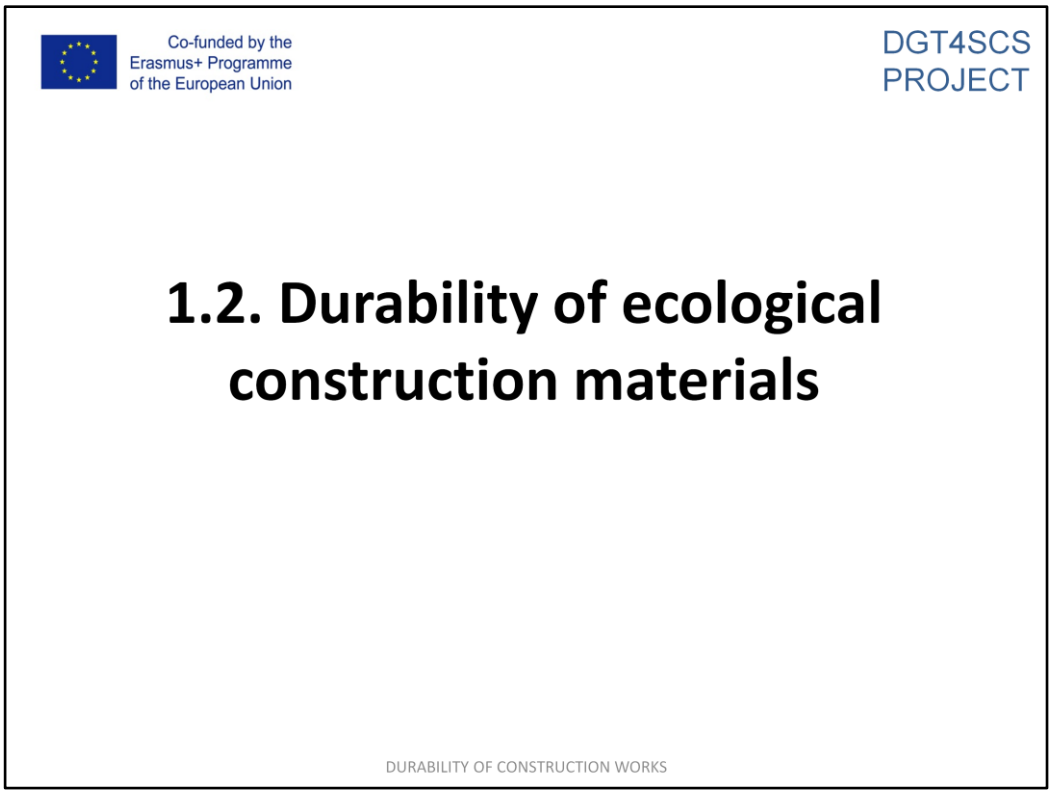
Notes for the trainer and additional information:

Clay plaster

Clay plaster is a blend of clay, fine aggregate (sand) and organic fibres. As a product it is supplied as a dry powder. In our climatic (Latvia) conditions clay plaster is most suitable for interior finishing. It absorbs heat well, regulates moisture and creates a pleasant indoor climate. It can be left in a natural clay colour or painted with a natural paint.

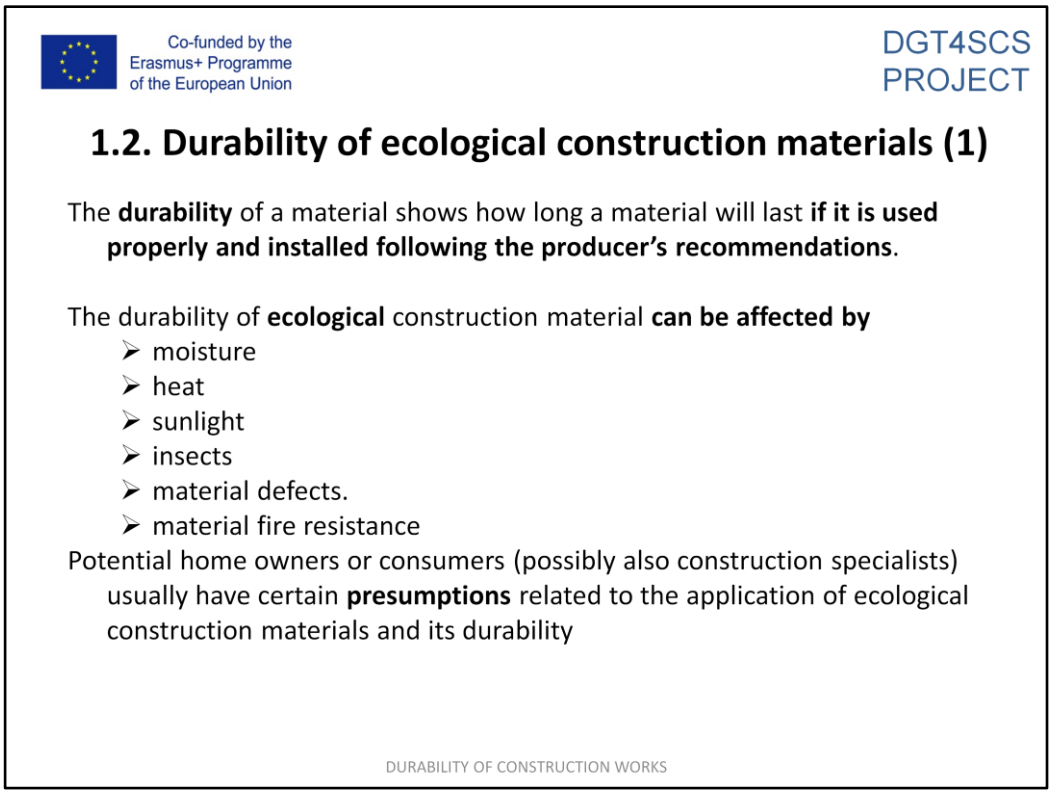
Lime plaster

Lime plaster is usually a mixture of lime, sand, smashed limestone and reinforcing fibres. It is suitable for internal and external works. Similarly to clay, lime plaster regulates the humidity of rooms and stabilises the temperature. Lime plastered surfaces are antistatic thus very suitable for the homes of people with allergies.



Notes for the trainer and additional information:

See the next slides



Source:

Using ecological construction materials in the Baltic States, p.27-28, In *"Ecology of construction materials*. A handbook. Baltic Environment Forum"

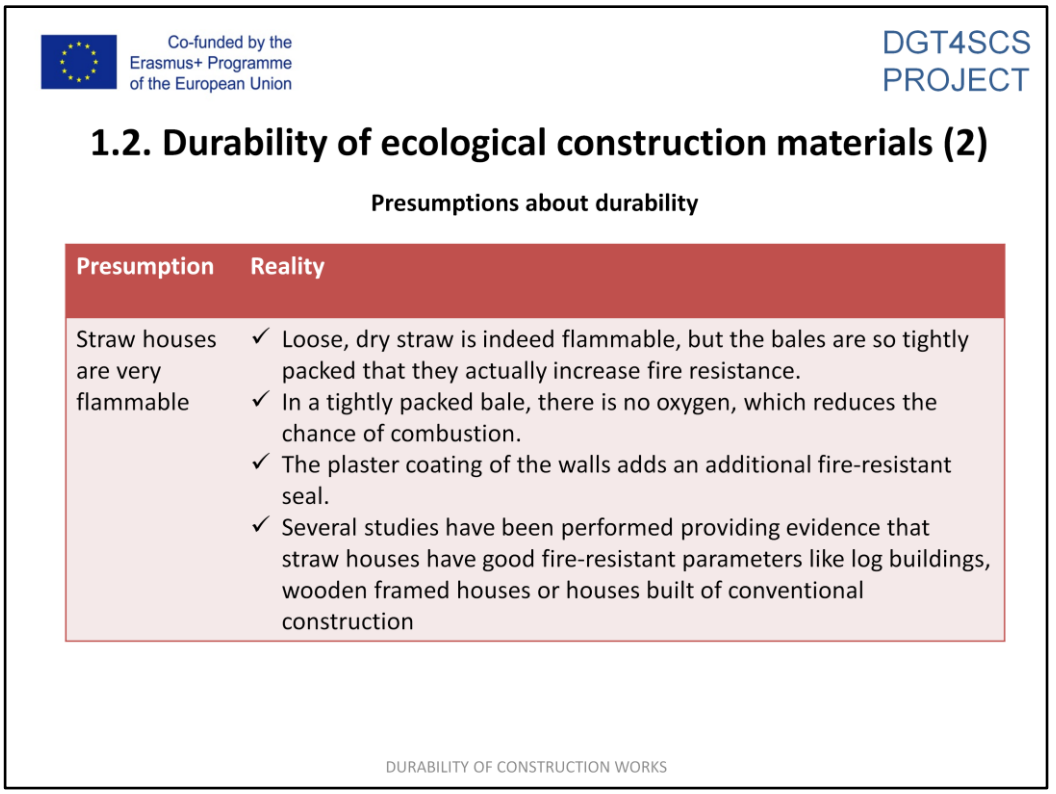
Notes for the trainer and additional information:

Many construction materials have various application possibilities. Thus it is very important to follow producer's recommendations on how to install and operate these materials correctly and to protect them from rain, wind and snow and other impacts. Inappropriate handling can be the reason for a short life time of the material or for an early need for renovation.
Fire-resistance is an additional important parameter to be considered when selecting a material.

A lot of potential home owners before starting to build their house consider, the design of the house, utilities and construction materials. And consumers (**possibly also construction specialists**) usually have **certain presumptions related to the application of ecological construction materials**, the impact on health and the environment, **durability** and costs that are based on earlier experiences or stories heard.
The most common **presumptions about durability** are indicated here.

Connection to other topics within the training material

"Use of environment friendly construction products and auxiliary materials"



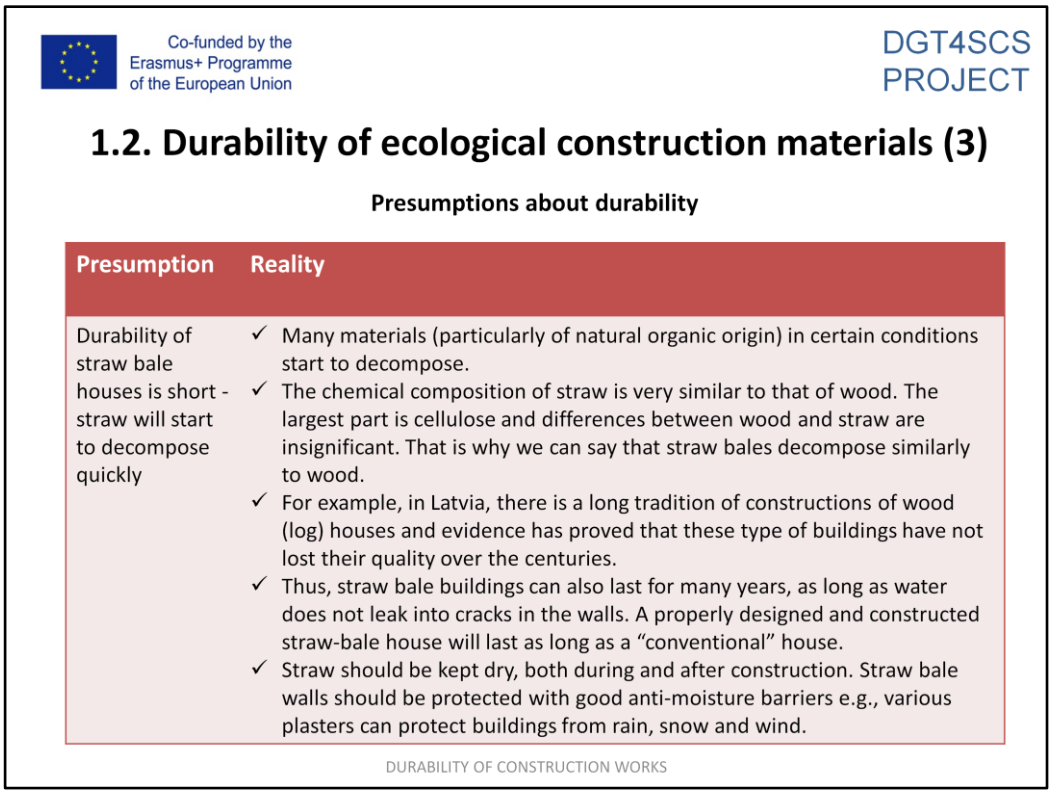
Source:

Using ecological construction materials in the Baltic States, p.27-28, In *"Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Connection to other topics within the training material

"Use of environment friendly construction products and auxiliary materials"



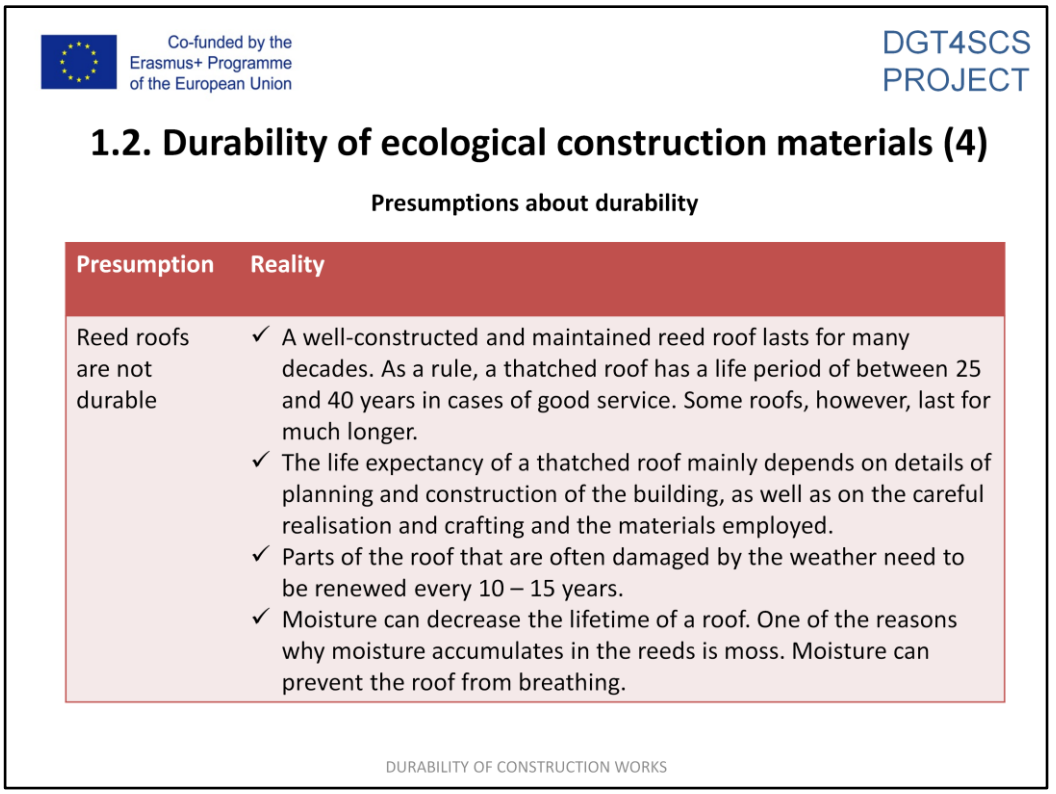
Source:

Using ecological construction materials in the Baltic States, p.27-28, In *"Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Connection to other topics within the training material

"Use of environment friendly construction products and auxiliary materials"



Source:

Using ecological construction materials in the Baltic States, p.27-28, In *"Ecology of construction materials*. A handbook. Baltic Environment Forum"

Notes for the trainer and additional information:

Connection to other topics within the training material

"Use of environment friendly construction products and auxiliary materials"

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DGT4SCS PROJECT

1.2. Durability of ecological construction materials (5)

Example/ Case – Straw houses in Latvia

https://www.youtube.com/watch?v=lvgm74epsUY

Notes for the trainer and additional information:

Latvia:

1. "Salmu mājas" Available from: https://salmumaja.lv/salmu-majas [Accessed 1 June 2020].
2. "Salmu mājas būvniecība – mīti un patiesība par dabai draudzīgo risinājumu." Available from: https://www.delfi.lv/tavamaja/remonts/47110795_salmu-majas-buvnieciba-miti-un-patiesiba-par-dabai-draudzigo-risinajumu [Accessed 1 June 2020].
3. "Ikdiena: No salmiem līdz mājas sienai", author RETV, video Available from: https://www.facebook.com/watch/?v=266677441050523 [Accessed 1 June 2020].
4. https://www.youtube.com/watch?v=lvgm74epsUY [Accessed 1 June 2020]
5. https://www.valmieraszinas.lv/vtv-burtnieku-novada-top-maju-paneli-no-salmiem/ [Accessed 1 June 2020]

Lithuania:

