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Centrum spolupráce s inklúziou Harmónia - Inclusion Cooperation Center Harmónia

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Educational Lesson - Workshop Clay Walls

Goal of the Workshop: Participants will gain practical experience in preparing clay mixtures, techniques for applying and forming walls, and will learn about the advantages and sustainability of clay buildings.

Preparation of the Clay Mixture

Step 1: Preparation of Raw Materials

- **Clay:** Must be clean, free of stones and organic impurities. Ideally, use clay with a high content of silt to ensure better cohesion of the mixture.
- **Sand:** Fine-grained, ideally with uniform granularity. Sand increases the strength of the mixture and prevents cracking during drying.
- **Water:** Clean, without chemical additives.
- **Straw:** Chopped into pieces approximately 5-10 cm long. Straw adds structure and strength to the mixture.

Step 2: Proportion of Components

- **Basic ratio:** 1 part clay : 2-3 parts sand : water as needed : 1 part straw (optional).
- **Exact proportions:** Depend on the quality and type of available clay and sand. It is recommended to start with a 1:2 ratio (clay/sand) and adjust as necessary based on the consistency of the mixture.

Step 3: Mixing Dry Ingredients On a large flat surface or in a mixer, thoroughly mix clay with sand in a 1:2 ratio (one part clay to two parts sand). If the mixture is too crumbly, increase the proportion of clay.

Step 4: Adding Water Gradually add water, ideally in small doses. Mix the mixture thoroughly until it reaches the consistency of thick dough. **Consistency test:** The mixture should hold its shape but not be too sticky.

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Step 5: Adding Straw (optional) If increased strength is needed, add chopped straw. Mix the mixture thoroughly to ensure even distribution of the straw.

Demonstration of Mixing the Mixture:

- Demonstrate the proper technique for mixing dry ingredients.
- Gradually add water to achieve the ideal consistency.
- Add and mix straw into the mixture.

Interesting Facts: Historical Use of Clay in Construction Worldwide: Clay was one of the first building materials humans used due to its availability and ease of handling. As early as the Neolithic period, around 10,000 BC, people discovered that clay could be shaped and hardened in the air or fire, leading to the production of the first ceramic containers for storing food and water. In Mesopotamia, the Sumerians used clay to produce tablets for cuneiform writing.

In Egypt, clay was used to make bricks mixed with straw, which were used, for example, in the construction of the city of Harappa and the pyramids. The Romans perfected the technique of fired bricks, which they used in the construction of public and private buildings throughout their empire.

Modern Examples of Clay Buildings: Today, the use of clay in construction is experiencing a renaissance due to its ecological properties and sustainability. Clay buildings, such as modern versions of traditional adobe structures, are still popular in many parts of the world, including Central America and Africa. In Morocco, clay houses are commonly used in the traditional kasbah style.

Another example is the use of modern geopolymers, created from clay and providing higher strength and durability. These materials are used, for instance, in the construction of modern ecological buildings that minimize environmental impact and utilize locally available resources.

These historical and modern examples demonstrate how versatile and durable a material clay can be and how its use continues to innovate by combining traditional knowledge with modern technologies.

For more information, you can visit the following links:

- [Barrocrafts - History of Clay](#)
- [Bluebeam Blog - Soil Construction](#)

Techniques for Applying and Forming Walls

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Introduction to Application and Forming Techniques: Clay is a versatile material that can be formed and applied using various techniques, allowing for a wide range of applications in construction. Below are the main techniques, tools, and materials needed for working with clay.

Overview of Various Techniques:

- **Hand Application**
 - **Technique:** This traditional method involves manually shaping the clay into desired forms. It can be as simple as patting and shaping the clay or more complex modeling to create detailed structures.
 - **Application:** Used mainly for small projects and sculpture, but also for repairing and modifying existing clay structures.
- **Using Molds**
 - **Technique:** Clay is placed into pre-prepared molds where it hardens into the desired shape. Molds can be made from wood, metal, or silicone.
 - **Application:** Ideal for producing repetitive shapes and elements such as bricks, tiles, or decorative elements.
- **Layering (rammed earth)**
 - **Technique:** Layering involves alternately applying layers of clay and compacting them into a solid mass. This process can be mechanized or done manually.
 - **Application:** Used for building solid, durable walls and structures. It is a technique known from traditional buildings in Africa, Asia, and South America.

Tools and Materials Needed for Work

- **Tools:**
 - **Spoon and spatula:** Used for mixing and applying clay.
 - **Molds:** Various sizes and shapes of molds for shaping clay.
 - **Mallet and tampers:** For layering and compacting clay.
 - **Cutters and knives:** For precise cutting and shaping of clay.
 - **Water sprays:** To maintain the correct moisture of the clay during work.
- **Materials:**
 - **Clay:** The basic material that can be mixed with sand or other aggregates to increase strength.
 - **Stabilizers:** Additives such as lime, cement, or bitumen to increase resistance and durability.
 - **Straw or fibers:** Added to clay to improve its structure and reduce cracking.

Work Procedure: Application and Forming Techniques

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Step 1: Preparing the Base Ensure that the substrate wall is clean and slightly moistened for better adhesion.

Step 2: Hand Application of the Mixture Scoop the mixture with your hands or a spoon and apply it to the wall in an even layer. Use gloves if the mixture is too abrasive.

Step 3: Using Molds Place the molds on the wall and fill them with the mixture, then remove them after compacting the mixture.

