DEVELOPING DESIGNER TILES FROM CERAMIC WASTE FOR INTERIOR DECORATION

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DEVELOPING DESIGNER TILES FROM CERAMIC WASTE FOR INTERIOR DECORATION

A Dissertation

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In partial fulfilment for

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(Interior Design)

By

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Institutional Ethics
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Ethical Compliance Certificate 2022-2023

This is to certify that **Ms. Naitri Shah's** study titled, **Developing Designer Tiles from Ceramic Waste for Interior Decoration** has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/M.Sc./2022/08.**

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CERTIFICATE

This is to certify that the thesis entitled **"DEVELOPING DESIGNER TILES FROM CERAMIC WASTE FOR INTERIOR DECORATION"** submitted for partial fulfilment of the requirement for the Degree of Masters in the Faculty of Family and Community Sciences (Family and Community Resource Management) to The Maharaja Sayajirao University of Baroda, carried out by Ms.Naitri Shah, is her original bonafide work.

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INTRODUCTION

CHAPTER I

INTRODUCTION

"In such a porcelain life, one likes to be sure that all is well least one stumble upon one's hopes in a pile of broken crockery." - Emily Dickinson, 1858

The word "ceramic" comes from the Greek word keramikos, "of pottery" or "for pottery", from keramos, "potter's clay, tile, or pottery" (Liddell and Scott, 1940). Ceramics are products made from inorganic materials having non-metallic properties, usually processed at a high temperature at sometime during their manufacturing. Some of the common examples are earthenware, stoneware, porcelain, and brick (Heimann, 2010).

According to Kingery, 1976,

> "Ceramics is, the art and science of making and using solid articles, which have, as their essential component, and are composed in large part of. inorganic non-metallic materials. In other words, what is neither a metal, a semiconductor or a polymer is a ceramic."

The earliest ceramics made by humans were pottery objects, pots, vessels or vases, or figurines made from clay, either by itself or mixed with other materials like silica, hardened and sintered in fire. Later, ceramics were glazed and fired to create smooth, coloured surfaces, decreasing porosity through the use of glassy, amorphous ceramic coatings on top of the crystalline ceramic substrates (Carter & Norton, 2007). Ceramics are now used in homes, businesses, and buildings. They are also used to make a wide range of materials, such as semiconductors, that are used in advanced ceramic engineering.

A ceramic material is an inorganic, non-metallic oxide, nitride, or carbide material. Some elements, such as carbon or silicon, may be considered ceramics. Ceramic materials are brittle, hard, strong in compression, and weak

in shearing and tension. They withstand chemical erosion that occurs in other materials subjected to acidic or caustic environments. Ceramics generally can withstand very high temperatures, ranging from 1,000 °C to 1,600 °C [1]. Applications include floor tiles, pipes, bricks, cookware, tableware, sanitary ware, pottery products, gas and fire radiant, kiln linings, glass and steel crucibles, knife blades, disc brakes in vehicles, watch cases, and biomedical implants [2].

Human beings appear to have been making their own ceramics for at least 26,000 years, subjecting clay and silica to intense heat to fuse and form ceramic materials. The earliest found so far were in southern central Europe and were sculpted figures, not dishes [3]. The earliest known pottery was made by mixing animal products with clay and baked in kilns at up to 800 °C. While actual pottery fragments have been found up to 19,000 years old, it was not until about ten thousand years later that regular pottery became common.

The invention of the wheel eventually led to the production of smoother, more even pottery using the wheel-forming technique, like the pottery wheel. Early ceramics were porous, absorbing water easily. When glazes were discovered, they could be used to cover pottery with silicon, bone ash, or other materials that could melt and harden into a glassy surface, making a vessel less porous to water. This made it useful for more things.

Traditional ceramic raw materials include clay minerals such as kaolinite, whereas more recent materials include aluminium oxide, more commonly known as alumina. Modern ceramic materials, which are classified as advanced ceramics, include silicon carbide and tungsten carbide. Both are valued for their abrasion resistance and hence find use in applications such as the wear plates of crushing equipment in mining operations. Advanced ceramics are also used in the medicine, electrical, electronics industries, and body armour [1].

