



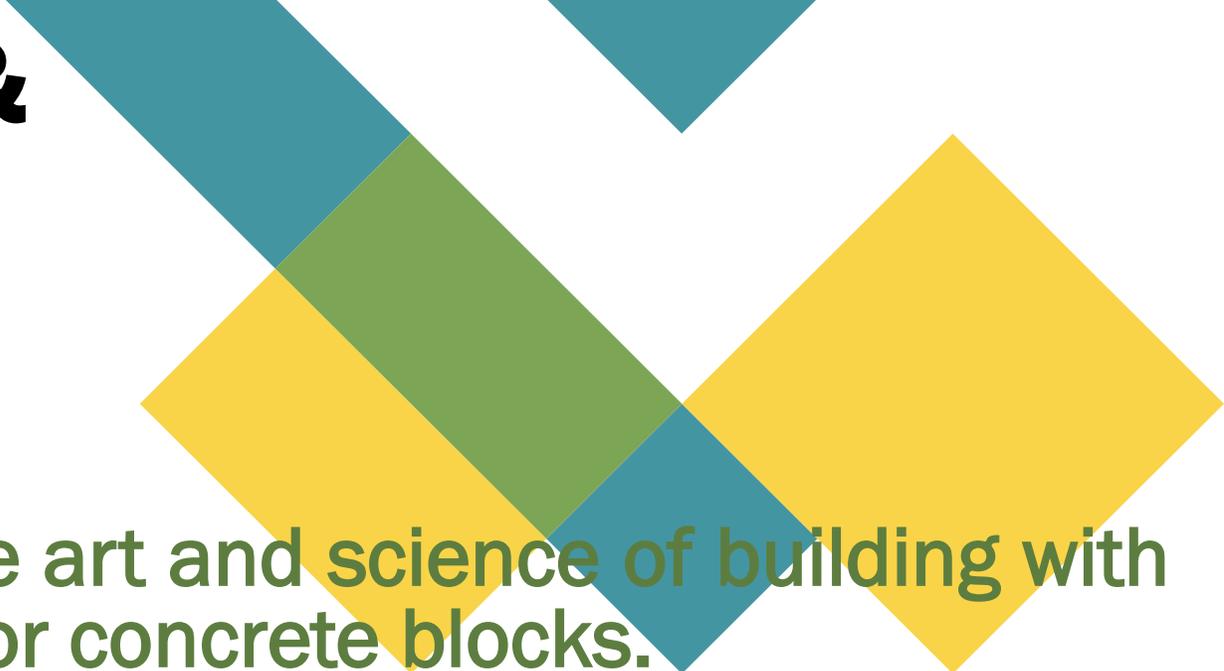
Building Materials & Construction Techniques

The Role of Materials in Construction



- **Why Materials Matter:** The choice of material is the most fundamental decision in a construction project.
- **Key Criteria:** Materials are chosen based on their:
 - **Strength:** Ability to resist forces.
 - **Durability:** How long they last against wear and tear.
 - **Cost:** The economic feasibility.
 - **Aesthetics:** Visual appeal.
 - **Environmental Impact:** Sustainability.

Introduction to Stone & Masonry



- **Definition:** Masonry refers to the art and science of building with individual units of stone, brick, or concrete blocks.
- **Stone:** One of the oldest building materials.
- **Advantages:** Exceptionally strong, durable, and fire-resistant.
- **Disadvantages:** Heavy, difficult to work with, and expensive.

Types of Building Stones

- **Granite:** Very hard and durable, used for facing and flooring.
- **Sandstone:** Formed from sand particles, good for decorative work.
- **Limestone:** A common stone, easy to cut and shape, used for building blocks.
- **Marble:** A metamorphic rock, highly valued for its aesthetic qualities.

Brick as a Building Material



- **What are Bricks?** Bricks are blocks of clay that are hardened by firing in a kiln.
- **Advantages:** Uniform size, high strength, and fire resistance.
- **Types of Bricks:**
 - **Burnt Clay Bricks:** The most common type.
 - **Fly Ash Bricks:** Made from a waste product of coal combustion, more eco-friendly.

Brick Masonry: Basic Terminology



- **Stretcher:** A brick laid with its longest side facing the exterior.
- **Header:** A brick laid with its shortest side facing the exterior.
- **Joints:** The spaces between bricks, filled with mortar.
- **Bond:** The pattern in which bricks are laid to distribute loads and provide strength.

