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CERAMICS

- The term “ceramic” covers a wide range of materials that are neither organic nor metallic, and which are processed at high temperatures.
- Clay-based ceramics are made by firing clay in a kiln to change the raw materials chemically. The clay melts only partially, resulting in a **vitreous** (glassy) phase that bonds the remaining crystalline mineral particles together.



Types of Ceramics

- Ceramic tiles are made of **earthenware**, **stoneware**, or **porcelain** (Table). They are generally glazed and are used for both walls and floors

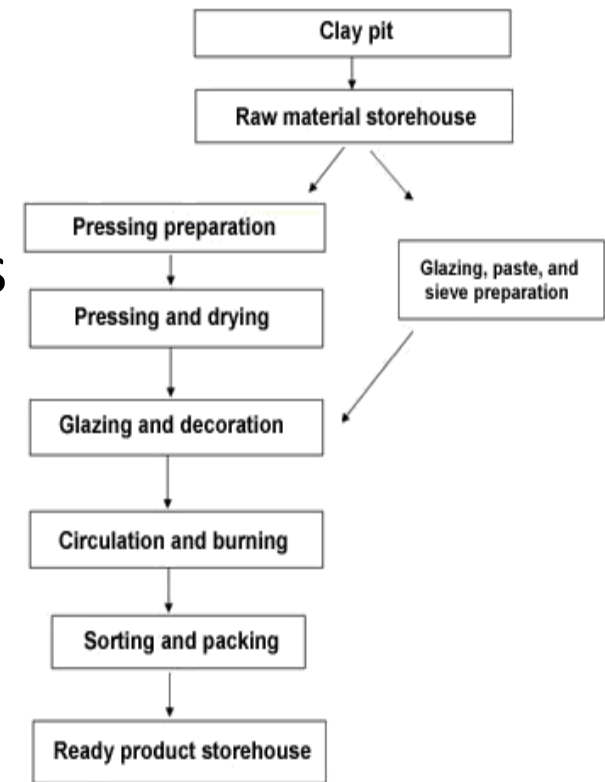
Type	Properties	Uses
Earthenware	Coarse, porous, breakable	Wall tiles
Stoneware	Up to 5% water absorption Impervious glazed/high fired	Plumbing, cladding, floor tiles, relief wall tiles
Porcelain	Fine, white, strong, vitreous. High electrical resistance	Sanitary ceramics, tile Insulating material

Ceramic Water Absorption

- **Water absorption** is measured as the **weight of water** absorbed as a percentage of the **tile weight**.
- **Vitreous** ceramics absorb less than 3 percent,
- **impervious** less than 5 percent,
- **semivitreous** from 3 percent to 7 percent,
- **nonvitreous** 7 percent or greater.
- **Bathroom** and **kitchen** tiles should **absorb 7 percent or less**, and **showers** less than **3 percent**.

Manufacturing Ceramics

- The characteristics of clay-based ceramics vary with the clays used.
- Water allows the clay particles to slide over each other as the clay is worked. A small residual amount of water holds the formed clay together as it slowly dries prior to firing; this evaporates as the clay is fired.
- Clay ceramic products are formed by either wet or dry processes.
- **Wet clay** must be dried slowly before being fired so that shrinkage takes place without cracking.
- A **dry process** in which powdered clay is compressed into a form results in better dimensional accuracy, and is used for most wall and floor tiles.



Environmental Impacts of Ceramics

ceramics were made locally near clay pits; now they are often found near sources of fuel.

Ceramic tile contains significant levels of embodied energy, much higher than those of terrazzo tile.

- The raw materials used to make ceramic products require **high firing temperatures**.
- Ceramic finishes may be **slippery, especially when wet**. Their use for floors must be carefully considered in regard to safety.