1.1.1 Types of Ceramic

Ceramics greatly differ in their basic composition, and their properties also vary greatly due to differences in bonding. Classification of ceramics based on their specific applications and composition are the two most

important ways among many ceramic classification methods [4]. The type of clay used and the temperature at which it's heated yield vastly varied ceramics. Determining which category your ceramic materials belong in can be difficult. There are two main types of ceramics. Pottery or traditional ceramics and advanced or modern ceramics.

A. Pottery Ceramics:

1. Earthenware: For thousands of years, potters have used ovens to fire earthenware. However, liquids could seep through these vessels. Unlike other traditional ceramics like stoneware and porcelain, they can be fired at temperatures as low as 1,200 °F. Some earthenware potters varnish their creations to make them watertight. However, you can still scrape and damage it with a knife because of the lower firing temperature. The majority of bricks used in structures nowadays are earthenware, as are terracotta planters and other kitchenware.

2. Stoneware: Earthenware is the earliest form of ceramic, followed by stoneware. It takes a long time to fire than earthenware. Most stoneware is fired at temperatures ranging from 2,000 °F to 2,400 °F, hotter than lava from a volcano. Those very high temperatures vitrify the stoneware, turning the glazes on the outside to glass. Stonewares are traditional ceramics that are durable, nonporous, and robust. Under the correct circumstances, it can also withstand the heat from a microwave, dishwasher, or even an oven. Stonewares are used to create sanitary fixtures like sinks and bathtubs. In the chemical industry, stonewares are also used to make piping vessels, drainage pipes, underground cable sheathings, sewerage pipes, home pipes, absorption towers, valves, and pumps. They are less expensive than many other building materials, but they are fragile and have no resale value once broken.

3. Porcelain: Porcelain was the last type of pottery to make its way to the west, gaining popularity in Europe and North America in the 1700s. In China, it is treasured for its durability and strength for an even longer time. Porcelain was fired at even higher temperatures than stoneware in the past. The final firing temperature was usually around 2,600 °F. Today, the

only significant distinction between porcelain and stoneware is that porcelain is almost always made with white clay. Porcelain can also be sculpted into more delicate shapes than earthenware or stoneware by sculptors. Collectors have cherished porcelain since the 18th century, and it has been used to replicate everything from a horse's flowing mane to the folds of fabric on a dress. However, as new technologies and ideas emerge, the distinctions between porcelain and stoneware become increasingly blurred for modern potters.

B. Advanced Ceramics:

1. Bone China: Ceramicists altered the traditional formula by adding powdered bone ash to make bone china, a type of porcelain that is less prone to chipping. In today's world, this has taken the place of pure porcelain. Bone China is the most durable form of porcelain.

2. Glass Ceramics: It is one of the numerous varieties of ceramics created by regulating crystallization and having qualities similar to glass. Still, with the hardness and strength of ceramics. Glass ceramics are made using cutting-edge manufacturing technology, resulting in materials with desirable properties such as zero porosity, mechanical strength, durability, high temperatures, transparency, and biocompatibility.

3. Fire Bricks: Bricks are common ceramics as they are frequently created by heating materials that resemble clay, and sand is classified as a ceramic. This type of pottery is found in many homes. The qualities of this ceramic vary greatly depending on how it is made and what it is made of. This porcelain is robust, brittle, heavy, and can withstand high temperatures in general. Chimneys, fireplaces, and walls are all suitable places to use this ceramic. They're frequently utilized in landscaping as well.

4. Silicon: Silicon is another prominent ceramic material that is generally regarded as superior due to its chemical properties. This type of ceramic is abundant, accounting for around 90 per cent of the earth's crust. Sand and silicon abide frequently used in clays used to produce typical pottery. For example, silica ceramic is used to make burnt bricks, and kaolinite is

used to make porcelain, silicate minerals. Therefore, there is a brittle and rigid crystalline solid as well as a semiconductor in this material.