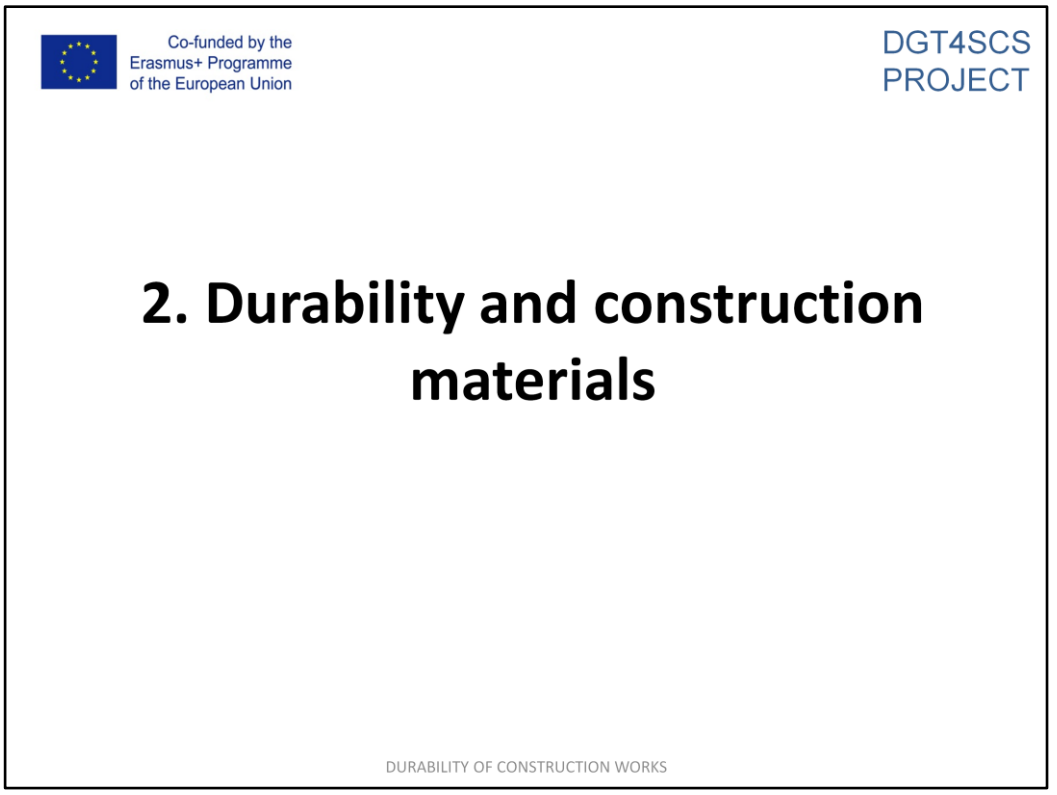
https://www.youtube.com/watch?v=PmBNPv--E44&feature=emb_logo [Accessed 1 November 2020]

Germany:

https://www.youtube.com/watch?v=RjNhJqnva3w [Accessed 1 November 2020]

Connection to other topics within the training material

"Use of environment friendly construction products and auxiliary materials"



Notes for the trainer and additional information:

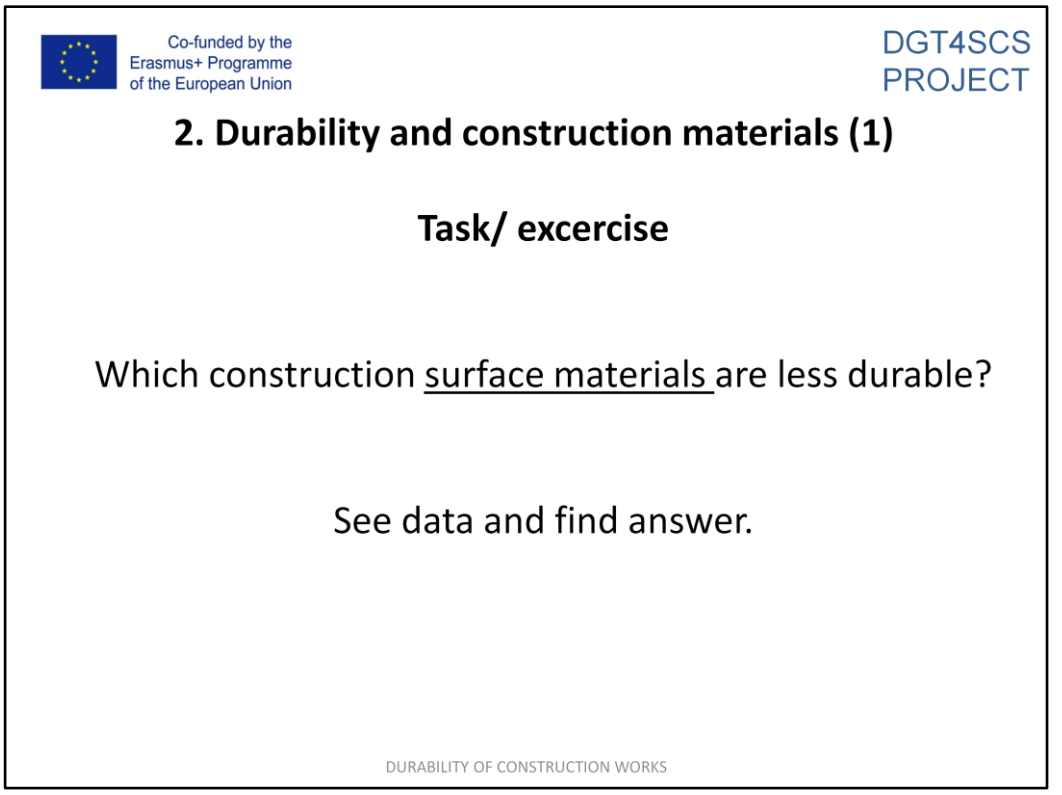
NB! The information at this subtopic should be adapted according to the level of education and knowledge of the trainees who will be trained within this module.

*** **Extra subtopic** can be highlighted by a teacher within a particular training programme – **protection of construction materials** against demolition/destruction during life time of building or construction element.

For example:
Timber constructions need to be protected from humidity. It means that the construction should allow rain to run or drip off. When such wooden constructions are properly designed, chemical treatment might be unnecessary.
Timber constructions need to be protected from vermin and humidity. Joints of different parts should be designed to allow air to circulate between wooden surfaces in order to lead humidity away. Direct contact of wooden surfaces should be prevented with a moisture barrier (foil). Such relatively simple principles can be used instead of chemical treatment

See: Using ecological construction materials in the Baltic States, p.28, In "*Ecology of construction materials*. A handbook. Baltic Environment Forum"

NB! Depends on training programme, qualification.



Notes for the trainer and additional information:

Task:
A trainer shows to the audience next 2 slides with data about durability of surface materials and asks to find less durable materials (or give printed data sheets).

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DGT4SCS PROJECT

2. Durability and construction materials (2)

Roofing

Material	Durability (years)
Corrugated galvanized steel sheeting from ore, 6.8 kg/m^2	30
Corrugated aluminium sheeting from ore, 2.4 kg/m^2	50
Copper sheeting from ore, 5.4 kg/m^2	50
Concrete tiles, 50 kg/m^2	50
Corrugated fibre reinforced cement slabs, 13 kg/m^2	35
Slate, 85 kg/m^2	50
Fired clay tiles, 35 kg/m^2	50
Bitumen sheeting, 5.2 kg/m^2	25
Polyvinyl chloride sheeting,2 kg/m^2	25
Timber, untreated, 18 kg/m^2	15

External cadding

Material	Durability (years)
Galvanized steel sheeting from ore, 3.7 kg/m^2	35
Aluminium sheeting from ore, 1.6 kg/m^2	50
Fibre reinforced cement slabs, 20 kg/m^2	50
Portland cement plaster, 90 kg/m^2	40
Lime sandstone veneer, 96 kg/m^2	50
Lime plaster, 85 kg/m^2	40
Slate, 85 kg/m^2	50
Brick veneer, 108 kg/m^2	50
Timber, untreated, 14 kg/m^2	40

DURABILITY OF CONSTRUCTION WORKS

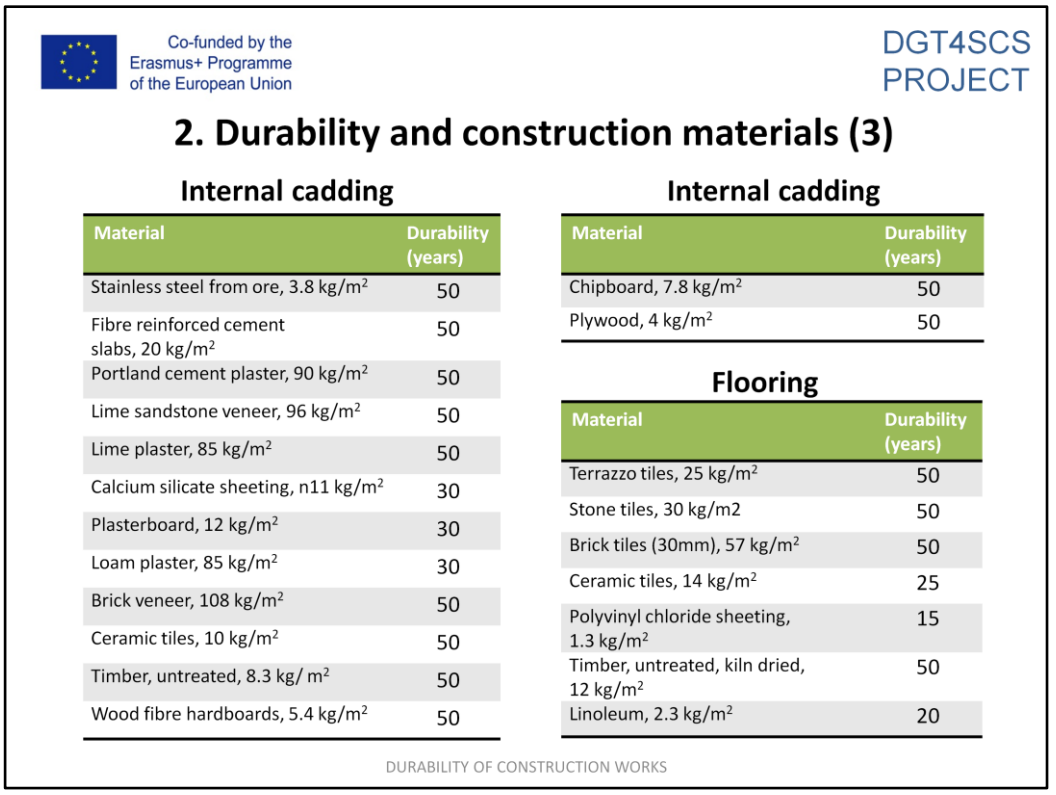
Source:
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 350-354 p.

Notes for the trainer and additional information:

Data: Durability of surface materials (1)
*The estimates and evaluations are made per m^2 layer and a house lifespan of 50 years.
*The volumes of materials and the loss factors are estimated on the basis of conventional practice.

Highlighted, that it is not possible to simply list the products that have been found to be durable in some projects and expect them to be the best choice for every project. There is no standard or widely accepted methodology for evaluating the durability of building materials.

But there are consideration criteria for evaluating durability: disposal frequency indicated by e.g., manufacturer's warranty period; durability based on appropriate maintenance, durability based on compatibility & interdependency of materials in the construction unit.



Source:
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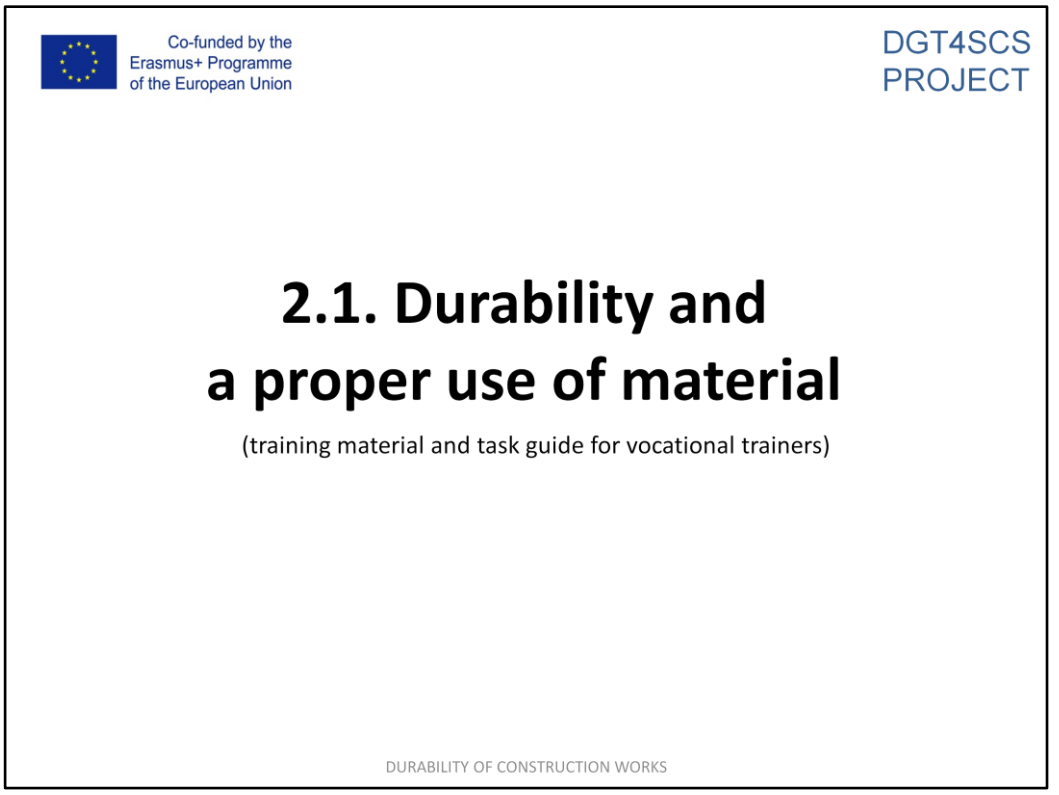

Notes for the trainer and additional information:

Durability and a proper use of construction materials - training material and task guide for vocational trainers.

It's a general subtopic
This part provides information of **importance to install construction material following the producer's recommendation of a proper use.** Constructions materials should be used according to usage purpose of construction/building elements which ensure durability of materials and construction works.
Incorrect choice of construction material affects durability and lifespan of construction element and/or system.

NB! information and tasks should be varied and adapted according to trainees' experience, background and level of knowledge as well as in line with a particular qualification.

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DGT4SCS PROJECT

2.1. Durability and a proper use of material (1) Example – laminate flooring AC ratings

- ✓ The main considerations when choosing a laminate floor is the durability, as denoted by its AC rating.
- ✓ The ratings represent the **suitability and durability of a floor for particular rooms or circumstances.**

DURABILITY OF CONSTRUCTION WORKS

Source:
https://tomgavintilesandflooring.com/2016/05/09/lovelylaminates/ [Accessed 1 December 2020].
https://www.eplf.com/en/laminate-made-europe/wear-classes [Accessed 1 December 2020].

Notes for the trainer and additional information:
Recomendation of material producer – laminate flooring

1. AC rating stands for abrasion class rating, and usually goes from **1 -6**.
When laminate floors are made they are subjected to a battery of tests, which assess how durable and hard wearing the flooring is. These tests are set out by the European laminate flooring producers (**EPLF**) and under EU law, all laminate sold must display either its **wear class (21-34) or AC rating**.
The ratings represent the suitability and durability of a floor for particular rooms or circumstances. An AC rating of 1 is fine for a guest room or bedroom, but will not last as long in a kitchen. An AC rating of 6 however, is (currently) the highest rating available, and can be used for car showrooms which undergo huge wear and tear, as these floors are thick and durable.

2. Wear classes for laminate flooring are specified in the European **standard EN 13329** ("Laminate floor coverings - Elements with a surface layer based on aminoplastic thermosetting resins - Specifications, requirements and test methods"). There is a differentiation between domestic and commercial usage.
In private use areas, the classification ranges from 21 (light use, e.g. in bedrooms) to 23 (intense use, e.g. in hallways). In commercial use areas the classification ranges from 31 (light use, e.g. hotel rooms or conference rooms) to 33 (intense use, e.g. in large offices, shopping malls or public buildings.) or even 34 (for commercial areas with very intense use).
NB! wear classes 21,22,23 currently no longer produced.

AC1 (~Wear class 21), AC2 (~Wear class 22), AC3 (~Wear class 23/31),
AC4 (~Wear class 32), AC5 (~Wear class 33), AC6 (~Wear class 34)

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DGT4SCS PROJECT

2.1. Durability and a proper use of material (2)
Example – ceramic tiles PEI ratings

- ✓ Ceramic **tiles come in several different types suited for different uses.**
- ✓ PEI ratings help you determine the hardness and durability of tile

Source:
https://www.thespruce.com/pei-ratings-help-with-tile-installation-areas-1822598
[Accessed 1 December 2020].
https://www.tilewarehouse.co.nz/commercial/blog-news-articles/what-is-pei-rating/
[Accessed 1 December 2020].

Notes for the trainer and additional information:
Recomendation of material producer – ceramic and porcelain tile

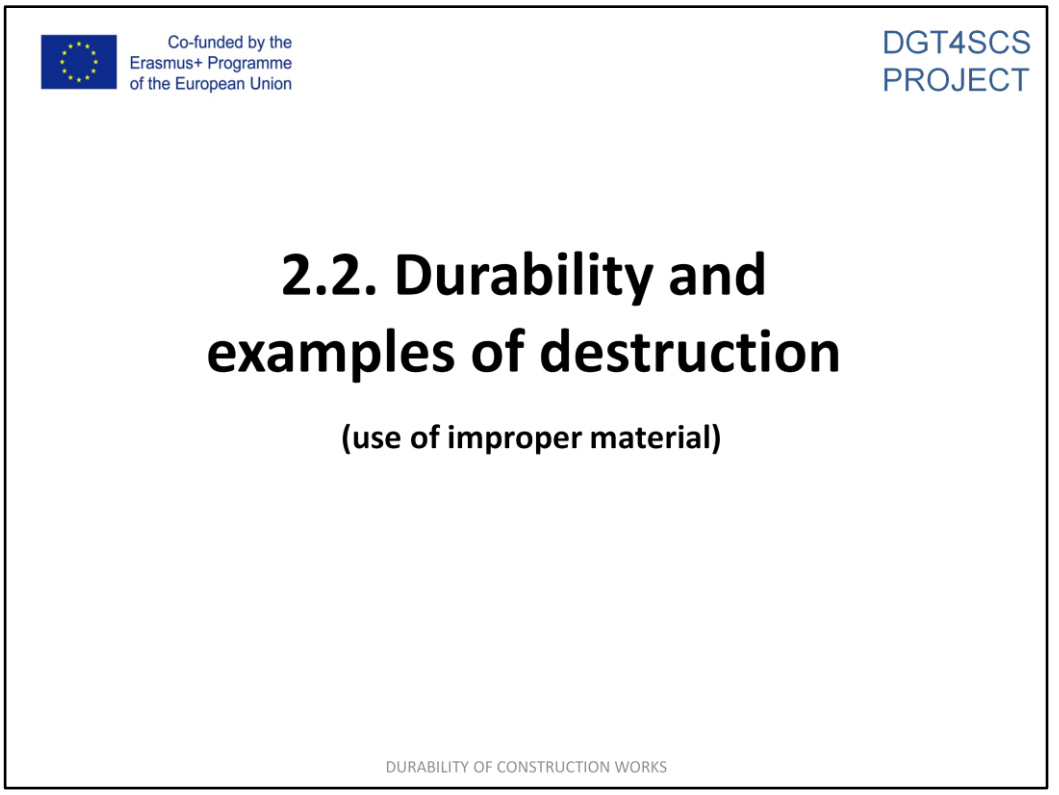
What does PEI in title rating mean?
PEI (Porcelain Enamel Institute) ratings help you determine the hardness and durability of tile.