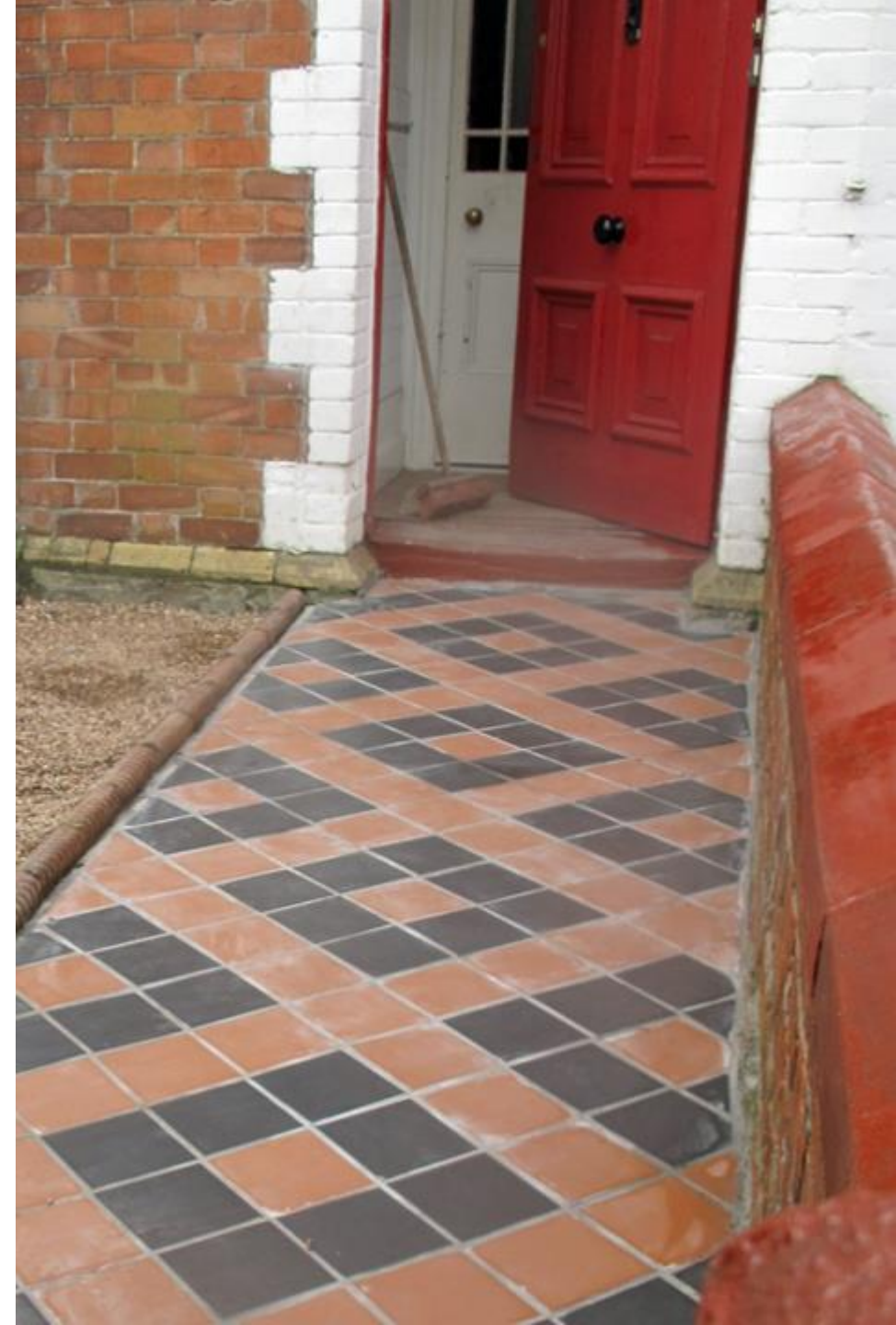
Interior Applications for Ceramics

- Many types of ceramic tiles are used for floors, walls, and countertops. They provide water-resistant surfaces that add color and detail to interior spaces.