5. Silicon Carbide: Other ceramic materials include silicon carbide, a high-quality semiconductor material containing carbon and silicon. It occurs naturally as the extremely uncommon stone moissanite. Silicon carbide ceramic materials are robust and exceedingly hard. It is a semiconductor that is in over 250 different crystalline materials. Cutting tools, furnaces, braking disks, abrasives, heating elements, lighting, and electrical power systems are examples of where this ceramic is used.

6. Titanium Carbide: It is a black-coloured heat-resistant, and exceptionally durable form of ceramic. Ceramics are heat-resistant, highly hard, corrosion-resistant, and wear-resistant. These ceramics are commonly used in tool bits, machine parts, heat shields, and watch mechanisms.

7. Tungsten Carbide: It is a hard and dense substance made from identical proportions of carbon and tungsten. Ceramics of this type are thick, hard, durable, strong, and have low electrical resistance. Industrial equipment, cutting tools, and sporting equipment are all available [5].

1.1.2 Utilization of Ceramic

From glass and brick to porcelain and cement, there are countless different things that can be described as ceramics; not surprisingly, then, there are literally hundreds of different applications for ceramic materials in everything from aerospace to zoo-keeping.

Airplane jet engines are examples of machines called gas turbines, which work by burning fuel mixtures at high temperatures to make a fiery exhaust that powers a plane through the air. The need to cope with incredible temperatures explains why engine components are often made from ceramics. It was for exactly the same reason that 31,000 ceramic tiles were used on the now-retired Space Shuttle to protect it from burning up on its way back to Earth from space. Tragically, it was the failure of a

ceramic tile that led to the demise of the Space Shuttle Columbia as it struggled to return to Earth in February 2003.

Construction is one of the best-known uses for ordinary, everyday ceramics. Even in our modern age of plentiful plastics, brick, glass, cement, concrete, porcelain, and tiles of all kinds are still the raw materials from which most buildings are made. The tools used on construction sites are often made with ceramics too. Whether it is cutting glass, drilling holes in tile, grinding concrete, or sawing through brick, engineering ceramics like tungsten or silicon carbide will help knock more traditional ceramics into shape, generally working better, for longer, than traditional tools made of steel.

Anything with an electric motor, that's every chore-busting, electric-powered machine in home, contains magnets, and quite often they're made from ferrite ceramics. While using conducting metals like copper to carry electricity from place to place, ceramics are used to insulate high-voltage electricity in places like power plant generators and transformers.

Sometimes, ceramics insulate electricity and heat at the same time: heating elements are often built into ceramic holders, electric cooktops are made from high-performance ceramic glass, and incandescent lamps have glass bulbs that protect from heat and electricity while protecting their filaments from the atmosphere. The most advanced electrical use of ceramics is probably in high-temperature superconductors, materials with virtually no electrical resistance. While traditional superconductors have to be cooled down to near absolute zero, −273.15 °C, these new ceramics become superconducting in relatively warm conditions, still a chilly −180 °C, which makes them far more practical for use in things like floating "maglev" trains and cutting-edge computers.

It's perhaps surprising, then, to find so many applications for ceramics in the world of medicine. The piezoelectric transducers that create ultrasonic waves used in pregnancy scans, dentures (false teeth) made from porcelain or glass eyes, bone implants made from silicon nitride, which are cleverly designed to be porous so they promote natural bone growth.

As for zoology, as suggested up above, plenty of dogs, just like humans, have had ceramic implants in their bones and teeth [6].

There are several other applications or uses of ceramics in daily life. It is logical to say that ceramic plays a major role as raw material in manufacturing industries and a host of other domestic fabrication processes [7].

1.1.3 Ceramic Tiles

Ceramic tiles are an important construction material used in almost all buildings. Ceramic tiles are a mixture of clay and other natural materials, such as sand, quartz, and water. They are primarily used in houses, restaurants, offices, shops, and so on, as bathroom wall and kitchen floor surfaces. They are easy to fit, easy to clean, easy to maintain and are available at reasonable prices. The global production of ceramic tile in the world is about 8500 million square metres [8]. The basic raw material for ceramic tile is clay, which derives from a granite type rock, having decomposed over millions of years. Studies show that a large number of ceramic tiles are broken and wasted during production, transportation, and during construction (Subedi et al., 2020).