Introduction to Concrete



- **Concrete:** A composite material made from a mixture of fine and coarse aggregates, a binder (usually cement), and water.
- **Composition:**
- **Cement:** The "glue" that holds it all together.
- **Aggregates:** Sand, gravel, or crushed stone.
- **Water:** Reacts with cement to form a strong paste.

The Role of Cement



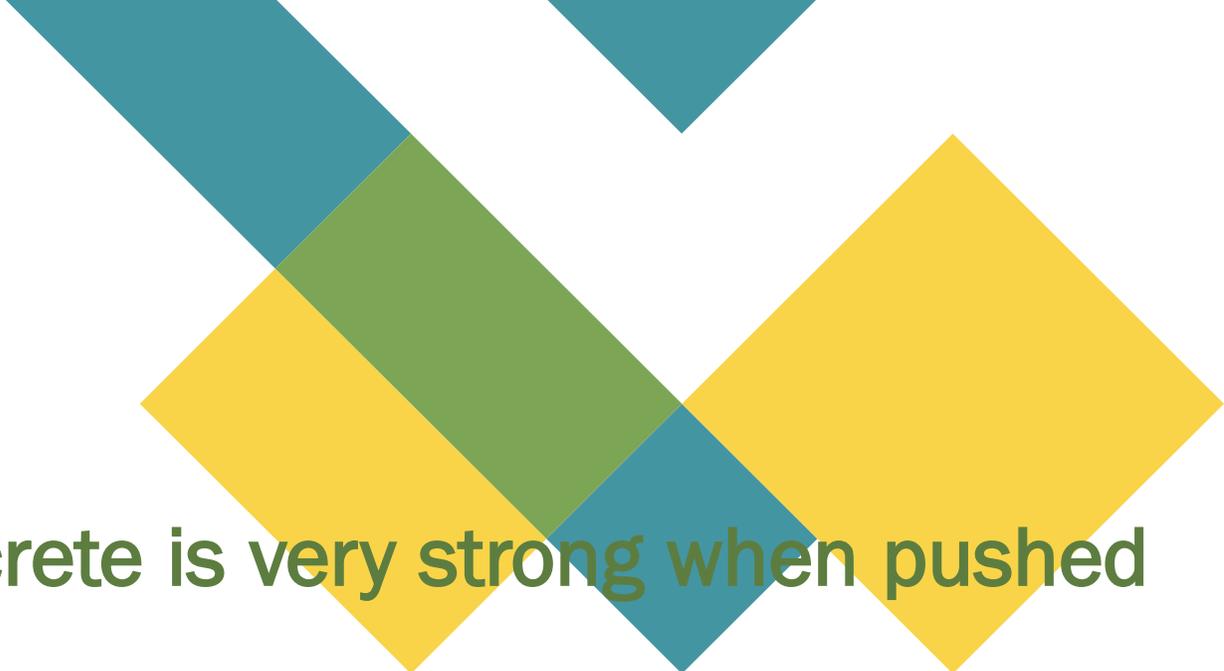
- **Cement:** A key ingredient in concrete. It's a fine powder that, when mixed with water, forms a paste that hardens over time.
- **Portland Cement:** The most common type of cement used worldwide.
- **Hydration:** The chemical reaction between cement and water that causes the concrete to harden.

Types of Concrete



- Plain Concrete: Concrete without any reinforcement.
- Reinforced Concrete (RC): Concrete with steel bars (rebar) embedded in it to improve its tensile strength. This is the most common type of concrete used today.
- Prestressed Concrete: Concrete that is intentionally put under compression to make it stronger under tension.

Concrete's Properties



- **High Compressive Strength:** Concrete is very strong when pushed together.
- **Low Tensile Strength:** It is weak when pulled apart. This is why it needs steel reinforcement.
- **Versatility:** Can be poured into any shape or form.

Steel as a Building Material



- **Steel:** An alloy of iron and carbon.
- **Advantages:** Extremely high tensile and compressive strength.
- **Durability:** Can be made resistant to corrosion.
- **Recyclability:** Highly recyclable and sustainable.

Steel in Construction: Applications



- Reinforcement Bars (Rebar): The most common use, providing tensile strength to concrete.
- Structural Steel: Used for beams, columns, and trusses in high-rise buildings and bridges.
- Steel Cables: Used for tensioning in suspension bridges.