Quarry Tiles

- Unglazed tile has a matte finish that is the same color as the clay from which it was made.
- **water absorption** not over 6 percent.
- These durable tiles are typically used for floors.
- good slip resistance.
- Quarry tiles are usually 1/2" (12 mm) thick and 6" (152 mm) square, but are available up to 12" (305 mm) square.
- color varies from brick red to shades of tan or terracotta



Terracotta Tiles

- Terracotta tiles are natural clay tiles fired at lower temperatures.
- **less durable** than most other tiles.
- handcrafted appearance is appealing.
- low density and high porosity make them **unsuitable for wet areas.**
- must be sealed regularly.



Glazed Ceramic Tiles

- available with satin, textured, or gloss finishes.
- resistant to stains, scratches, and fading, and are easy to maintain.
- Glazed ceramic floor tiles are pressed from ceramic dust and usually given a single firing.



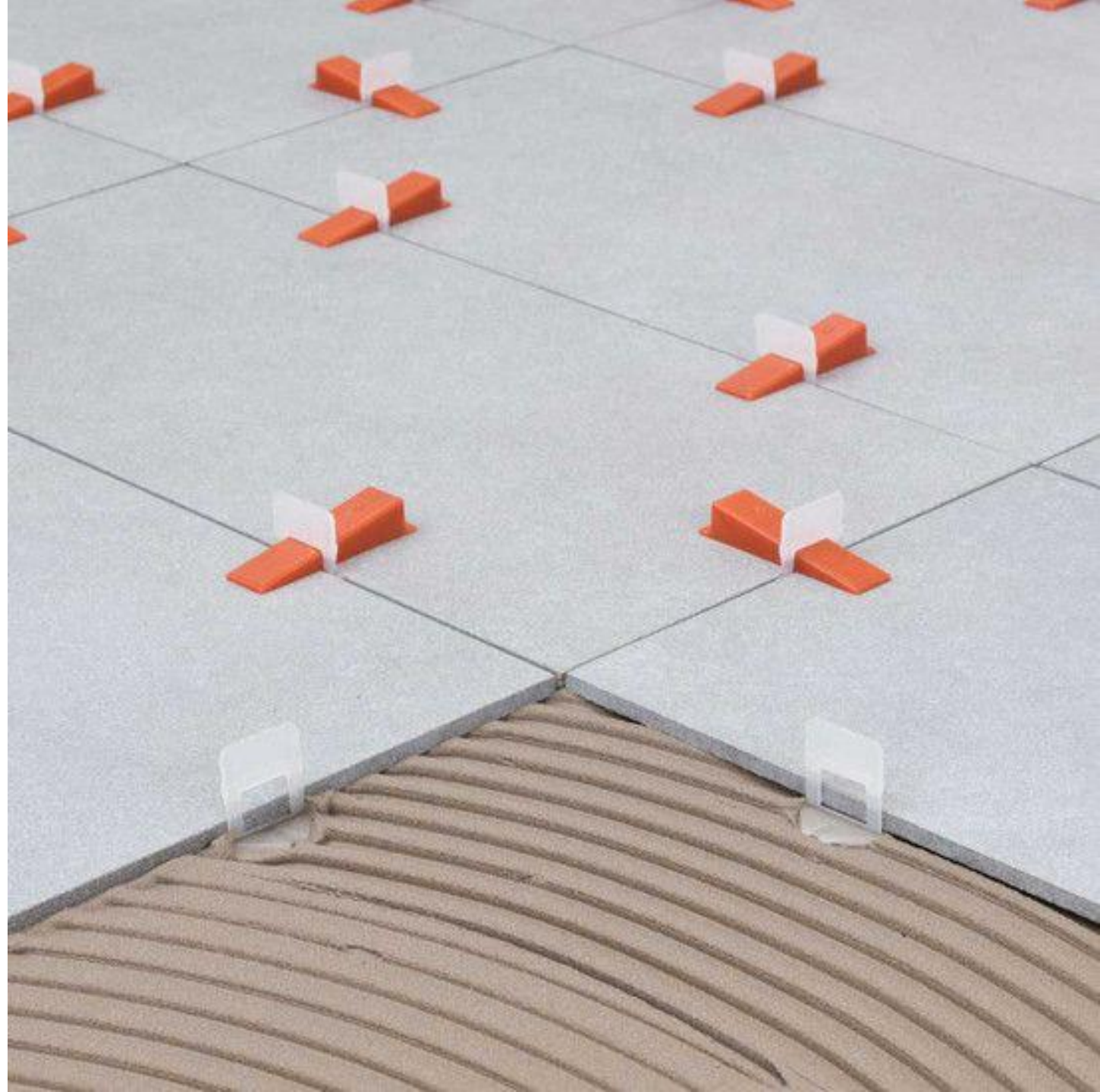
Ceramic Pavers

- are glazed or unglazed vitreous floor tiles a minimum of 3/8" (10 mm) thick and 6" (152 mm) square.
- Their surfaces may be rough, ribbed, or with other textures that make them **slip resistant**, but are **unsuitable for countertops**.



Porcelain Tiles

- are made from highly refined white clay and fired at a very high temperature for nearly twice as long as other ceramic tiles.
- They are extremely dense, very water-resistant, frost-proof, and durable enough for heavy traffic.
- Slip resistance can be improved by selecting tiles with a textured surface.
- Porcelain tiles are resistant to breakage and wear, and are often used for flooring in public areas



Mosaic Tiles

- Mosaic tiles are generally defined as glass or porcelain tiles **smaller than 6" (152 mm) square**.
- Mosaic tiles are usually mounted in sheets.
- They are extremely **durable** and **frost proof**, and are used both indoors and outdoors for floors



Wall Tiles

- They are available in bright or matte glazes in a wide range of colors and surface designs.
- Wall tiles are usually $5/16''$ (8 mm) thick,