The demand for ceramic tiles is primarily driven by the growing construction and infrastructure industries. Strong growth of the construction industry in emerging economies such as India, China, Brazil and South Asian countries is expected to fuel the growth of the ceramic tile market in the future. Technological advancement in the manufacturing of ceramic tiles and the availability of abundant raw materials have also contributed to the growth of the ceramic tile market.

Floor tiles, wall tiles, and others are the key product segments of the ceramic tile market. In 2014, floor tile was the most important product segment, accounting for more than half of total volume consumption. Floor tiles are also expected to be the fastest growing product segment in terms of volume throughout the forecast period. Wall tiles were the second leading segment.

Ceramic tiles are widely used in a host of applications in different industries, such as residential replacement, commercial, new residential, others (facades, countertops, etc.). Residential replacement was the largest application in 2014, accounting for more than 45 per cent of the total volume consumed. Demand for ceramic tiles used for residential replacement has increased due to their potential as a substitute for paints and other products. New residential is also expected to grow rapidly [8].

One of the main advantages of ceramic tiles is that they're more affordable than other kinds of flooring. This kind of tile is generally cheaper compared to similar options like porcelain tiles, because it uses less refined clay. Ceramic tiles also have a low life cycle, which means they can last a very long time without having to be repaired or replaced. Ceramic tiles are one of the most durable kinds of tiles on the market and can last around 10 to 20 years with proper maintenance. The tiles are also water resistant, making them an excellent option for kitchen and bathroom floors. Ceramic tiles are more fire resistant than other tiles because they are manufactured at a very high temperature [9].

This study will generate designs for selected designer tiles to be used for interior decoration, all made from ceramic waste. This work may inspire interior designers and makers to reconsider the use of waste materials in their work, discover the beauty and utility of these materials, create attractive commercial products, raise awareness of material reuse, and have a positive impact on the environment through a structured design process using the guidelines.

Justification of the study

Ceramic has been utilised by humans since ancient times. Ceramic is a versatile material. Hence, ceramic waste varies widely. Ceramic waste is a precious resource that is abundantly available and can be used either for material replacement or energy production, depending on the quality grade. Ceramic waste is becoming a partial substitute for cement, concrete, and aggregate on an increasingly large scale. Whiteware ceramic products such as tableware, cookware, wall tiles, pottery products, and sanitary ware cannot be recycled; they can either be donated or tossed. Waste ceramic pieces can be used to develop tiles for interior use. The proper utilisation of ceramic waste through reuse will reduce environmental pollution, create wealth and employment, and thereby, foster the economic development of the country. Reusing the ceramic waste can also help in healing the environment by reducing the damage that has already been done. It can also be of great use to hike up the economy of the ceramic industry.

During the review of literature, the researcher had come across various studies conducted on the significant use of ceramic waste viz; "Ceramic Waste: Effective Replacement of Cement for Establishing Sustainable Concrete" (Raval, Patel, and Pitroda, 2013). "The use of ceramic waste aggregates in concrete: a literary review" (Cristiano, 2014). "The Use of Ceramic Waste Powder (CWP) in Making Eco-Friendly Concretes" (El-Dieb, Taha and Abu-Eishah, 2018), "Use of ceramic wastes as aggregates in concrete production: A review" (Ray et al., 2021), "Utilization of Crushed Ceramic Tile Wastes as Partial Replacement of Coarse Aggregate in Concrete Production" (Subedi, Wagle and Basnet, 2020), "Reuse of Ceramic Demolition Waste in the Reconstruction of Planked Timber Floor Slabs" (Rubio de Hita et al., 2017). "Reusing Ceramic Wastes in Concrete" (Pacheco-Torgal and Jalali, 2010), "Application of Ceramic Wastes in Concrete" (Qu Shuying et al., 2014). From the various studies, it was understood that ceramic waste has extremely high potential and is reused for various purposes. Therefore, the present study aimed to identify the sources of ceramic waste in Vadodara City and to develop designer tiles for interior decoration from the available ceramic waste.