The Synergy of Steel & Concrete



- **A Perfect Partnership:** Reinforced concrete is a prime example of two materials working together to cover each other's weaknesses.
- **Concrete's Role:** Resists compression.
- **Steel's Role:** Resists tension.
- **Thermal Expansion:** Both materials expand and contract at a similar rate, preventing cracking.

Introduction to Timber



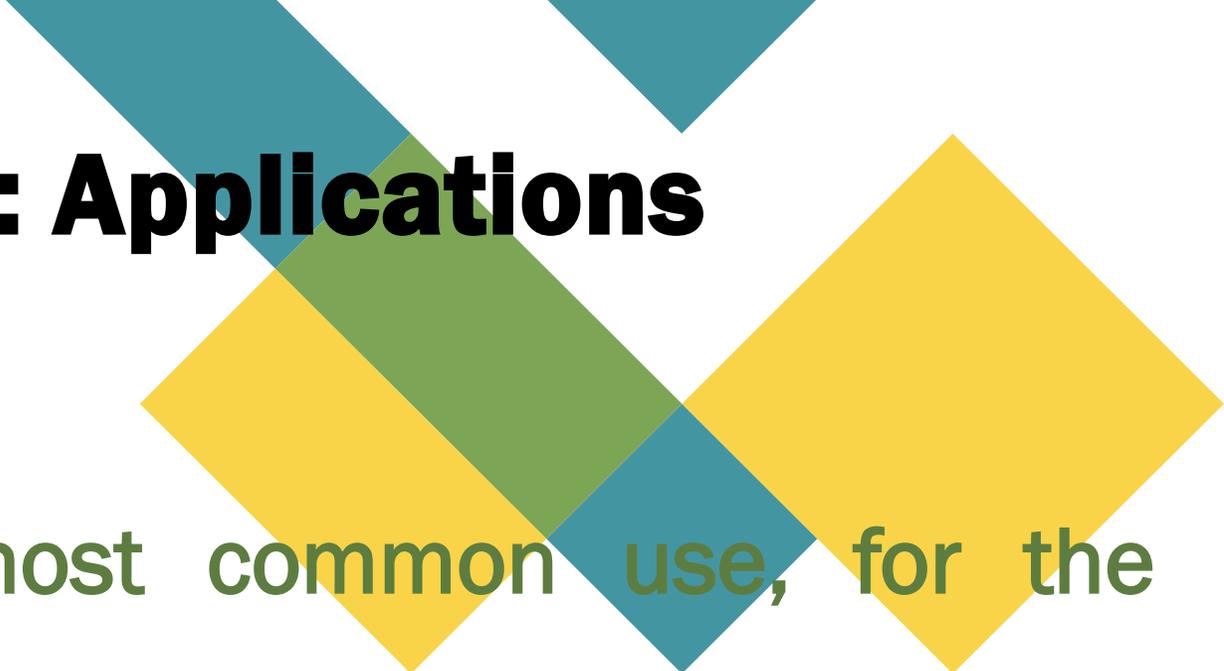
- **Timber:** Wood used as a building material.
- **Advantages:**
 - **Lightweight:** Easy to transport and work with.
 - **Renewable:** A sustainable resource.
 - **High Strength-to-Weight Ratio:** Strong for its weight.
 - **Aesthetic:** Visually appealing.
- **Disadvantages:** Susceptible to rot, insects, and fire.

Types of Timber



- **Hardwood:** From deciduous trees (lose their leaves). Examples: Oak, Maple. Used for flooring and furniture.
- **Softwood:** From coniferous trees (evergreens). Examples: Pine, Fir. Used for structural framing.

Timber in Construction: Applications



- **Structural Framing:** The most common use, for the skeleton of a building.
- **Flooring and Decking:** Wood provides a warm, natural surface.
- **Roofing:** Used for roof trusses and shingles.

Glass as a Building Material



- **Composition:** Made from sand and other minerals.
- **Advantages:**
 - **Transparency:** Allows light to enter.
 - **Aesthetics:** Provides a modern, sleek look.
 - **Thermal Properties:** Can be treated to be energy-efficient.
- **Disadvantages:** Brittle and a poor insulator unless specifically treated.

Types of Glass



- **Float Glass:** The most basic type, used for windows.
- **Laminated Glass:** Two layers of glass with a plastic interlayer, used for safety.
- **Tempered Glass:** Heats and cools glass rapidly to make it much stronger.