Ceramic and porcelain **tiles come in several different types suited for different uses**. For example, some are designed for use on walls only, others for floors only, and some can be used for either floor or wall applications. Tiles may also carry room recommendations for where they are best suited, based on finish, design, or surface texture.

It's important **to pay close attention to the PEI class when choosing a tile for a particular application.** A light-duty class 0 or 1 tile is likely to crack if used on floors, and a very thick class 6 tile may be so heavy that adhesives will have trouble holding it in place on a wall. The PEI class is not the only means of choosing a tile, however, and some tiles do not even carry a PEI class rating.

The PEI categorization primarily **defines the hardness and durability of the various ceramic products** that are tested.

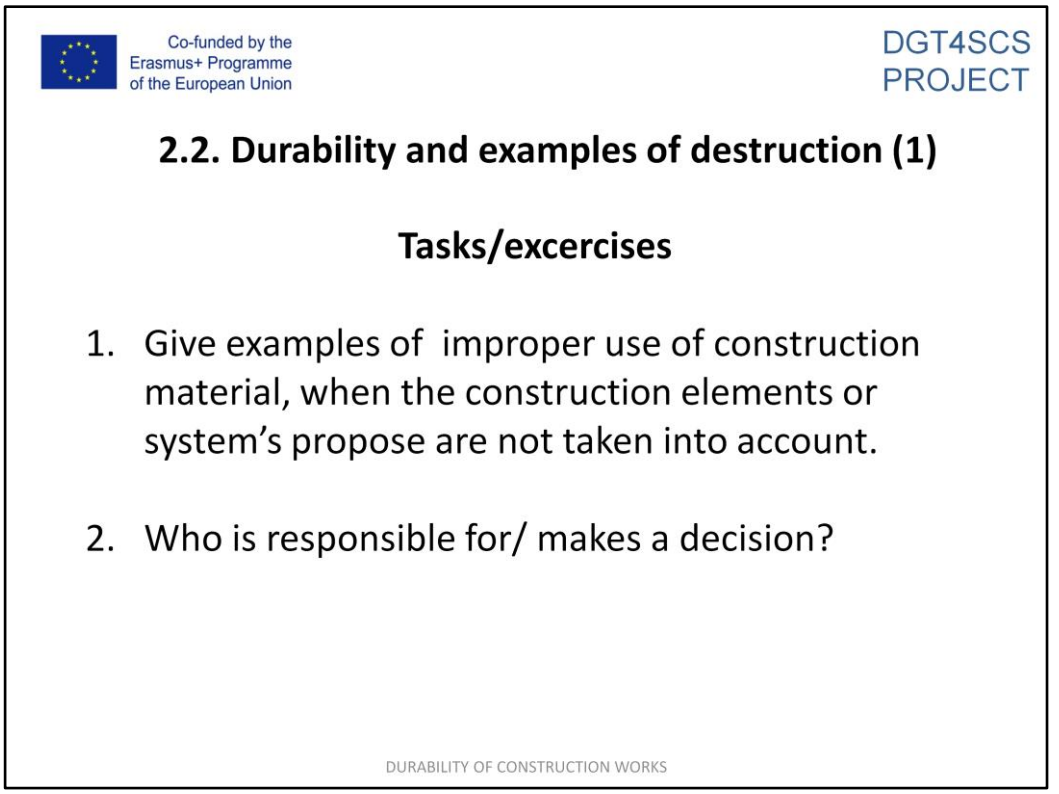
A tile is given a PEI hardness rating on a 6-point scale, in addition to a 0 or NR category. The assigned PEI class is based on how many revolutions of the testing machine are required before noticeable abrasions are seen.



Notes for the trainer and additional information:

See the next slides about improper use of costruction materials and its effect on material liefespan.

The information at this subtopic should be adapted according to the level of education and knowledge of the trainees who will be trained within this module.



Notes for the trainer and additional information:

Task 1: A trainer asks students to give possible examples of improper use of construction material in different areas construction works (e.g. tilling, plastering, masonry, painting, floor covering, paving).
"Give examples of improper use of construction material, when the construction elements or system's propose are not taken into account "

Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of construction material "Who is responsible for/ makes a decision?"

Notes for the trainer and additional information:

A trainer shows to the audience pictures/photos with the defect (destruction) of construction materials/elements/systems caused by improper use of construction material within a particular construction work and explains it (in different areas of construction works, e.g. tilling, plastering, masonry, painting, floor covering, paving).

Using the wrong outdoor tile
For outdoor work, it is necessary to use materials that can be considered resistant to low temperatures. In the photo, this rule is ignored, and non-frost-resistant tiles and tile glue were used. As a result, the tile cracks, exfoliates from the base along with the adhesive composition.

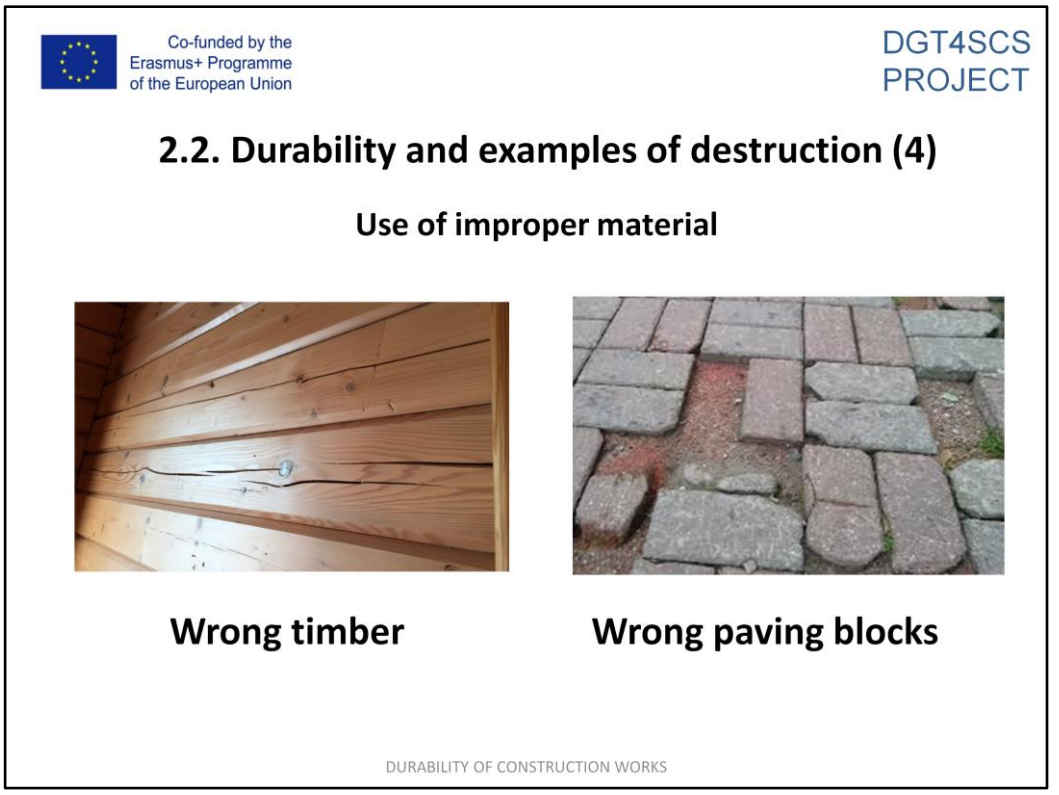
Using the wrong category of laminate
Not abrasion resistant laminate was used, and as a result, in a short period of time, the top layer (texture) of the laminate was scratched with the wheels of an office chair.

Notes for the trainer and additional information:

A trainer shows to the audience pictures/photos with the defect (destruction) of construction materials/elements/systems caused by improper use of construction material within a particular construction work and explains it (in different areas of construction works, e.g. tilling, plastering, masonry, painting, floor covering, paving).

Using the wrong putty type
The use of a non-moisture resistant putty in rooms with high humidity leads to surface cracking, swelling, as well as to its gradual delamination.

Using the wrong type of paint
Using a water-borne paint in a humid environment causes the pigmentation of paint and flaking off. Also, using paints that are inappropriate for intended use, for example, for facade decoration, due to atmospheric exposure and aggressive environment.



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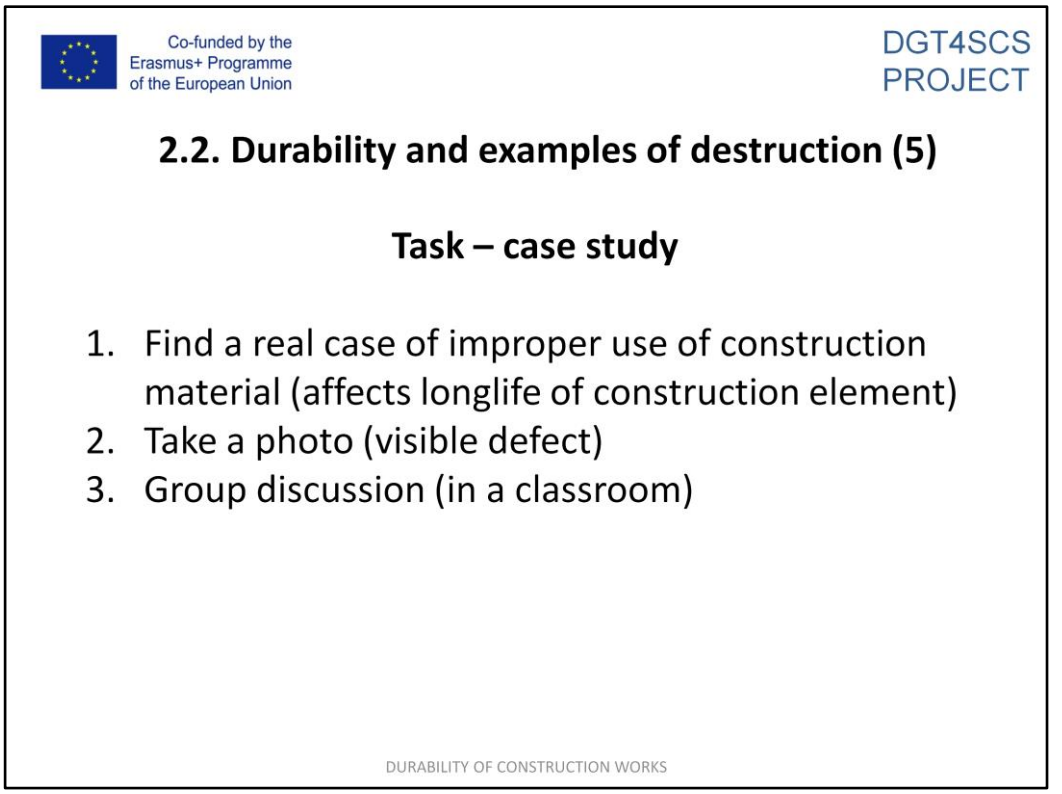
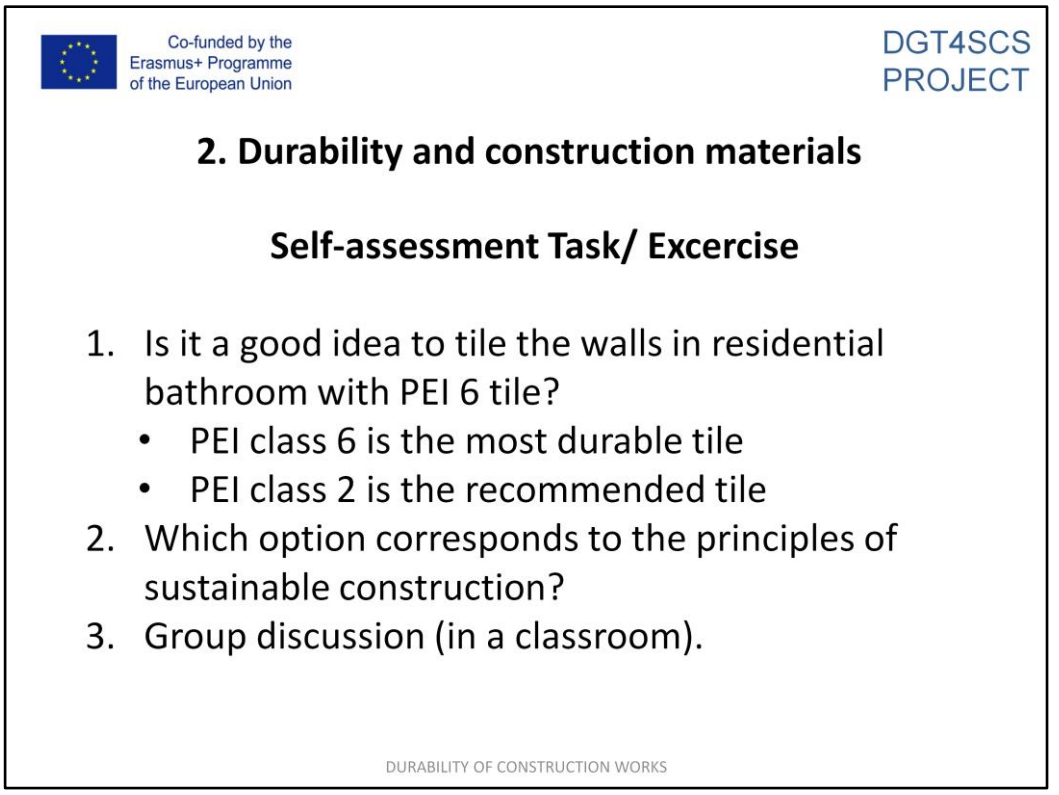
Using the wrong timber
The species and moisture content of the wood is important. The use of wood of natural and high humidity leads to the formation of longitudinal cracks, causes warping of elements and promotes the formation of rot

Using the wrong type of paving blocks
The use of paving stones with low concrete density and strength, results in the low frost resistance of material. There are also restrictions regarding material thickness, depending on the loads and purpose of the area (sidewalk or carriageway, road).



Notes for the trainer and additional information:

Task - **Case study (home work)**
Ask students to find a real case of improper use of construction material which affects lifespan of construction element. Students should take a photo of the visible defect, or only improper use of material (defect will be visible in future). A student chooses a particular area of construction works, e.g. tilling, plastering, masonry, painting, floor covering, paving. Group discussion is organised in a classroom.



Notes for the trainer and additional information:

Assumption: It's your own apartments, where your plan to live alone or with your friend for 5 years while studying at the university.

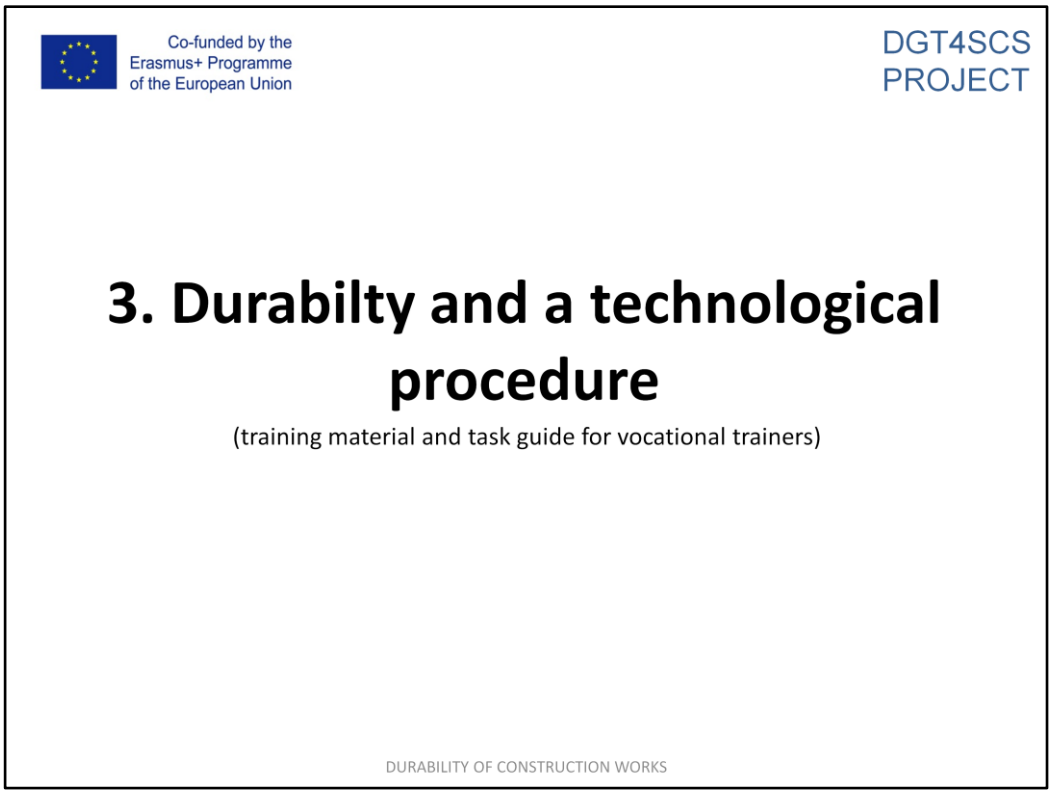
A trainer discusses with students which option corresponds to the principles of sustainable construction (minimizing energy use, minimizing resources use, less wastage etc.)? **Which option allows saving more energy and resources?**

During discussion it is highlighted**, that the most durable construction works (materials) can be too expensive or can demand much energy and resources (material producing).**

A trainer can provide data for students about tilling wall square, tile PEI6 and PEI2 prices (the same manufacturer) and ask them to calculate quantity of tile needed and costs.