The study will contribute to the field of Family and Community Resource Management as it offers Interior Design subjects as a specialization and a diploma course in Hotel Interiors as the objectives of the study, such as developing designs of tiles to be developed from ceramic waste and cost estimation, will provide first-hand information for practical applications. The study will benefit other academic institutes offering courses in Interior Design and Architecture. The study will be beneficial to the manufacturer, retailer of the tile, and ceramic industry, as the developed design can be used as an example for reusing the maximum amount of ceramic waste to create utility and décor articles, other construction materials, and tiles from ceramic waste. The study will also benefit interior design and architecture students as they can start their own business by designing similar kinds of handicrafts and creative products based on various themes and get them patented.

Statement of problem

The present study aimed to develop designer tiles for interior decoration from ceramic waste and to assess the opinions of the homemakers, interior designers and the students of interior design specialization, regarding the selected aesthetic aspects and functional aspects of the developed designer tiles from ceramic waste for interior decoration.

Objectives of the study

1. The study aimed to develop designer tiles from ceramic waste for interior decoration.
2. To assess the opinions of the homemakers, interior designers and the students of interior design specialization, regarding the selected aesthetic aspects and functional aspects of the developed designer tiles from ceramic waste for interior decoration.
3. To prepare a cost estimate and catalogue for the developed designer tiles from ceramic waste for interior decoration.

Delimitations of the study

1. The present study was limited to only those homemakers, interior designers and students of interior design specialization who were involved in homemaking and interior designing activities.
2. The present study was limited to those homemakers, interior designers and students of interior design specialization who gave consent to participate in the study.
3. The study was limited to those ceramic shops and residential working sites that gave ceramic waste at minimal cost or free of cost.
4. The development of designer tiles from ceramic waste was limited to selected areas of house namely:

    A. Living Room
    - Wall

    B. Kitchen
    - Wall

    C. Dining Area
    - Wall

    D. Bedroom
    - Wall

    E. Bathroom
    - Wall

    F. Staircase Area
    - Wall
    - A Step Raiser

Note - The development of the products was subjective to the availability of the ceramic waste and financial considerations.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The major areas of related literature, survey, scholarly articles, books and other sources relevant to particular issues, area of research, or theory, providing a description, summary and critical evolution of each work are presented here. In order to make the review clear and understanding, the present chapter was divided into the following section:

2.1 Theoretical Orientation

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2.1.3.1 Usage of Ceramic Waste

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Conclusion of Review of Literature

2.1 Theoretical Orientation

2.1.1 Ceramic Waste: An Overview

The term “ceramics” represents both man-made and manufactured non-metallic inorganic solid materials. The name comes from keramos, clay used by potters, objects made of clay, which originated from keramikos, of clay, of pottery, or keramikos in Greek. Heat treatment has been typically used for ceramic “manufacturing” since ancient times. Therefore, ceramics is the term used to express ceramic products such as pottery and porcelain products made by high-temperature processing in furnaces. The term also indicates technologies and the science utilized to manufacture these products. The majority of potteries, porcelains, refractory’s, cement and glass have been made from silicate-based natural materials since early times, and these products are sometimes called traditional ceramics or classical ceramics. The terms “traditional” or “classical” do not necessarily indicate that the technologies are outdated. Both traditional ceramics and classical ceramics have been evolving with social needs and the incorporation of the latest technologies (The Ceramic Society of Japan, 2012).

In ceramic industry, about 30 per cent production goes as waste. This waste is not recycled in any form at present. However, the ceramic waste is durable, hard and highly resistant to biological, chemical, and physical degradation forces. As the ceramic waste is piling up every day, there is a pressure on ceramic industries to find a solution for its disposal (Al Bakri et al., 2013).

According to Giddens et al., 1996,

> “Instead of creative destruction, let us think of sustainable innovation.”

According to European Parliament, Council of the European Union, and European Commission (2008), waste is defined as “any substance or object which the holder discards or intends or is required to discard”. This same directive defines a hierarchy of waste prevention and

treatment methods in order of priority: reduction in production and toxicity, reuse, recycling, other recovery, including energy and elimination.