Plastics in Construction



- **Definition:** Synthetic materials made from polymers.
- **Advantages:** Lightweight, corrosion-resistant, and low cost.
- **Applications:**
 - **PVC Pipes:** For plumbing and drainage.
 - **Insulation:** Used in foam and panels.
 - **Window Frames:** Used as a durable, low-maintenance alternative to wood.

The Evolution of Building Materials



- Ancient: Stone, mud, timber.
- Industrial Revolution: Iron and steel become common.
- Early 20th Century: The invention of reinforced concrete revolutionized construction.
- Modern Era: The rise of engineered materials like composites and advanced plastics.

Introduction to Construction Techniques



- **Technique:** The specific method used to assemble materials and build a structure.
- **Foundation:** The first step, providing a stable base.
- **Framing:** Building the structural skeleton.
- **Cladding:** Adding the outer layer or "skin" of the building.

Foundations: The Critical First Step



- **Function:** Transfers the load of the building safely to the ground.
- **Types of Foundations:**
 - **Shallow Foundations:** Used when the ground is strong near the surface. Examples: Spread footings.
 - **Deep Foundations:** Used when the ground is weak. Examples: Piles and piers.

Shallow Foundations

- **Spread Footing:** A wide base that spreads the load of a column or wall over a larger area.
- **Mat Foundation:** A single, large concrete slab that supports the entire building. Used for very heavy loads or weak soil.



Deep Foundations

- Piles: Long columns of concrete, timber, or steel driven deep into the ground.
- Piers: Short, wide columns that transfer loads to a deeper, stronger soil layer.



Superstructure: The Part Above Ground



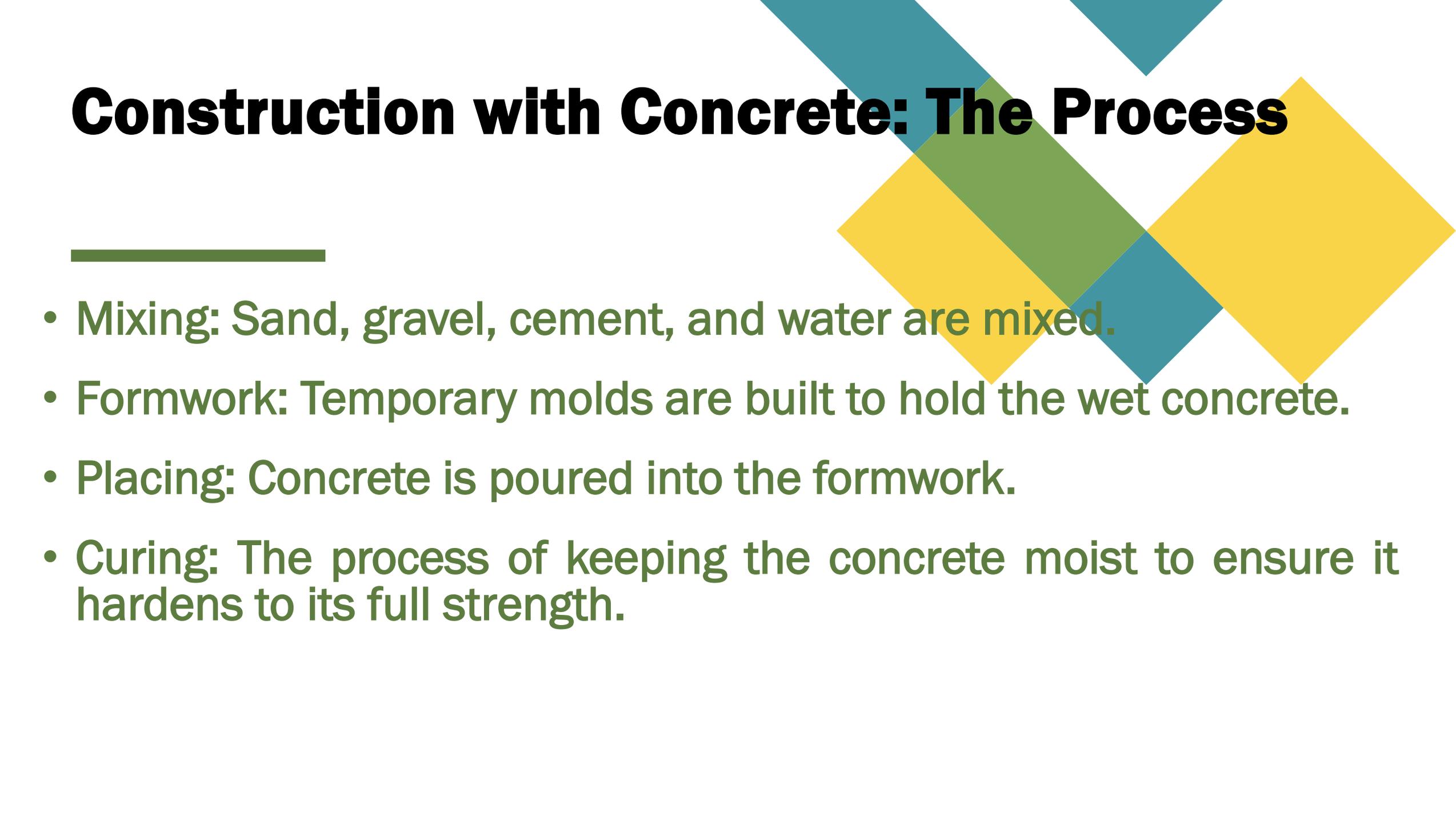
- **Definition:** The part of the building that is visible above the foundation.
- **Main Components:**
 - **Columns:** Vertical structural elements that support loads.
 - **Beams:** Horizontal structural elements that support floors and roofs.
 - **Slabs:** Flat, horizontal elements that create floors and ceilings.