See Introduction:
Principles of Sustainable Construction are: Energy Efficiency, Resource Efficiency, Durability, Water efficiency, Indoor Environmental Quality, Reduced Community Impact, Homeowner Education and Maintenance, Sustainable Site Development.

NB! **It is important to match the resource quality to the task required, so as not to use a high-grade resource when a lower grade one will suffice.**
NB! The key question is optimum rather than maximum durability.



Notes for the trainer and additional information:

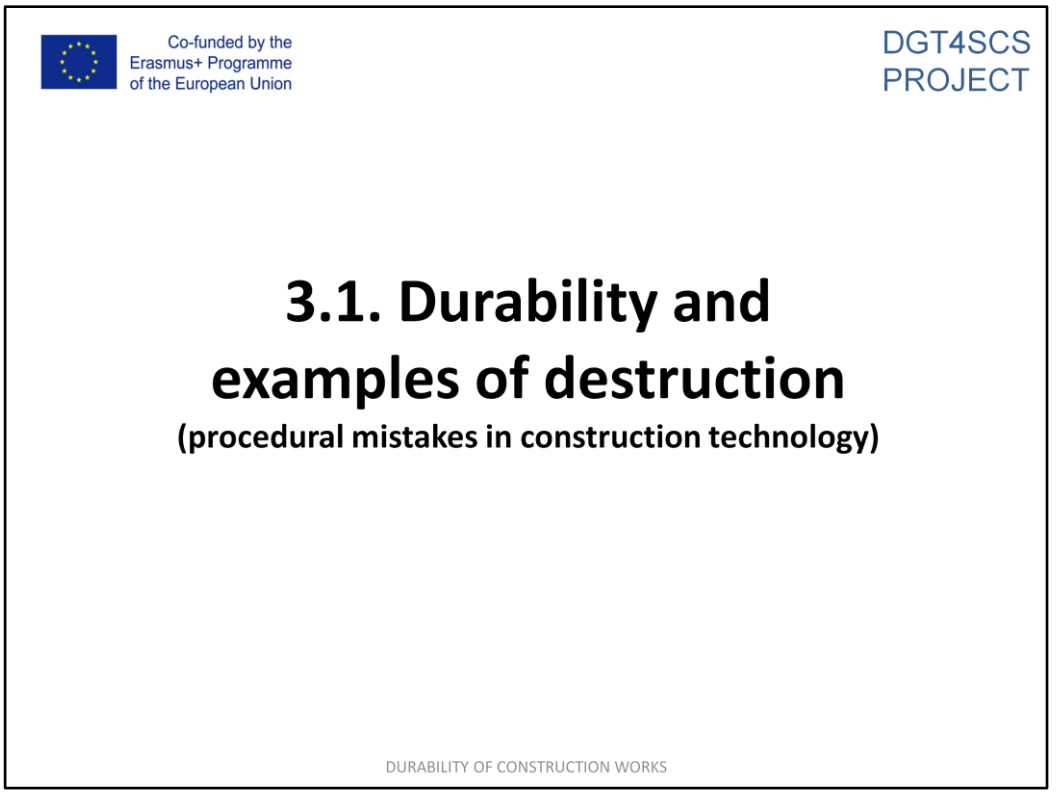
Durability and technological procedure of construction works(training material and task guide for vocational trainers)

Explanatory text:

It highlights **the importance of following the technological process and manufacturers' recommendations** for a construction specialists.
Students gain knowledge about the importance of correct procedure of applying different construction technologies to ensure durability of construction systems.

This part of training material emphasises the importance of implementing construction works in right way, it is **in accordance with a particular procedure (technological process and technique), because it affects durability and lifespan of construction element or the system made.**

NB! The information at this subtopic should be adapted according to the level of education and knowledge of the trainees who will be trained within this module.



Notes for the trainer and additional information:

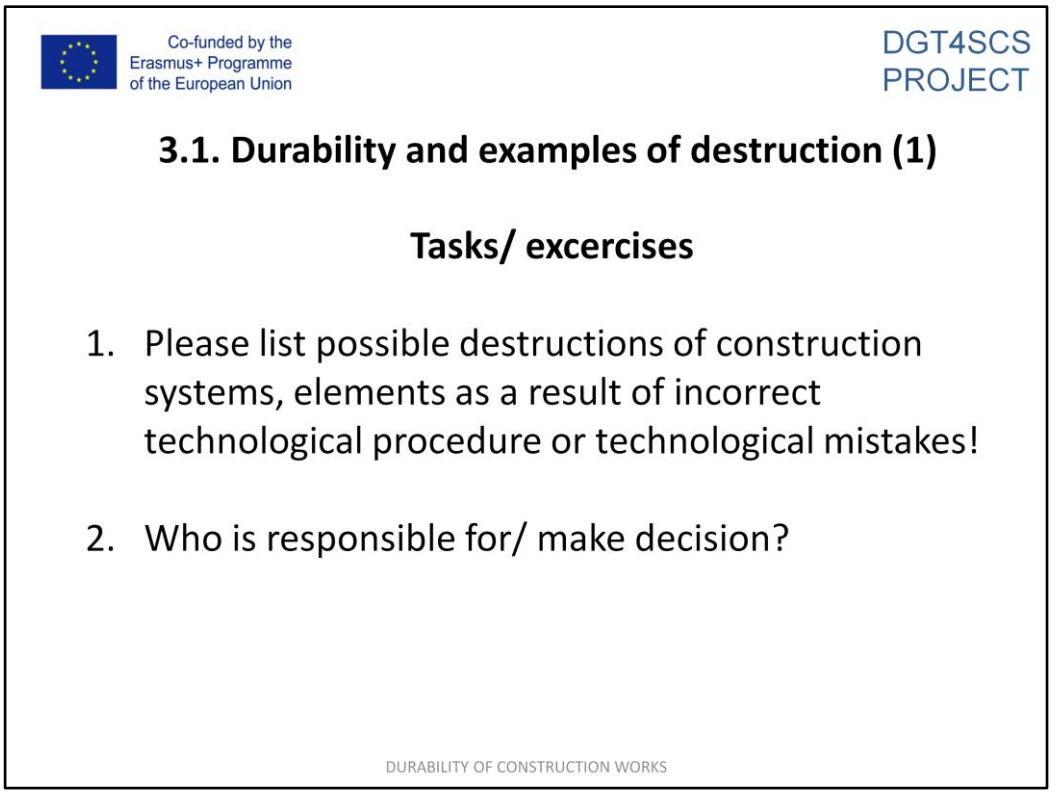
Destruction of construction elements/system **because of technological mistakes** (incorrect work procedure)

Explanatory text:

It's a general part of subtopic in which

- an idea of necessity to follow technological procedure at applying and operating construction materials **in different types of construction works**
- trainees gain the information and general insights of the **negative effect on the lifespan** of elements and systems if the construction works are not implemented in accordance of appropriate technological procedure and/or if there are **technological mistakes**

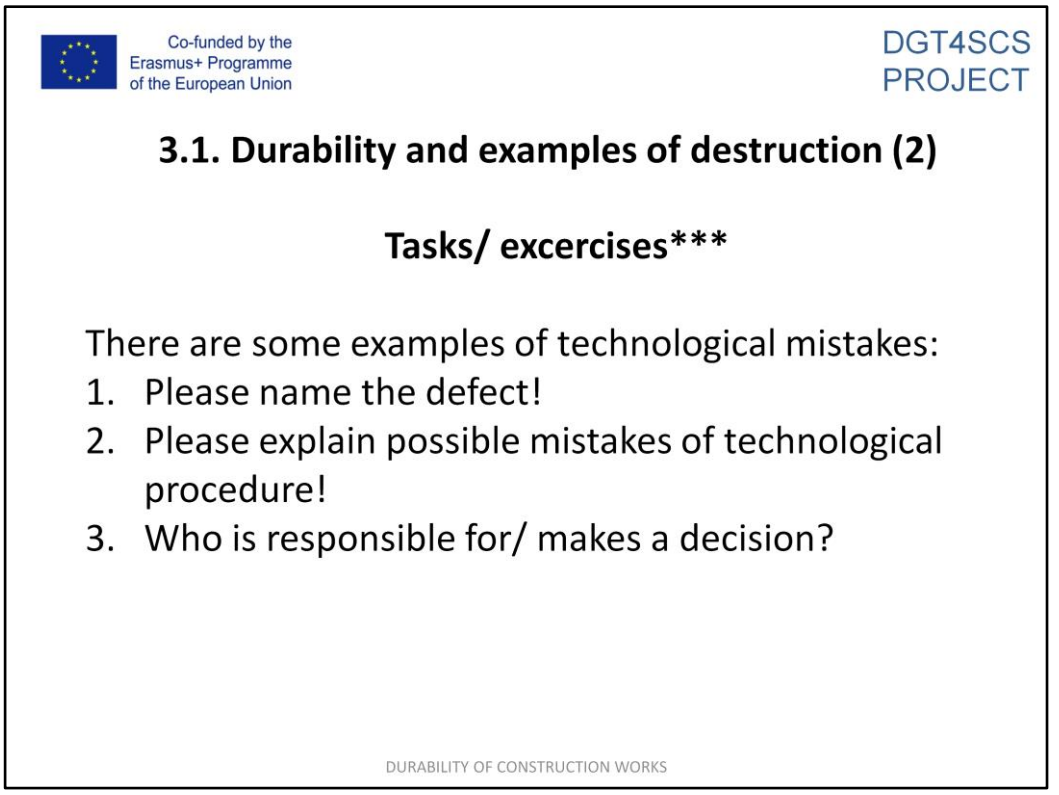
Trainees gain an idea and general information about destruction of construction elements and the system by illustrations, involving them in discussions, by asking questions and offering some tasks (**dependson the degree of participants' level of knowledge and background**).



Notes for the trainer and additional information:

Task 1. A trainer asks students to list possible destructions of construction systems, elements, which obviously are caused by incorrect procedure of construction work due to mistakes (for different types of construction works: e.g. tilling, plastering, masonry, painting, floor covering, paving).

Questions: "Please list possible destructions of construction systems, elements as a result of incorrect technological procedure or technological mistakes!"
"Who is responsible for/ makes a decision?"



Notes for the trainer and additional information:

Task 2 (***depends on level of trainees)

A trainer shows to the audience pictures/photos with destruction of construction elements/systems (in different fields of construction works) and

- **ask trainees** what is wrong and ask them to explain possible mistakes of technological procedure – for **experienced trainees** with background knowledge.
- **explain to students** where is defect affecting durability and explain mistakes of technological procedure – for participants **without background** knowledge/ lower knowledge or general public.

Notes for the trainer and additional information:

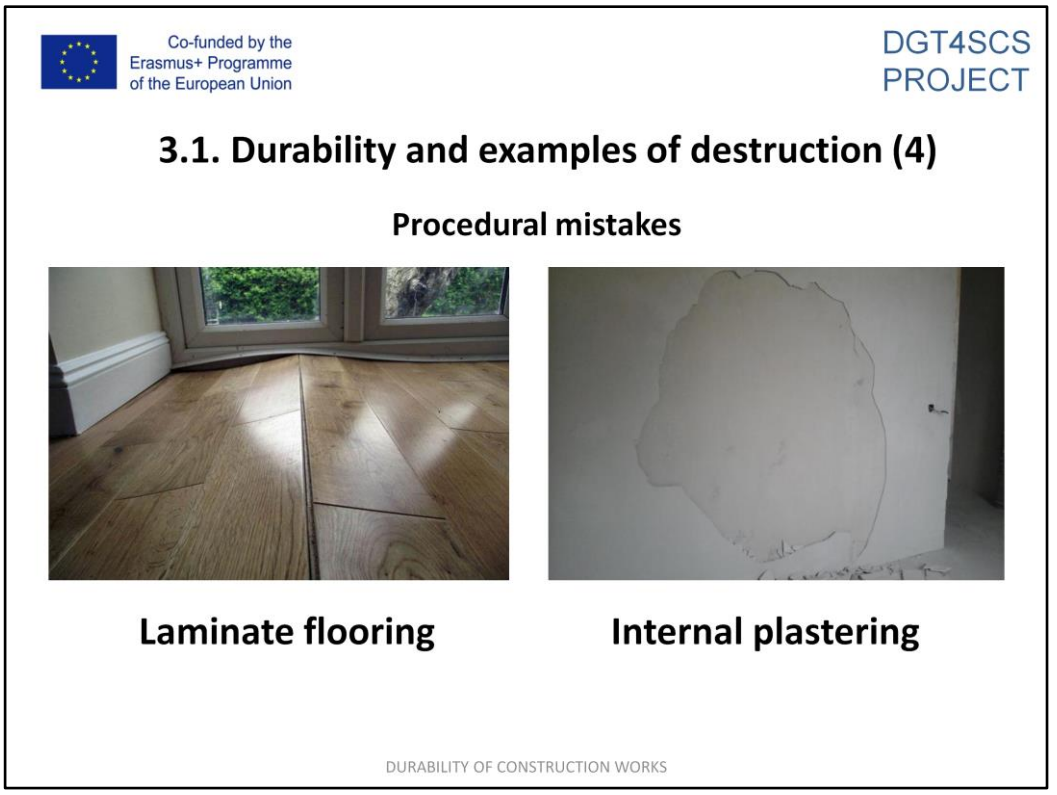
Task 2 (***depends on level of trainees)

A trainer shows to the audience pictures/photos with destruction of construction elements/systems (in different fields of construction works) and

- **ask trainees** what is wrong and ask them to explain possible mistakes of technological procedure – for **experienced trainees** with background knowledge.
- **explain to students** where is defect affecting durability and explain mistakes of technological procedure – for participants **without background** knowledge/ lower knowledge or general public.

Bricklaying
Non-compliance with bricklaying rules, binding and unfilled mortar joints in brick masonry. As a result, the masonry can crack due to improper load distribution, in the winter season - problems with freezing.

Tilling
Ceramic tiles are laid on freezing floors without a waterproofing layer; as a result of freezing, ceramic tiles peel or fall off the base, cracks appear forming voids under the tiles.



Notes for the trainer and additional information:

Task 2 (***depends on level of trainees)

A trainer shows to the audience pictures/photos with destruction of construction elements/systems (in different fields of construction works) and

- **ask trainees** what is wrong and ask them to explain possible mistakes of technological procedure – for **experienced trainees** with background knowledge.
- **explain to students** where is defect affecting durability and explain mistakes of technological procedure – for participants **without background** knowledge/ lower knowledge or general public.

Laminate flooring
Laminate is a floating flooring, i.e. when laying, it does not need to be placed close to walls or other fixed elements. In the photo: the deformation gap around the perimeter of the room, as a result, the laminate cannot expand freely.

Inernal plastering
The plaster falls off the surface. As a rule, this indicates the use of inappropriate surface preparation technologies, i.e. to plastering. As a result, all defective places must be dismantled, prepared and re-plastering.
The stability of the base also affects the quality of the surface; if the building is deformed, the cracks and other defects may appear on all surfaces.

Notes for the trainer and additional information:

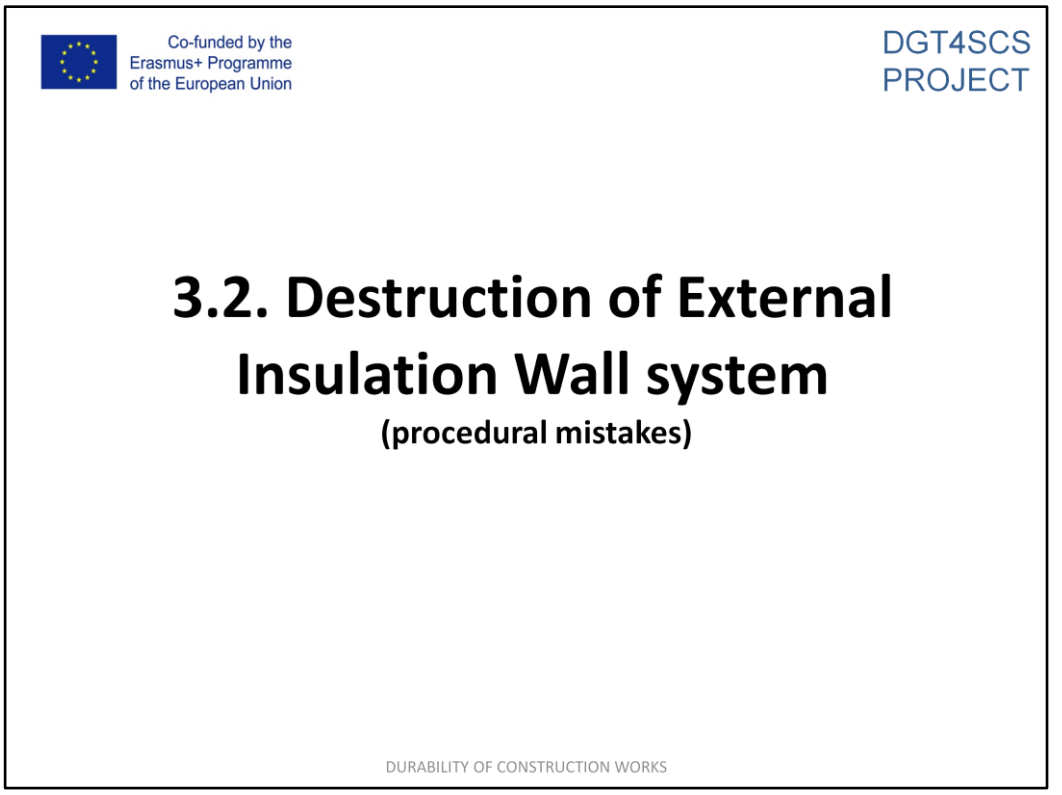
Task 2 (***depends on level of trainees)

A trainer shows to the audience pictures/photos with destruction of construction elements/systems (in different fields of construction works) and

- **ask trainees** what is wrong and ask them to explain possible mistakes of technological procedure – for **experienced trainees** with background knowledge.
- **explain to students** where is defect affecting durability and explain mistakes of technological procedure – for participants **without background** knowledge/ lower knowledge or general public.