- Nonvitreous glazed wall tiles with light-duty glazes should not be used on floors or countertops.



Relief and Art Tiles

- The design is **carved**, **modeled**, engraved, or pressed into the clay, and then sometimes **colored to emphasize its three-dimensional appearance**. Relief tiles are used for backsplashes and fireplaces and as borders and trims on walls.



Tile Ratings

- Labels on ceramic tile cartons have icons and information regarding tile properties. **Grade ratings of 1 and 2 indicate tiles suitable for floor use; grade 3 tiles are for walls only.**
- Porcelain Enamel Institute (PEI) wear ratings indicate the abrasion resistance of glazed ceramic floor tiles.
- Floor tiles are rated III, IV, or IV+, while tiles rated I and II are for wall use only. Coefficient of friction (COF) ratings range from 0 to 1; lower numbers indicate less friction and lower slip resistance. Floor tiles greater than 0.50 should be used for standard residential applications.

GLAZED TILE SUITABILITY

WHAT YOU NEED TO KNOW

PEI 0		Glazed tiles in this class are wall tiles only and unsuitable for use on floors.
PEI 1		Floor coverings for use on very light-wear areas, using soft footwear, e.g. Domestic bathrooms and bedrooms without direct access from exterior areas.
PEI 2		Floor coverings for light-traffic living areas where people are using soft-soled or normal footwear, excluding kitchens, entrances and other more highly-trafficked areas.
PEI 3		Floor coverings for light to moderate traffic areas, e.g. Kitchens, hall-ways, entrance ways and balconies.
PEI 4		Floor coverings for moderate to heavy traffic. All residential applications as well as medium commercial and light institutional, e.g. Commercial kitchens, hotels, foyers and offices.
PEI 5		Floor coverings for heavy to extra heavy traffic for all residential and heavy commercial, industrial and institutional spaces, e.g. Stores, public walkways, schools, shops, hotel floors and airport concourses.

Installing Ceramic Tile

- Tile can be thickset in mortar or thinset with adhesive
- Mechanical installment of ceramics