Structural Framing Systems



- **Framing:** The system of beams, columns, and other elements that make up the skeleton of a building.
- **Types:**
 - **Skeletal System:** Uses a grid of columns and beams.
 - **Load-Bearing Wall System:** Walls support the loads from floors and the roof.

Construction with Concrete: The Process



- **Mixing:** Sand, gravel, cement, and water are mixed.
- **Formwork:** Temporary molds are built to hold the wet concrete.
- **Placing:** Concrete is poured into the formwork.
- **Curing:** The process of keeping the concrete moist to ensure it hardens to its full strength.

Curing of Concrete



- **Importance:** This is a crucial step. It allows the hydration process to continue.
- **Methods:**
 - **Spraying water** on the surface.
 - **Covering with wet burlap.**
 - **Using a curing compound** to seal in moisture.
- **Key Idea:** Properly cured concrete is significantly stronger.

Brickwork: Laying and Bonding



- **Laying:** Bricks are laid in rows (courses) with mortar.
- **Bonding:** Different patterns (bonds) are used to prevent vertical joints from aligning, which would make the wall weak.
- **Common Bonds:** English Bond, Flemish Bond, Stretcher Bond.

Steel Erection Process



- Fabrication: Steel beams and columns are manufactured off-site.
- Transport: The steel is delivered to the construction site.
- Erection: A crane lifts the steel members into place, where they are bolted or welded together.
- Key Idea: Steel construction is often faster than concrete construction.

The Building Envelope: The Outer Skin



- **Definition:** The exterior of the building that separates the inside from the outside.
- **Components:**
 - **Walls:** The exterior walls.
 - **Windows:** Provide light and ventilation.
 - **Roof:** Protects the building from the elements.
- **Function:** Provides weather resistance, thermal insulation, and security.

Roofing Materials

- Shingles: Common for residential homes.
- Metal Roofs: Durable, long-lasting, and fire-resistant.
- Membrane Roofing: Used for flat or low-sloped roofs, often made of rubber or plastic.



Flooring Systems



- **Concrete Slab-on-Grade:** A common foundation for floors on the ground level.
- **Suspended Slabs:** Concrete slabs supported by beams and columns, used for upper floors.
- **Timber Floors:** Constructed with wood joists and subflooring.

Sustainability in Building Materials



- **Green Building:** The practice of creating structures and using processes that are environmentally responsible.
- **Sustainable Materials:**
 - **Recycled Steel:** Reduces the need for new iron ore.
 - **Recycled Aggregates:** Reuses concrete from demolition.
 - **Timber:** A renewable resource.

Construction Safety



- **Importance:** Safety is the number one priority on any construction site.
- **Key Practices:**
 - **Personal Protective Equipment (PPE):** Hard hats, safety vests, gloves.
 - **Site Safety Plans:** Outlines procedures for handling hazards.
 - **Regular Inspections:** Ensures all equipment and practices are safe.