Interior painting
Peeling paint. Such a defect occurs due to the fact that the surface to be painted was not cleaned well enough (from dust, stains, oil).
As a result, it is necessary to redo not only the surface painting, but also its preparation.

Paving
Paving slabs/blocks must be laid on a compacted cushion consisting of several layers. In each case, the recipe for the cake is different. If the substrate does not correspond to the load, the coating is destructed.



Notes for the trainer and additional information:

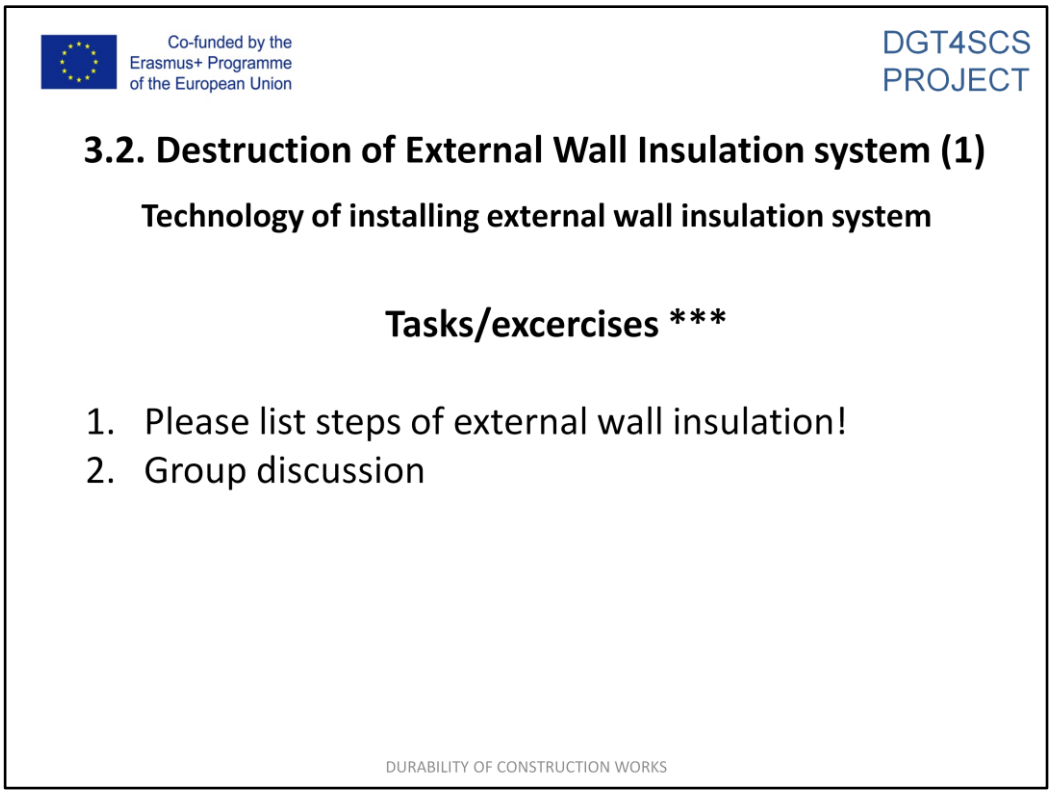
Destruction of **external wall insulation (EWI) system** because of technological mistakes (incorrect work procedure).

Explanatory text:

It's a specific part of subtopic providing trainees with detailed (depending on qualification and training programme they are acquiring) information and analyze mistakes of a particular/ specific construction procedure which affects durability of construction system/ elements.

For example, **wall insulation works** are studied within the training programme "Building technician" implemented in Latvia. A Trainer has possibility to offer students **more detailed learning material** about effect of insulation mistakes **on the system durability**. At the same time **material and tasks can be adapted i**n line with participants' level of knowledge's or upgraded/ simplified within other qualification (depends on – is/or insulation works included in the programme).

NB! According to trainees' experience, background and level of knowledge presenting of information and tasks (active involvement in learning) should be varied and adapted.



Notes for the trainer and additional information:

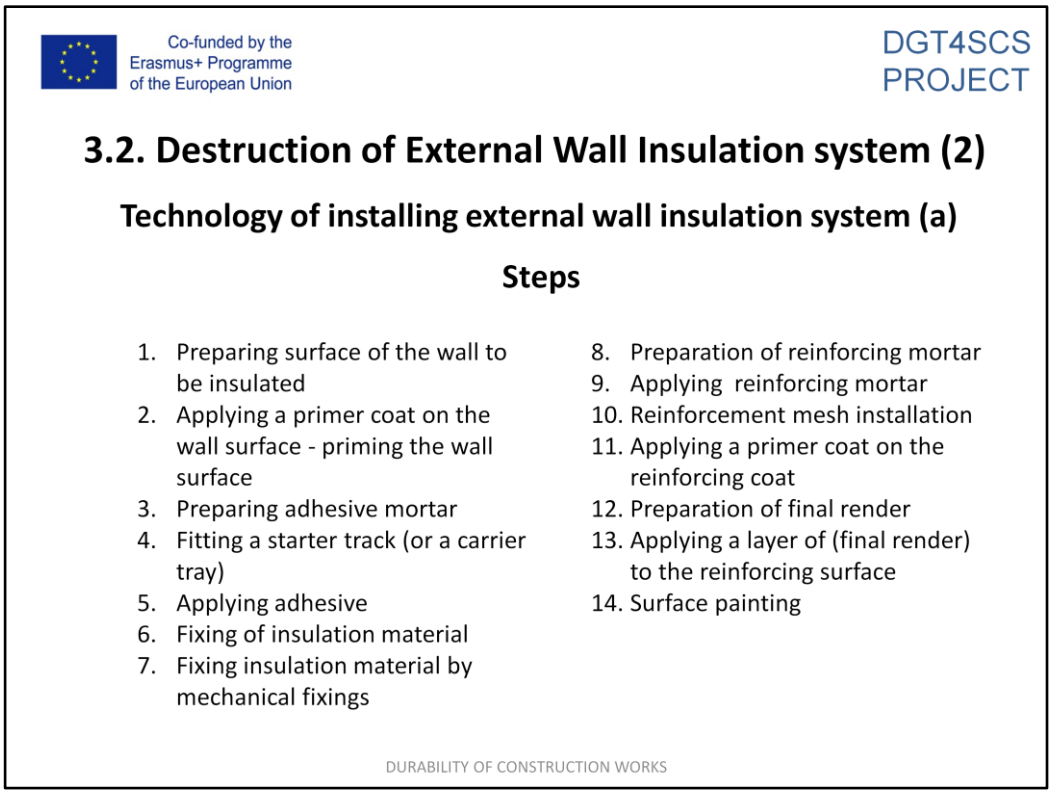
The trainer presents the general theory on external wall insulation system (pictures, oral, videos, discussion) involving students in the process by doing tasks and discussion depending on their level of knowledge.

Name/list steps of EWI system installation technological procedure in slide

Task 3 (***depends on level of trainees)
Before ask students to list steps of wall insulation (**especially, experienced**)

Explain/discuss with group next steps of insulation procedure
- oral - with advanced/experienced trainees using information at the next 4 slides
- by creating **extra slides** containing information mentioned below in the notes - with **not experienced trainees**

Application and installation of an external wall insulation (EWI) system - external wall solutions comprise of an insulation layer fixed to the exciting wall, with a protective render and decorative finish.



Notes for the trainer and additional information:

Explain/discuss with group next steps of insulation procedure

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2. Applying a primer coat on the wall surface - priming the wall surface (considering primer working time and drying time according to the instructions)

Functions of substrate primer:

- ✓ strengthens the top surface of the primed wall
- ✓ provides better "grip" i.e. adhesion of the wall and adhesive mortar
- ✓ reduces the absorption of water by the surface of the wall to be insulated during the subsequent application of the adhesive mortar

3. Preparing adhesive mortar according to the manufacturer's technological instructions

While preparing, take into consideration

- ✓ ratio of dry mixture and water
- ✓ mixing time and repeats number of mixing
- ✓ temperature
- ✓ water quality (neutral PH, drinking water)
- ✓ working time or open time* (active action) and time of hardening or drying (on average 1 hour) and accordingly prepare the quantity of the adhesive can be used or "worked out" during this open time (*open time – the time between when the adhesive is mixed and parts must be mated).

4. Fitting a starter track (or a carrier tray) (insulated material installation basis)

- ✓ Should be installed horizontally (strictly according to the level)
- ✓ Must be securely fastened (be stable, "do not dangle")
- ✓ Installing the profile, the slope of the wall is taken into account, i.e. the angle of deviation from the vertical - it is found out by "hanging" the wall (as a result, the location of the profile in the horizontal plane is shifted)
- ✓ NB! If there is a significant slope of the wall, there can be a problem of uneven thickness of the wall insulation system (so-called "pie of layers").

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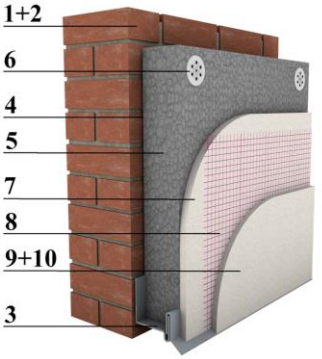
DGT4SCS PROJECT

3.2. Destruction of External Wall Insulation system (3)

Technology of installing external wall insulation system (b)

Elements/layers



1. Prepared surface
2. Substrate primer
3. Starter track
4. Adhesive mortar
5. Insulation board
6. Mechanical fixings
7. Reinforcing mortar
8. Reinforcement mesh
9. Primer
10. Final render

Notes for the trainer and additional information:

Explain/discuss with group next steps of insulation procedure

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5. Applying adhesive directly to the insulation material

- ✓ a layer of adhesive is applied to each board
- ✓ according to the adhesive manufacturer's instructions (the recommended / permissible layer thickness is indicated)
- ✓ excluding the possibility to get adhesive on the seam of the insulation board (otherwise, if the adhesive gets on the butt of the seam, a "thermal bridge" will appear, i.e.heat losses)

6. Fixing of insulation material (boards of expanded polystyrene or mineral-wool) to the wall (to the surface of the wall to be insulated)

- ✓ when gluing plates of insulating material are placed "with a bandage", i.e. in a staggered pattern (at the junction of two slabs of the lower row in the upper row there is an offset slab that overlaps the lower joint, there should not be vertical through seams)
- ✓ above/over the corners of window and door there should also be no vertical through seams; for this, an L-shaped cut (corner) is made in the insulation board
- ✓ use of insulation plates of the size specified by the manufacturer

7. Fixing insulation materials by mechanical fixings (insulation anchors)

- ✓ additional fixing of the insulation material to the wall
- ✓ ensure the insulation boards will not get blown off or fall during periods of bad weather
- ✓ taking into account the required number of capped fixings/anchors per square meter - according to the recommendations of the applied EWI system manufacturer (eg.Sakret, Knauf)
- ✓ fixings are driven through the insulation panels
- ✓ fixings/anchors should not be metal, otherwise a "thermal bridge" will be created and occur heat loss

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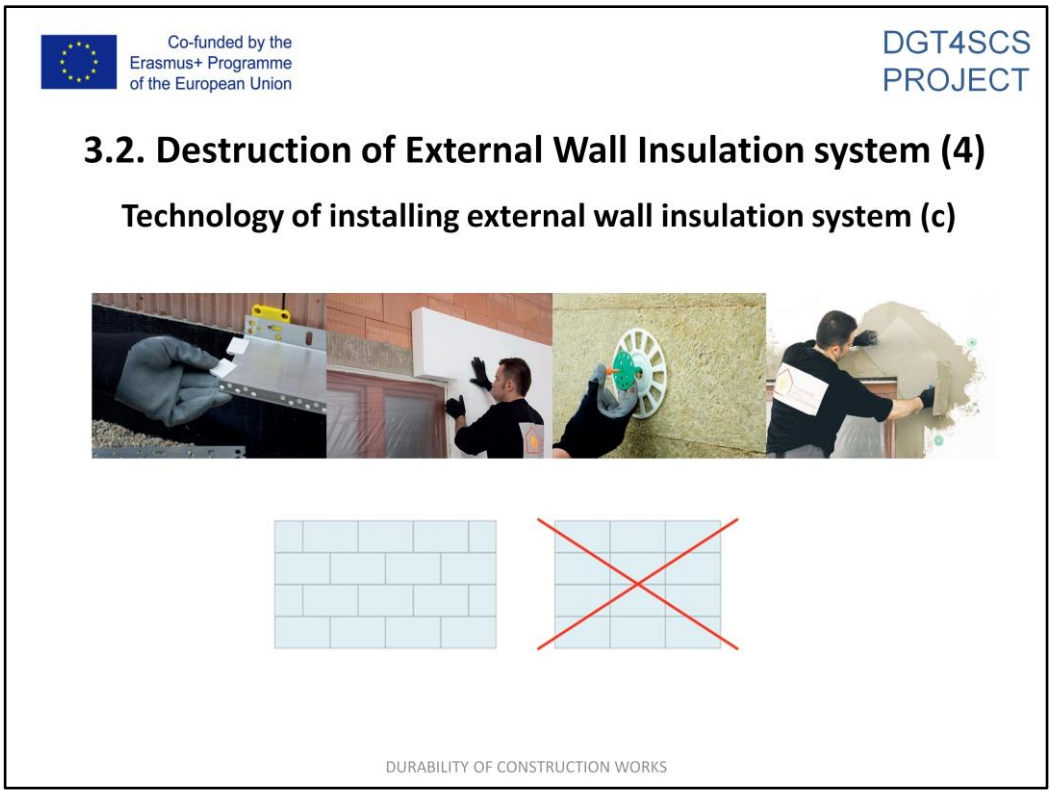

Notes for the trainer and additional information:
Explain/discuss with group next steps of insulation procedure

_____

8. Preparation of reinforcing mortar according to the manufacturer's technological instructions . You must consider

- ✓ ratio of dry mixture and water
- ✓ mixing time and remixing times
- ✓ temperature
- ✓ water quality (neutral PH, drinking water)
- ✓ working time or open time (active action) and time of hardening or drying (on average 1 hour) and accordingly prepare the quantity of the mortar can to be used or "worked out" during this open time

9. Applying reinforcing mortar to the surface of insulation boards (glued to the wall)

- ✓ appropriate thickness (according to manufacturer's of materials and technology recommendations)
- ✓ the reinforcement mortar layer is applied according to the width of the reinforcement mesh (which will be inserted on top)

10. Reinforcement mesh installation

- ✓ a reinforcement mesh is sunk into the mortar layer
- ✓ the mesh is installed overlapped, with an overlap of about 10 cm
- ✓ additional "kerchiefs" of the reinforcing mesh are installed in the corners of window and door

Functions of mesh:

- performs the function of reinforcement for a wall-insulation layer system (EWI system layers)
- strengthens the surface of the insulation boards (mineral wool or expanded polystyrene) - hold the panels in position
- makes the insulating layer a united structural unit (ensures the strength of the system)

11. Applying a primer coat on the reinforcing coat according to the manufacturer's technology (**considering primer working time and drying time** according to the instructions)

Functions of substrate primer

- ✓ strengthens the top surface of the reinforcing coat
- ✓ provides better "grip" i.e. adhesion of the reinforcing layer and final render
- ✓ reduces the absorption of water by the surface of the reinforcing layer of the insulated wall during the subsequent application of final render.

_____

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DGT4SCS PROJECT

3.2. Destruction of External Wall Insulation system (5)

Technology of installing external wall insulation system (d)

https://www.youtube.com/watch?v=VCoyISYIN_c

For insulation to work properly on exterior wall and **have along functional lifespan**, the EWI (External Wall Insulation) system or the wall system needs to have all the appropriate components and be attached/ installed following the procedure's recommendations.