Step 4: Layering and Smoothing Apply additional layers as needed and smooth each layer thoroughly with a trowel or similar tool. Create textures or decorative elements as needed.

Practical Demonstrations and Group Work

1. **Group Work:** Participants will be divided into groups and collaborate on building model clay walls. Discussion and problem-solving during work.
2. **Work Procedure: Building a Clay Wall**
 - **Step 1: Design and Preparation**
 - Plan the dimensions and shape of the wall.
 - Prepare all necessary materials and tools.
 - **Step 2: Building the Base Layer**
 - Apply the first layer of the mixture to the substrate surface, ensuring it is even.
 - **Step 3: Gradually Applying Additional Layers**
 - Continue applying layers, allowing each layer to partially dry before applying the next.
 - **Step 4: Wall Reinforcement**
 - After reaching the desired height, allow the wall to dry thoroughly.
 - **Step 5: Surface Finish**
 - Smooth the surface or apply protective coatings if necessary.

Discussion and Final Questions

1. **Discussion:**
 - **Advantages and Sustainability of Clay Buildings**
 - **Ecological and material availability**
 - **Local resources:** Clay is available almost everywhere in the world, reducing transportation costs and emissions.
 - **Recyclability:** Clay materials can be easily recycled and reused, minimizing waste and the need for new raw materials.
 - **Energy Efficiency**

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- **Thermal stability:** Clay walls have high thermal mass, meaning they can effectively regulate indoor temperature, keeping cool in summer and warm in winter.
- **Low energy consumption in production:** The production of clay bricks and other building materials requires less energy than the production of cement or fired bricks.
- **Health Benefits**
 - **Natural moisture regulation:** Clay naturally regulates indoor humidity, contributing to a healthier indoor environment and reducing the risk of mold growth.
 - **Non-toxicity:** Clay is a natural material that does not contain toxic chemicals, making it a safe choice for living spaces.

Sustainability of Clay Buildings

- **Reducing Carbon Footprint**
 - **Low emissions in production:** The process of producing clay building materials generates less CO₂ compared to conventional building materials such as concrete.
 - **Reducing energy consumption:** Clay buildings, due to their thermal mass, reduce the need for artificial heating and cooling, leading to lower energy consumption and greenhouse gas emissions.
- **Durability and Longevity**
 - **Resistance to natural elements:** Properly constructed clay buildings can be very resistant to earthquakes, floods, and other natural disasters.
 - **Low maintenance costs:** Clay buildings often require less maintenance than conventional buildings, further reducing their ecological footprint.
- 3. **Ecological Aspects**
 - **Biodegradability:** Unlike many modern building materials, clay materials are biodegradable, minimizing their environmental impact after the building's lifespan.
 - **Minimizing Waste:** Using clay in construction can significantly reduce the amount of construction waste, as clay can be easily recycled and reused.

Final Questions:

- **Answering participants' questions.**
- **Recommendations for further study.**

Examples and Interesting Facts:

Historical Examples:

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- Ancient clay buildings in Mesopotamia.
- Traditional clay houses in Africa (e.g., the Dogon people in Mali).

Modern Examples:

- **Earthship Homes in the USA**
 - Earthship homes are a unique example of sustainable architecture that uses recycled and natural materials to create energy self-sufficient homes. These homes were developed by architect Michael Reynolds and are designed to produce their own energy, water, and food. They are built from materials such as earth-filled tires, cans, and glass bottles, and use passive solar energy to maintain a constant temperature inside the building.
 - In the USA, specifically in Taos, New Mexico, there is a large community of Earthship homes known as the Greater World Earthship Community. This community covers over 300 acres of shared land and is completely off-grid, using solar and wind energy.
 - For more information on Earthship homes and visiting or renting opportunities, you can visit the following links:
 - Earthship Biotecture: Official website with information on construction, rentals, and educational programs.
 - Earthship Rentals and Visitor Center: Rental and visit opportunities for the Earthship community in Taos, New Mexico.

Ecological Buildings in Europe, such as the Center for Alternative Technology in Wales.

Video Demonstrations:

1. Preparation of Clay Mixture

- Preparing a clay mixture involves selecting the right raw materials and mixing them into a homogeneous consistency. This process includes removing impurities from the soil and then mixing it with water and sand. Watch the following video that details this process:
 - Finish Clay Plaster Recipe & Wall Preparation

2. Techniques for Applying Clay

- Techniques for applying clay include applying the mixture to various surfaces such as wooden frames or walls using traditional methods like wattle and daub. This video will show you the basic techniques and procedures for applying clay mixtures:
 - Intro to Light Straw Clay Construction

3. Modern Clay Buildings

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- **Modern clay buildings combine traditional methods with modern techniques to ensure energy efficiency and ecological sustainability. Watch this video that presents contemporary applications of clay buildings and their benefits:**
 - **Basic Guide to Wattle and Daub Construction**
 - **Modern Off-Grid Cob House Built With Sand Clay & Straw - Sustainable Green Building Tour**

Further Educational Resources:

Books:

- "The Hand-Sculpted House" by Ianto Evans, Michael G. Smith, and Linda Garland.
- "Building with Earth" by Gernot Minke.

Websites:

- [The Cob Cottage Company](#)
- [Earth Building Association of New Zealand](#)

Online Courses:

- Udemy: [Sustainable Building with Earth](#)
- Coursera: [Sustainable Construction Methods](#)

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