The Role of the Civil Engineer

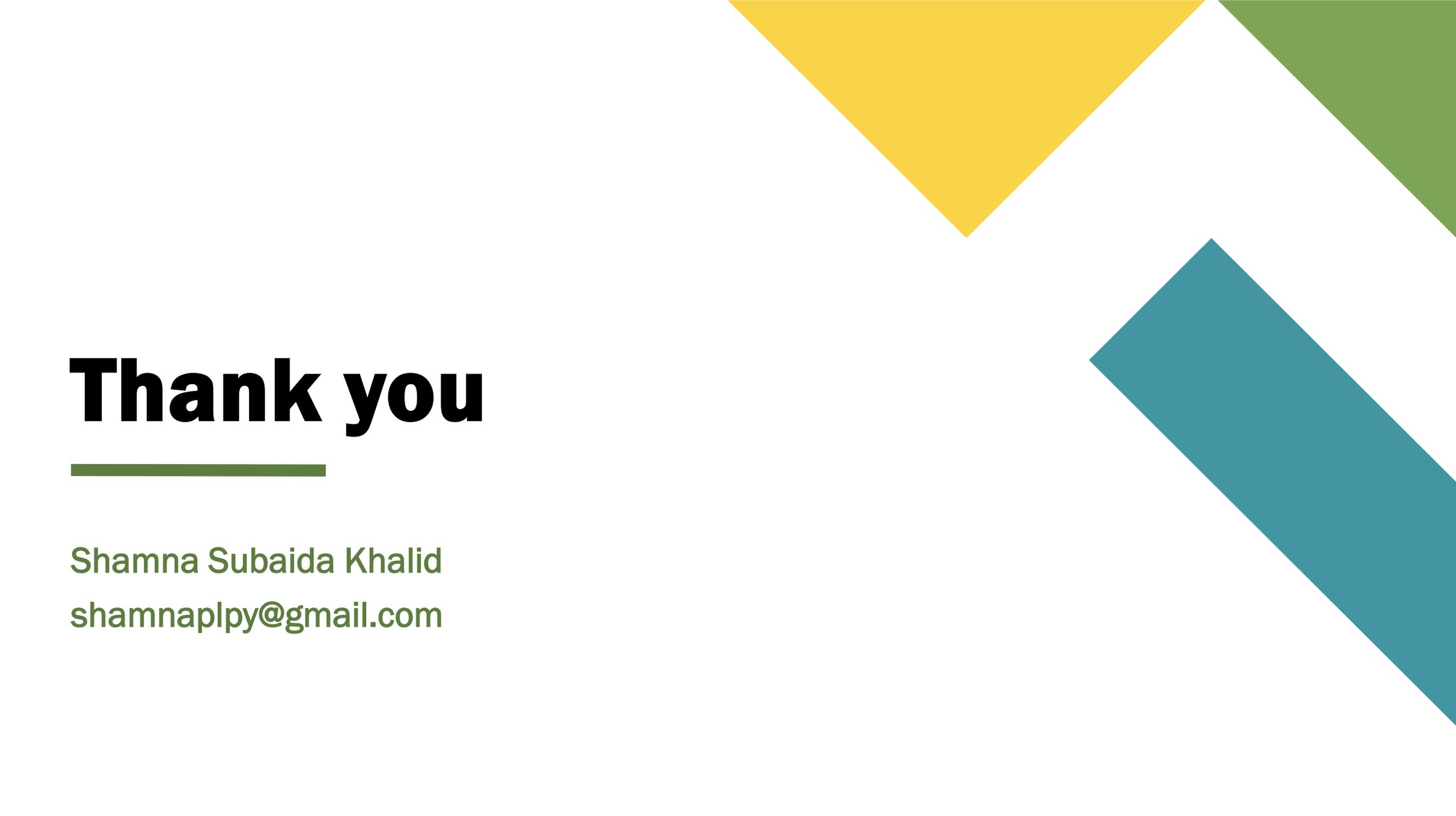


- **Design:** Choosing the right materials and techniques for a project.
- **Analysis:** Calculating the loads and forces to ensure structural integrity.
- **Management:** Overseeing the entire construction process to ensure it is safe, on time, and within budget.

The Impact of Technology



- **Building Information Modeling (BIM):** A digital model that helps engineers plan and visualize a project before construction begins.
- **Drones:** Used for site surveys and progress monitoring.
- **3D Printing:** A new technology being explored to create building components



Thank you

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