DURABILITY OF CONSTRUCTION WORKS

Notes for the trainer and additional information:

Explain/discuss with group next steps of insulation procedure

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12. Preparation of final render according to applied EWI system manufacturer's recommendations and open/working time in accordance with the manufacturer's technological instructions
While preparing, you must consider

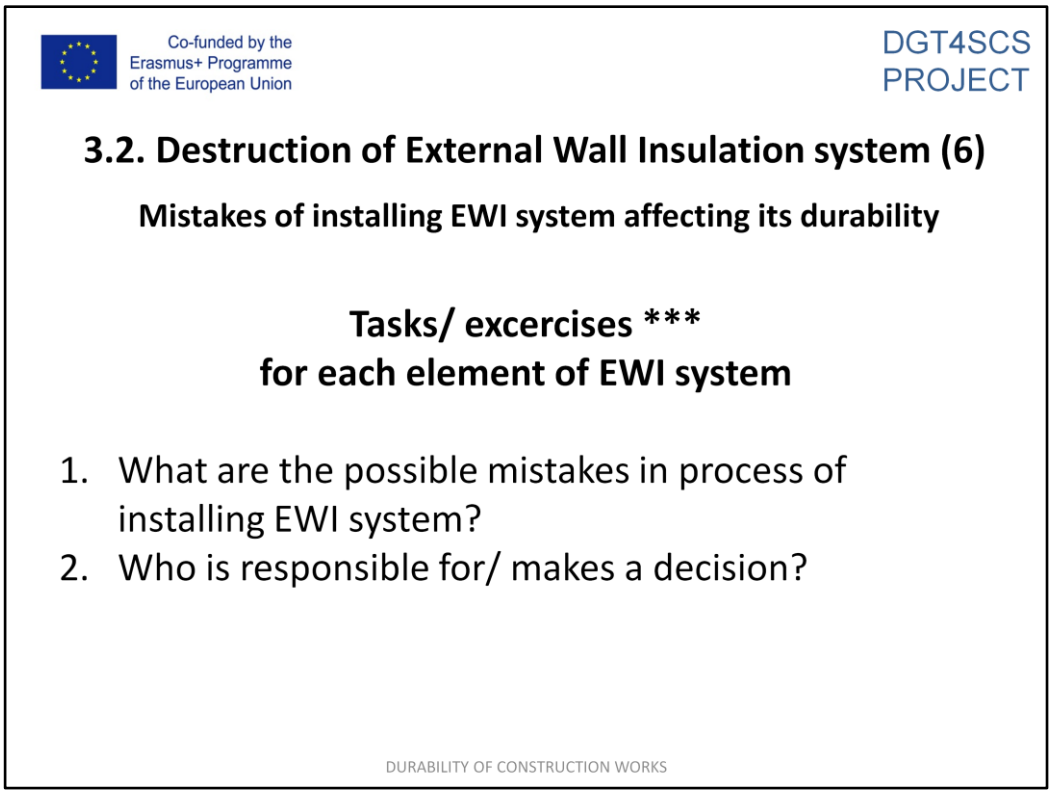
- ✓ ratio of dry mixture and water
- ✓ mixing time and remixing times
- ✓ temperature
- ✓ water quality (neutral PH, drinking water)
- ✓ working time or open time (active action) and time of hardening or drying (on average 1 hour) and accordingly prepare the quantity of the render can to be used or "worked out" during this open time.
- ✓ the time required to "grout" the wet layer (until dry)

13. Applying a layer of (final render) to the reinforcing surface

- ✓ thickness of the applied coat-according to the manufacturer's technological instructions
- ✓ it is necessary to observe the division into sections of the area of the surface to be rendered according to the possibilities of performing work in a certain period of time (in order to avoid an aesthetic defect at the junction of dry and wet render sections)
- ✓ taking into account grouting of the wet layer (required time - till not dried)
- ✓ if the render is collared- completion of work

14. Surface painting (if the render was not collared) should be done in 2 layers of facade paint appropriate for the external environment, following the manufacturer's instructions
NB! It is not recommended to use primer, adhesive, reinforcing mortar and render from different manufacturers. The manufacturer of the insulating material, reinforcing mesh, anchors may differ.

Show a **video about EWI** installation – a trainer chooses one according to trainees' knowledge and qualification.
For example: https://youtu.be/d-Ie7i960vc (EN) [Accessed 8 November 2020].
https://www.youtube.com/watch?v=VCoyISYIN_c (EN) [Accessed 8 November 2020].
https://www.youtube.com/watch?v=_OloldpTF-g (EN) [Accessed 8 November 2020].
https://www.youtube.com/watch?v=ET2PjRmkU_Q (LV) [Accessed 8 November 2020].



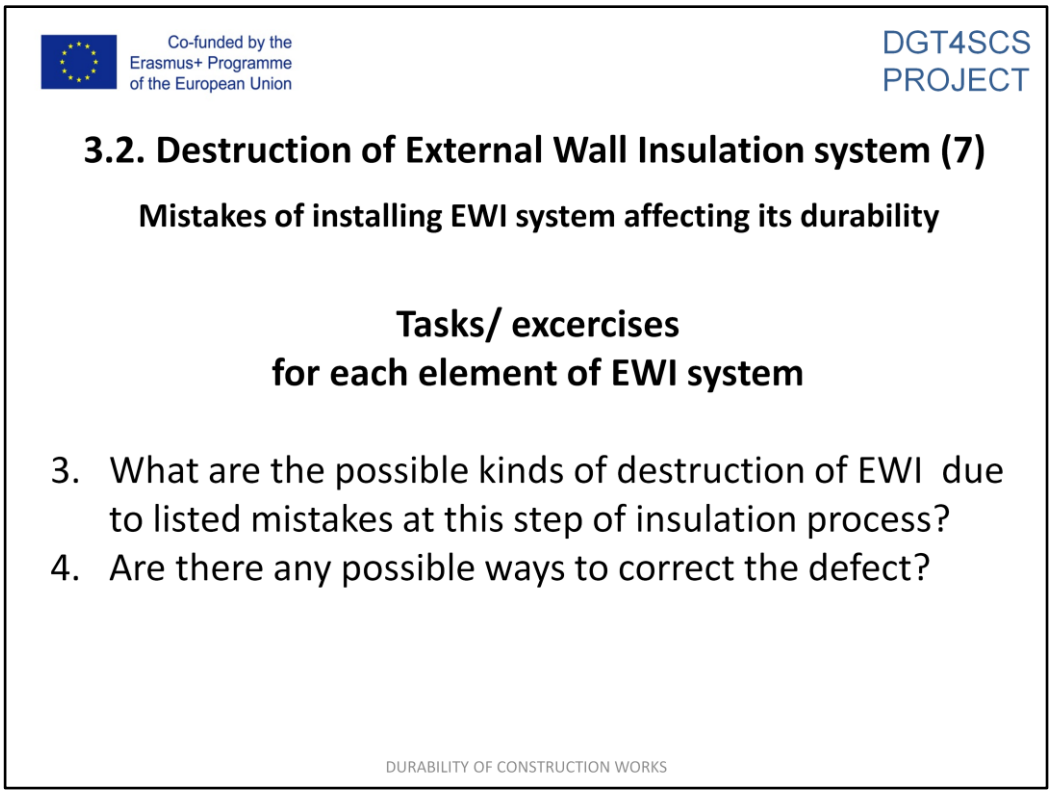
Notes for the trainer and additional information:

Explonary text:
Each element of EWI system is analyzed and discussed **separately**. Possible technological mistakes at every step of works affecting durability of external wall insulation (EWI) system are mentioned here. Possible ways of solving insulation mistakes are provided as well.

A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**

Task 1 (4): **firstly,** ask student to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"

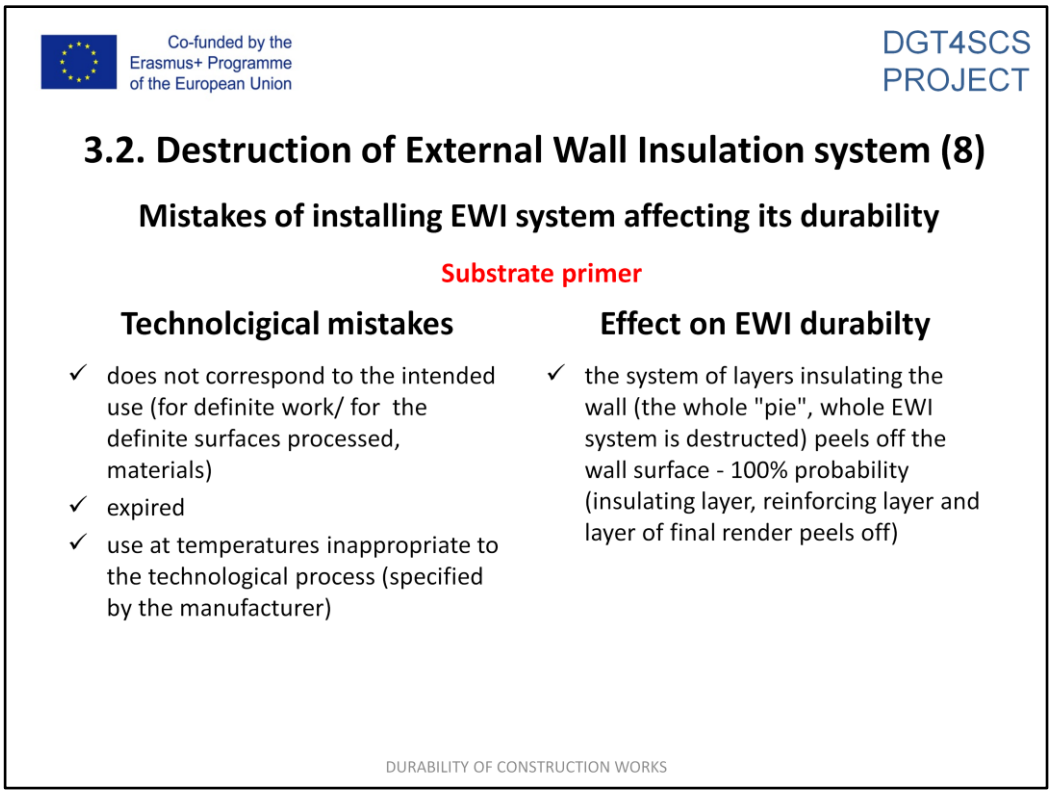
Task 2 (5): Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"



Notes for the trainer and additional information:

A trainer names and gives illustration of EWI system defect (destruction) which is a result of listed mistakes.
Task 3 (6): Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

A **trainer gives students information about possibility and way of correction** EWI system defects
Task 4 (7): **Firstly ask trainees** to suggest possible way of correction/ solving and express their opinions about the probability to correct "Are there any possible ways to correct the defect?"



Notes for the trainer and additional information:

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
   Task 1: **firstly,** ask students to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"
   Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"

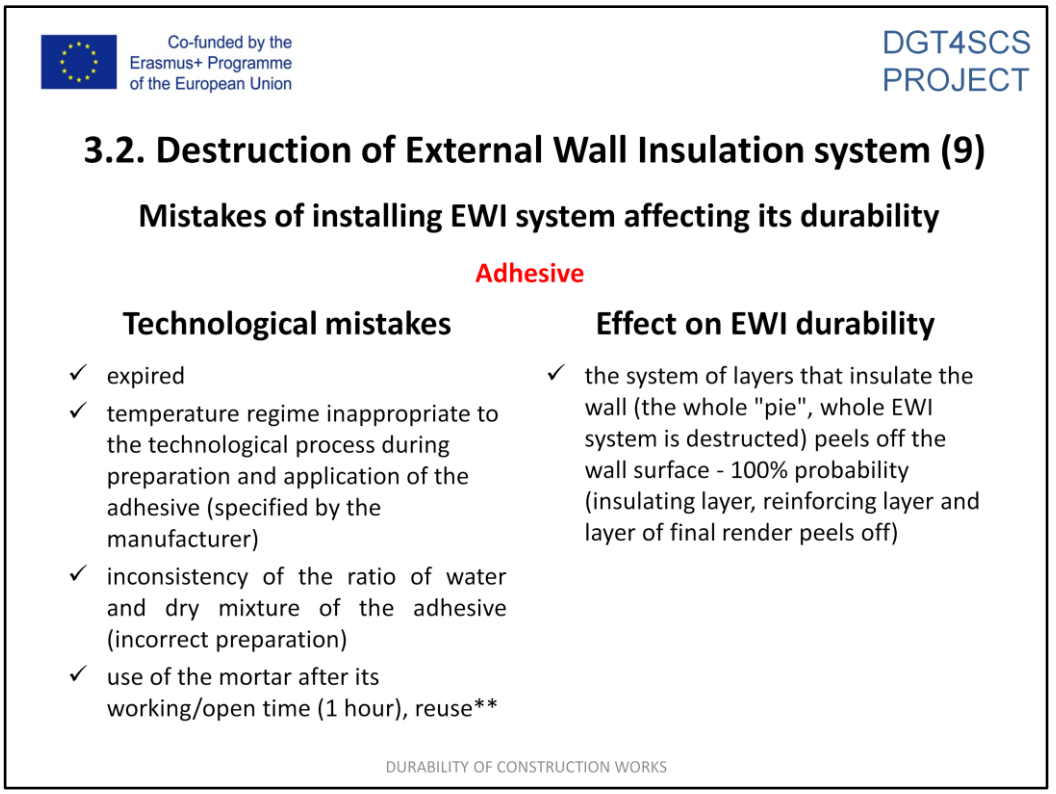
2. A trainer **names** and gives illustration of **EWI system defect** (destruction) which is a result of listed mistakes
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – substrate primer (applying on wall before adhesive)

Probability and ways to correct:

- **correction is not possible,** the system is dismantled and the wall **insulation process should be repeated**
- in order to avoid peeling of the insulating "pie", it is necessary to follow the technology and **avoid the mentioned possible mistakes (incorrect works)** (take into account the affecting factors)



Notes for the trainer and additional information:

** For example, after 1 hour the residues/unused adhesive are not thrown away, but diluted with water and used.

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
   Task 1: **firstly,** ask students to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"
   Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"

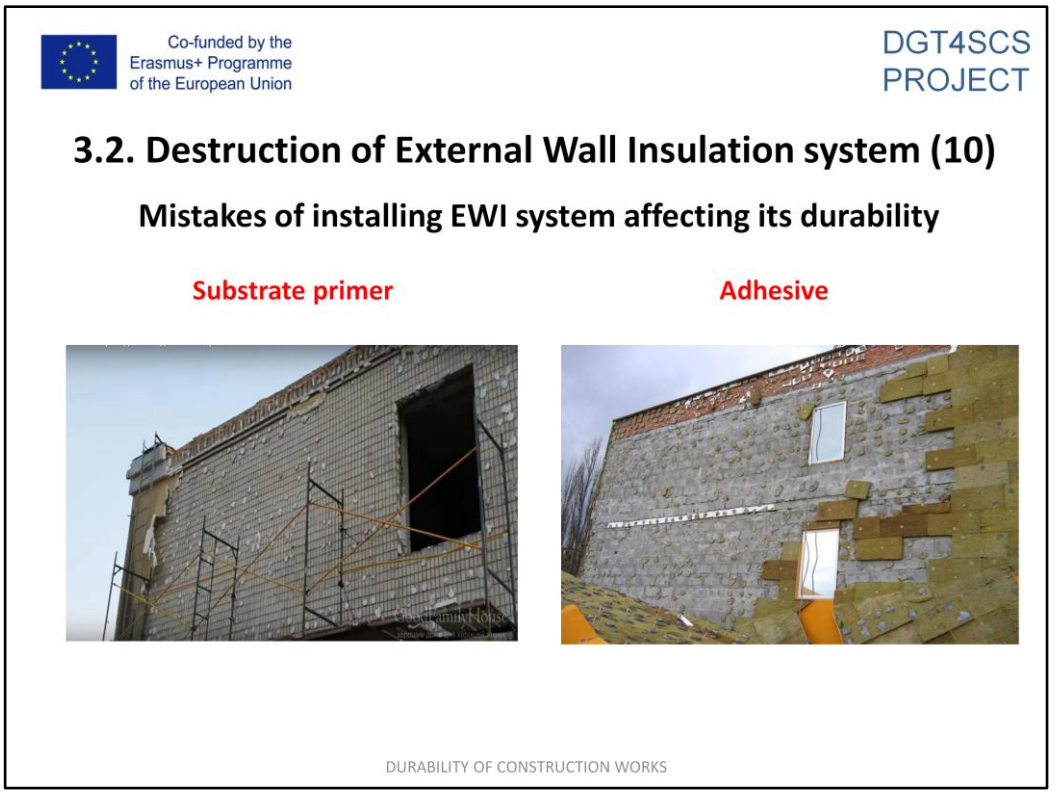
2. A trainer **names** and gives illustration of **EWI system defect** (destruction) which is a result of listed mistakes
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – adhesive

Probability and ways to correct:

- **correction is not possible**, the system is dismantled and **new work on the wall insulation** is carried out
- in order to avoid peeling of the insulating "pie", it is necessary to follow the technology and avoid the mentioned **mistakes (incorrect works)** (take into account the affecting factors)



Notes for the trainer and additional information:

Element of EWI system – substrate primer (before adhesive)

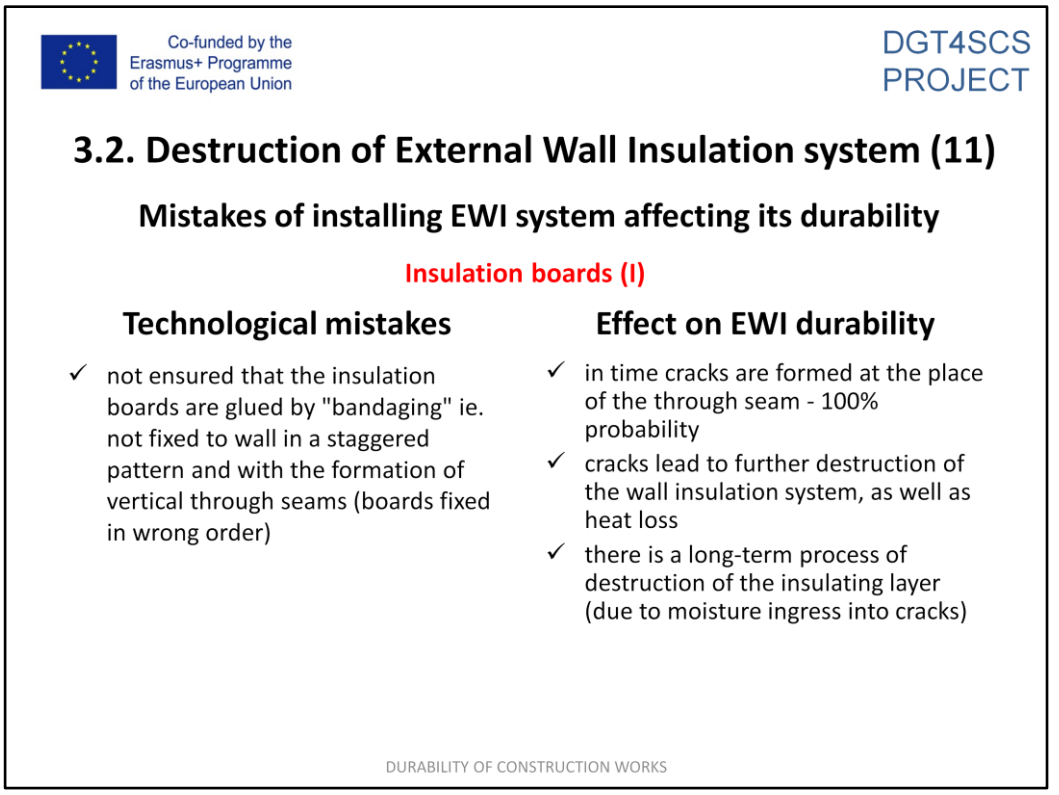
Probability and ways to correct:

- **correction is not possible,** the system is dismantled and the wall **insulation process should be repeated**
- in order to avoid peeling of the insulating "pie", it is necessary to follow the technology and **avoid the mentioned possible mistakes (incorrect works)** (take into account the affecting factors)

Element of EWI system – adhesive

Probability and ways to correct**:**

- **correction is not possible**, the system is dismantled and **new work on the wall insulation** is carried out
- in order to avoid peeling of the insulating "pie", it is necessary to follow the technology and avoid the mentioned **mistakes (incorrect works)** (take into account the affecting factors)



Notes for the trainer and additional information:

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
   Task 1: **firstly,** ask students to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"
   Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"

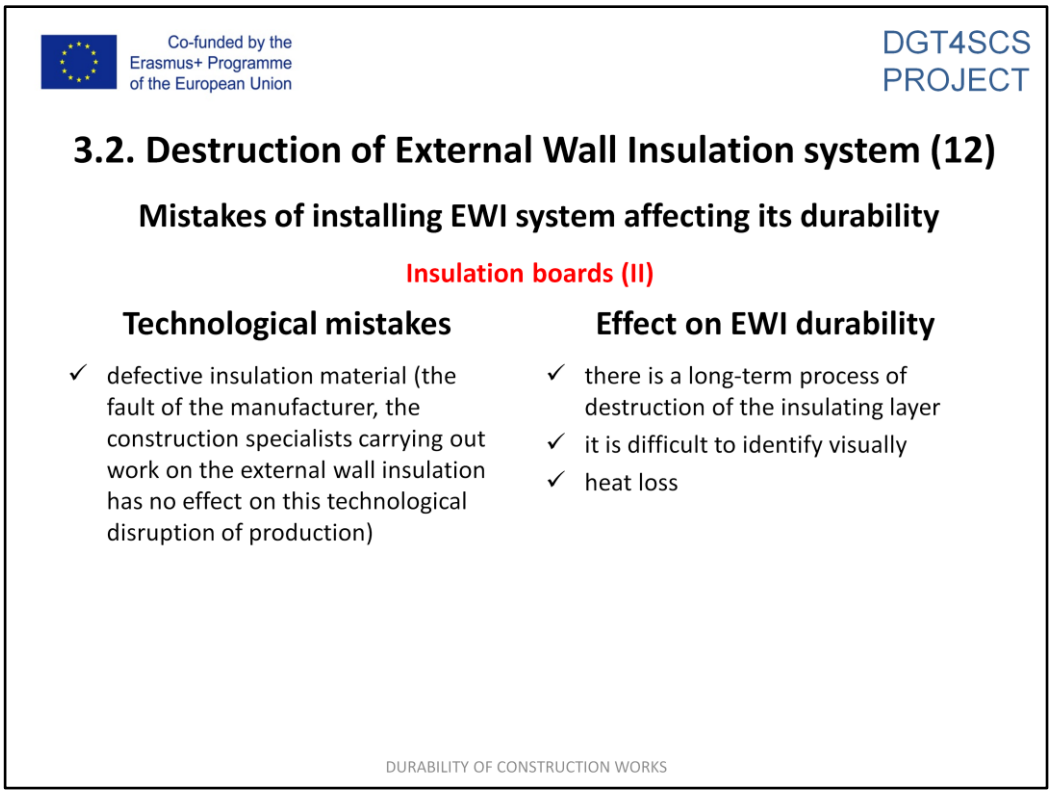
2. A trainer **names** and gives illustration of **EWI system defect** (destruction) which is a result of listed mistakes
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – thermal insulation boards (fixing to wall with adhesive)

Probability and ways to correct:

- **partial correction** is possible: cut out a place with damage (crack) and carry out the technological process of wall insulation again (as a result aesthetics deteriorates)
- in order to avoid the formation of cracks and long-term destruction of the insulating layer, it is necessary to follow the technology of fixing insulation boards and their correct placement – **to avoid the mentioned mistake**



Notes for the trainer and additional information:

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
   Task 1: **firstly,** ask students to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"
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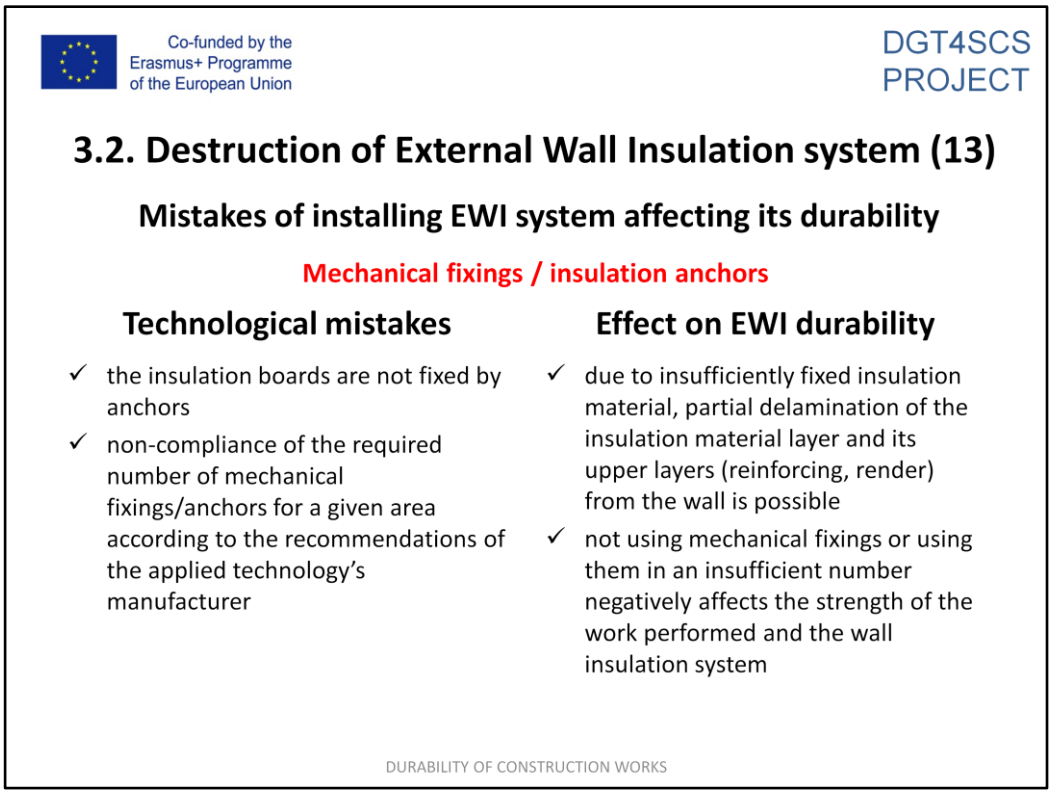
2. A trainer **names** and gives illustration of **EWI system defect** (destruction) which is a result of listed mistakes
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – thermal insulation boards

Probability and ways to correct:

- **correction is not possible**, the system is dismantled and work on the wall insulation is **carried out again**
- difficult to avoid since visually in the process of work is difficult to identify the defect



Notes for the trainer and additional information:

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
   Task 1: **firstly,** ask students to suggest what are the possible mistakes during applying/ installing this element which affects durability of EWI: "What are the possible mistakes in process of installing EWI system?"
   Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"

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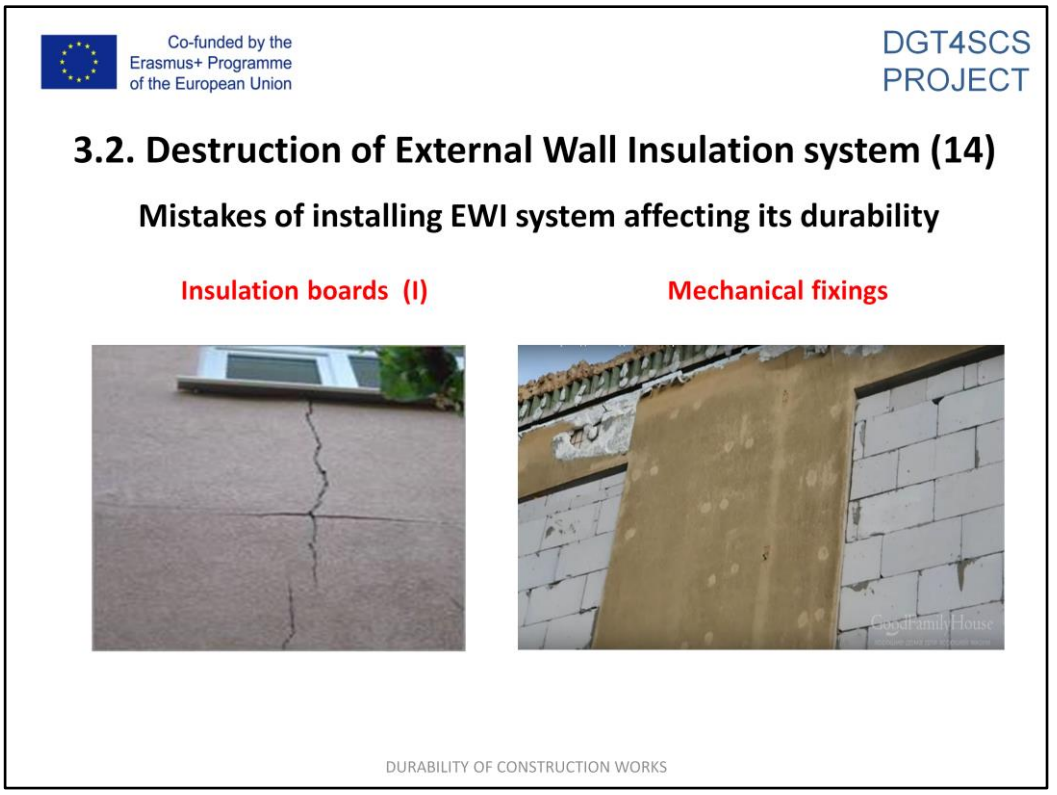
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – mechanical fixings / insulation anchors

Probability and ways to correct:

- **partial correction** is possible: we cut out a place with damage and carry out the technological process of wall insulation in this place again (as a result aesthetics deteriorates)
- in order to avoid partly peeling of the insulating "pie", it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)



Notes for the trainer and additional information:

Element of EWI system – thermal insulation boards (fixing to wall with adhesive) (I)

Probability and ways to correct:

- **partial correction** is possible: cut out a place with damage (crack) and carry out the technological process of wall insulation again (as a result aesthetics deteriorates)
- in order to avoid the formation of cracks and long-term destruction of the insulating layer, it is necessary to follow the technology of fixing insulation boards and their correct placement – **to avoid the mentioned mistake**

Element of EWI system – thermal insulation boards (II)

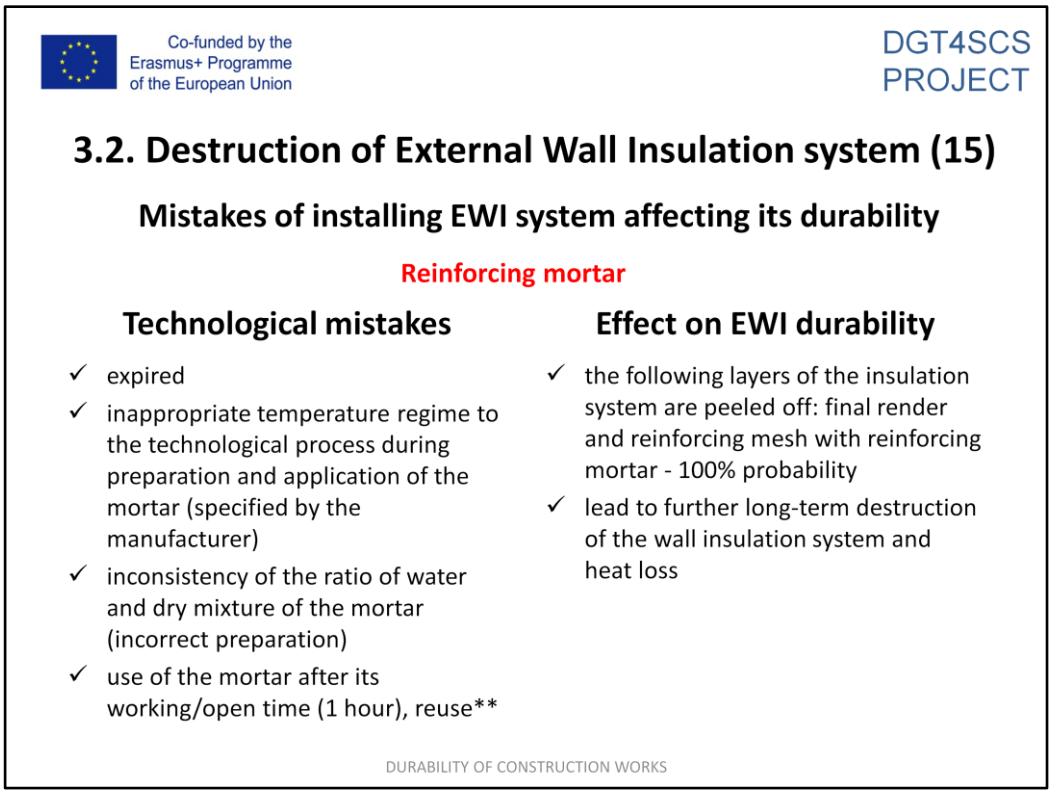
Probability and ways to correct:

- **correction is not possible**, the system is dismantled and work on the wall insulation is **carried out again**
- difficult to avoid since visually in the process of work is difficult to identify the defect

Element of EWI system – mechanical fixings / insulation anchors

Probability and ways to correct:

- **partial correction** is possible: we cut out a place with damage and carry out the technological process of wall insulation in this place again (as a result aesthetics deteriorates)
- in order to avoid partly peeling of the insulating "pie", it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)



Notes for the trainer and additional information:

** For example, after 1 hour, do not throw away the residues/ unused mortar, but dilute with water and use

1. A trainer names elements of EWI (or step of installing EWI system) **and lists possible mistakes**
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   Task 2: Ask students to explain who is responsible/ makes decisions affecting lifespan of insulation system: "Who is responsible for/ makes a decision?"

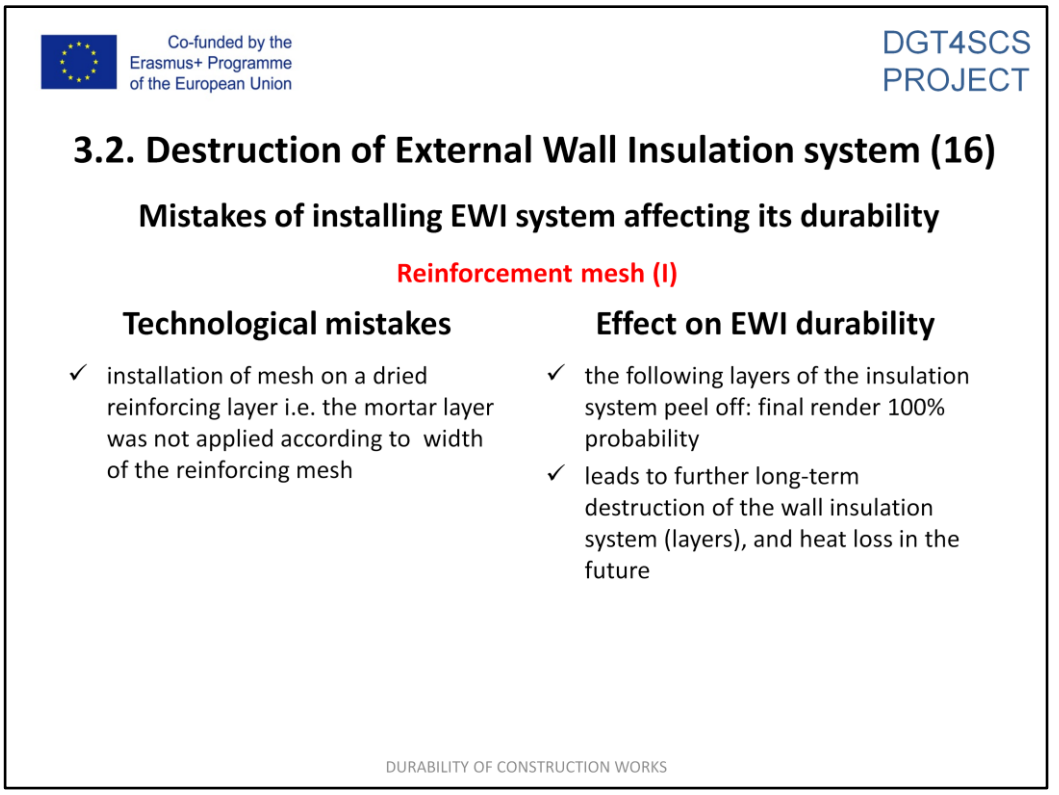
2. A trainer **names** and gives illustration of **EWI system defect** (destruction) which is a result of listed mistakes
   Task 3: Before defect is named and picture is shown ask trainees: "What are the possible kinds of destruction of EWI due to listed mistakes at this step of insulation process?"

3. A trainer gives students information about **possibility and way of correction** EWI system defects
   Task 4: Firstly ask trainees to suggest possible way of correction/ solving and express their opinions about the probability to correct: "Are there any possible ways to correct the defect?"

Element of EWI system – reinforcing mortar

Probability and ways to correct:

- **partial correction** is possible: peeling layers are removed (final render, reinforcing layer with mesh), only the attached layer of insulating material remains and the technological process of insulation is carried out again step by step (starting with the application of the mortar)
- in order to avoid peeling of the insulation layers, it is necessary to follow the technology **and avoid the mentioned possible mistakes (incorrect works)** (take into account the affecting factors)



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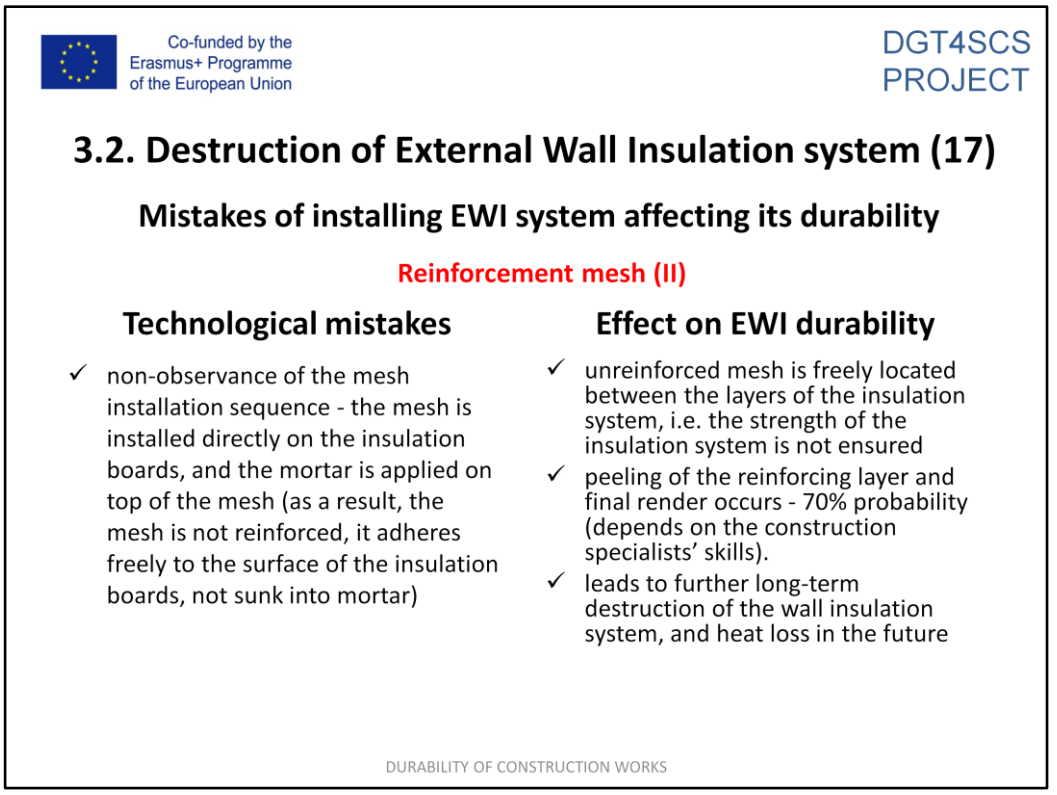
Element of EWI system – reinforcement mesh (I)

Probability and ways to correct:

- **partial correction** is possible: the detached layer (final render), as well as the mesh and the reinforcing layer are removed, only the attached layer of insulation material remains and the technological process of insulation is carried out again, step by step, starting with the application of the reinforcing mortar (reinforcing mortar, mesh, prime, final render)
- in order to avoid peeling of the final render, it is necessary to follow the technology of work - **avoid the possible mistake (incorrect work)**



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Element of EWI system – reinforcement mesh (II)

Probability and ways to correct:

- **partial correction** is possible: peeling layers (final render, reinforcing, mesh) are removed, only the attached layer of insulating material remains and the technological process of insulation is carried out again, starting with the application of the reinforcing mortar solution step by step (mortar, mesh, primer, final render)
- in order to avoid peeling of layers, it is necessary to follow the technology of the sequence of work done- a**void the possible mistake (incorrect works)**

Notes for the trainer and additional information:

Element of EWI system – reinforcing mortar

Probability and ways to correct:

- **partial correction** is possible: peeling layers are removed (final render, reinforcing layer with mesh), only the attached layer of insulating material remains and the technological process of insulation is carried out again step by step (starting with the application of the mortar)
- in order to avoid peeling of the insulation layers, it is necessary to follow the technology **and avoid the mentioned possible mistakes (incorrect works)** (take into account the affecting factors)

Element of EWI system – reinforcement mesh (I)

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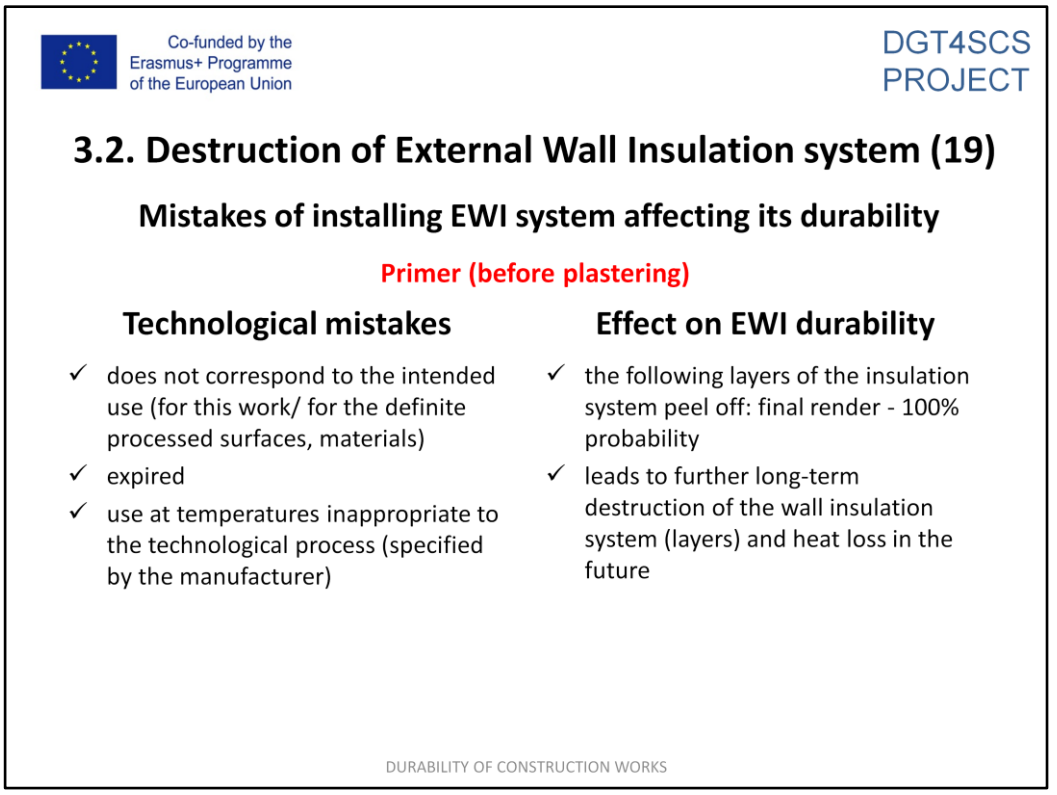

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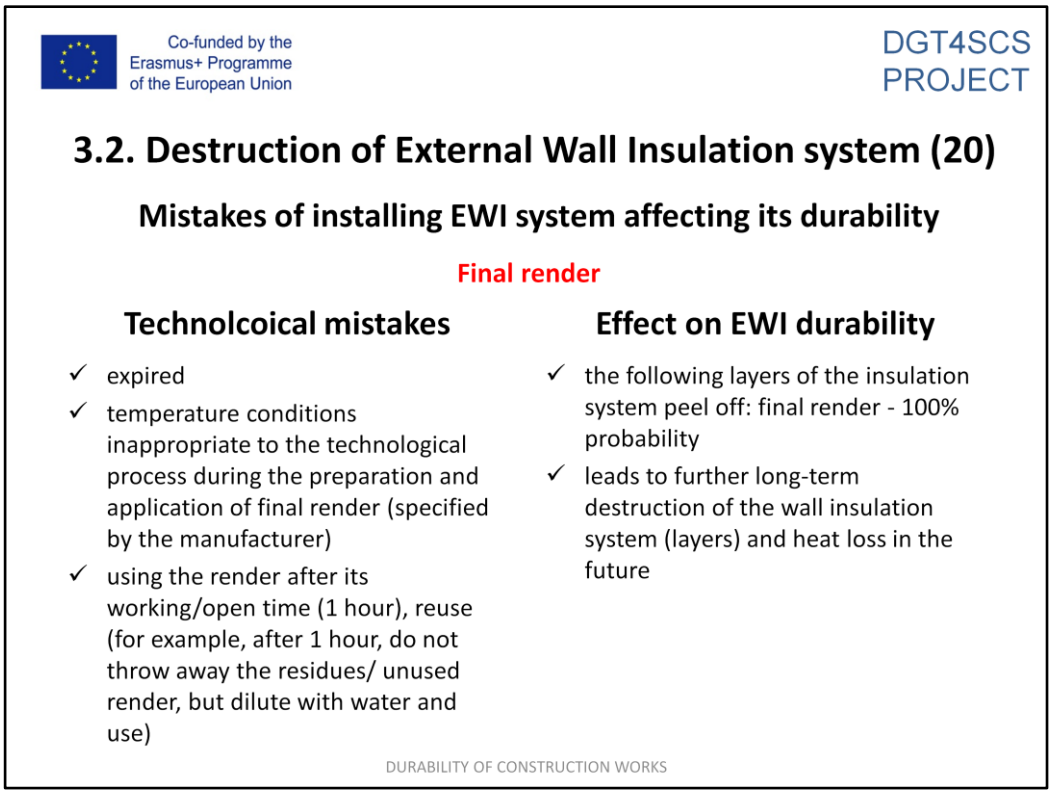
Element of EWI system – primer (before plastering)

Probability and ways to correct:

- **partial correction** is possible: remove the exfoliated layer (final render), and carry out the technological process of insulation again, starting with the application of the render step by step (primer, final render)
- in order to avoid peeling of the final render, it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)



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Element of EWI system – final render

Probability and ways to correct:

- **partial correction** is possible: remove the exfoliated layer (final render), and carry out the technological process of insulation again, starting with the application of the primer step by step (primer, final render)
- in order to avoid peeling of the final render, it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)

NB! Facade painting is insignificant for the durability of the external wall insulation system (layers) - only aesthetic defects are possible

Notes for the trainer and additional information:

Element of EWI system – primer (before plastering)

Probability and ways to correct:

- **partial correction** is possible: remove the exfoliated layer (final render), and carry out the technological process of insulation again, starting with the application of the render step by step (primer, final render)
- in order to avoid peeling of the final render, it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)

Element of EWI system – final render

Probability and ways to correct:

- **partial correction** is possible: remove the exfoliated layer (final render), and carry out the technological process of insulation again, starting with the application of the primer step by step (primer, final render)
- in order to avoid peeling of the final render, it is necessary to follow the technology and avoid the mentioned possible **mistakes (incorrect works)** (take into account the affecting factors)

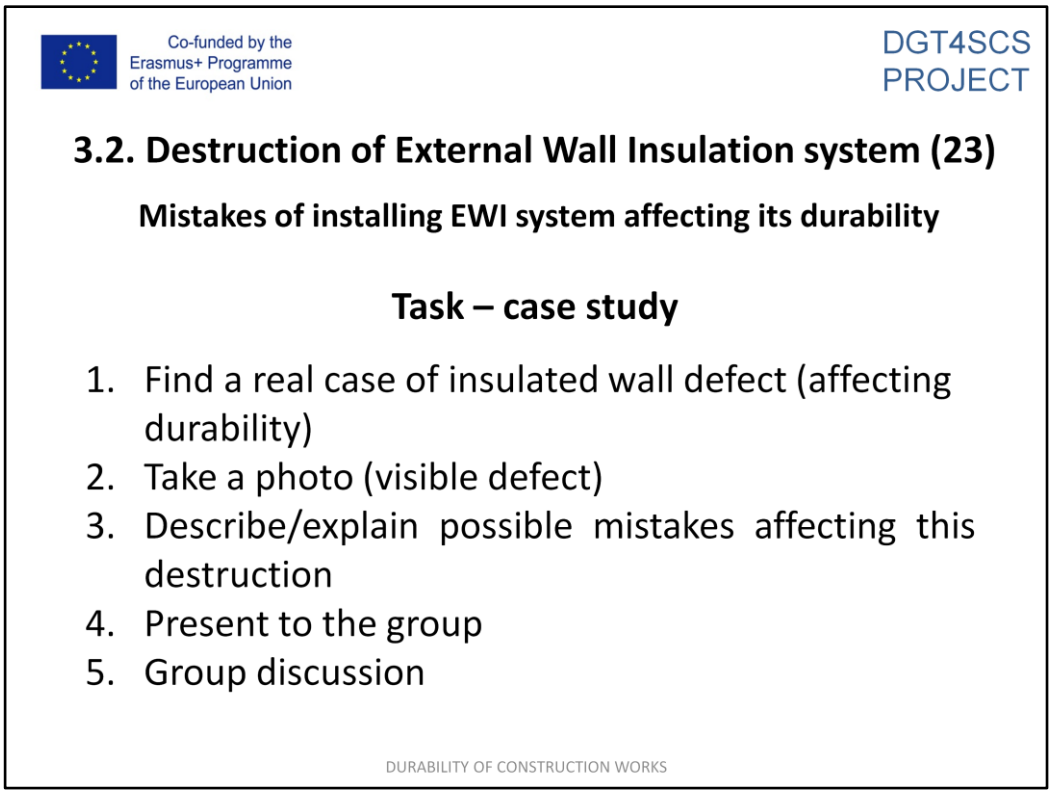
Notes for the trainer and additional information:

Case study (***depends on level of trainees)

Show video about **EWI installation technology mistakes** – a trainer chooses one according to trainees' knowledge and qualification.

For example:
https://www.youtube.com/watch?v=02GbDLxe8E0 (LV) [Accessed 8 November 2020].

NB! **It is suggested for trainer to organise a training excursion**. **The case, structure, material should be prepared by the trainer beforehand in order to ensure high quality training process.**

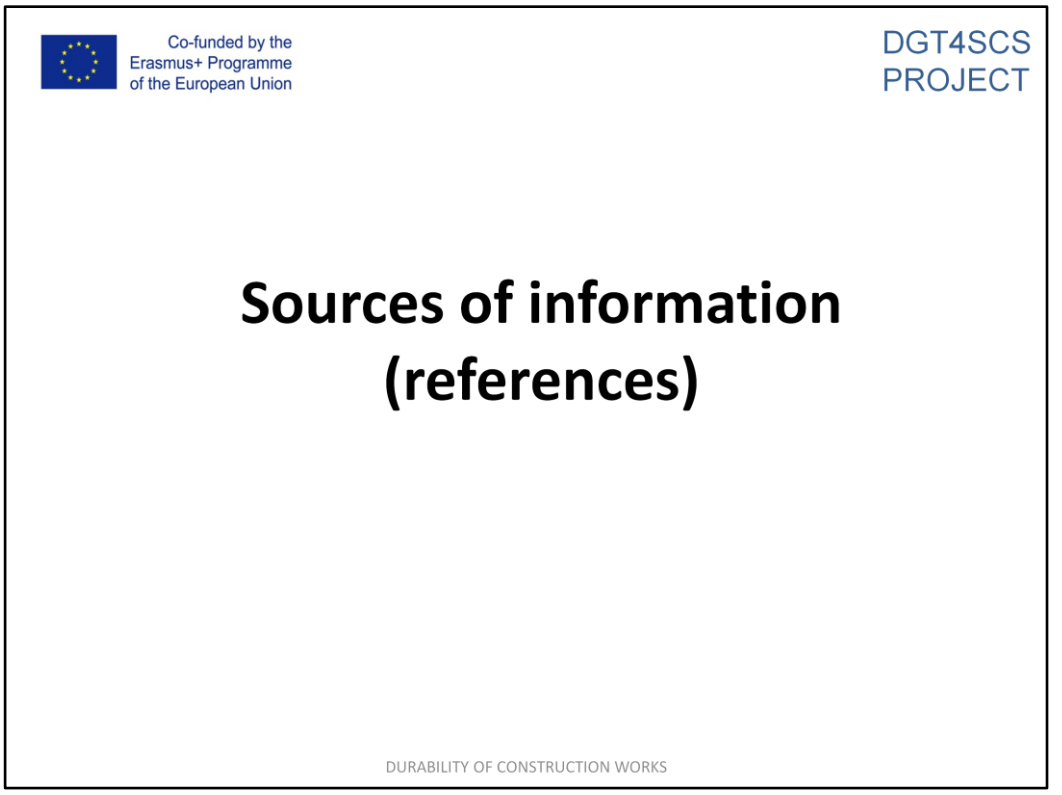


Notes for the trainer and additional information:

Task 8 – Case study (home work + presentation in class)

Ask students to find a real case of insulated wall defect (affecting durability), take a photo and describe/explain possible mistakes which affected this destruction of EWI system, and present to the group.
Students present results of their surveys in a class, a trainer discuss a case with students.

NB! **It is suggested for trainer to organise a training excursion**. **The case, structure, material should be prepared by the trainer beforehand in order to ensure high quality training process.**



Notes for the trainer and additional information:

See the next slide.

Sources of information (references)

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2. *Ecology of construction materials.* A handbook. Baltic Environment Forum. Baltic Environmental Forum, Latvia, 2011
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4. Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 608 p.
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6. *Training material developed by Daugavpils Construction Technical School* vocational trainers and used within the school training programme "Construction" qualification "Building technician" (not published). Adopted to the module goal.