2.1.1.1 Sources of Ceramic Waste

Ceramic Waste from factories producing construction industry materials has been accumulating on frequently, creating increasingly large piles. Although they are usually chemically inert, the waste accumulates depending upon their size and the scant environmental control exercised, have a significant visual impact that destroys the intrinsic quality of the landscape. Indian ceramic production is 100 million ton per year. In ceramic industry, about 15 per cent to 30 per cent waste material is generated from the total production.

Ceramic waste may come from two sources. The first source is the ceramics industry, and this waste is classified as non-hazardous industrial waste (NHIW). According to the Integrated National Plan on Waste 2008-2015, NHIW is all waste generated by industrial activity which is not classified as hazardous in Order MAM/304/2002, of the 8th February, in accordance with the European List of Waste (ELW) and identified according to the following codes:

- 10 Waste from thermal processes
- 10-12 Waste from the manufacture of ceramic products, bricks, roof tiles and construction materials
- 10-12-08 Ceramic, brick, roof tile and construction materials waste (fired)

The second source of ceramic waste is associated with construction and demolition activity, and constitutes a significant fraction of construction and demolition waste (CDW). This kind of waste is classified by the ELW according to the following codes:

- 17 Construction and demolition waste
- 17-01 Concrete, bricks, roof tiles and ceramic materials
- 17-01-03 Roof tiles and ceramic materials

These wastes pose a problem in present-day society, requiring a suitable form of management in order to achieve sustainable development (Rani, 2016).

2.1.1.2 Classification of Ceramic Waste

Types of Ceramic Waste

The principal waste coming into the ceramic industry is ceramic powder, specifically in the powder forms. Ceramic waste is generated as a waste during the process of dressing and polishing. It is estimated that 15 per cent to 30 per cent of the total raw material used results in waste. Although a portion of this waste may be utilised on-site, such as for excavation pit refills, the disposal of these waste materials acquires large land areas and remains scattered all around, spoiling the aesthetic of the entire region. It is very difficult to find a use for the ceramic waste produced.

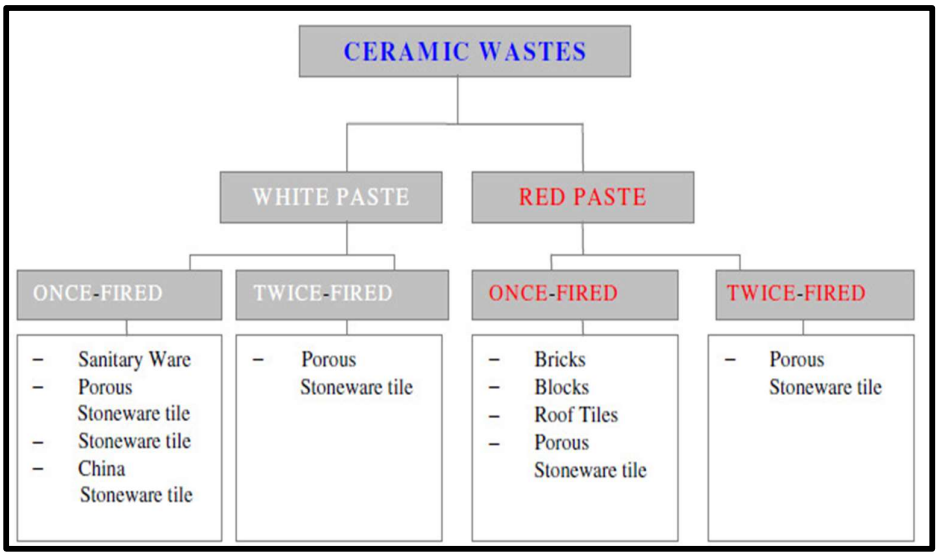


Figure 1: Various Categories of Ceramic Wastes (Cristiano, 2014)

Ceramic waste can be separated into two categories in accordance with the source of raw materials. The first one is all the fired wastes generated by the structural ceramic factories that use only red pastes to manufacture their products, such as bricks, blocks, and roof tiles.

The second one is all the fired waste produced in stoneware ceramics, such as walls, floor tiles, and sanitary ware. In each category, the fired ceramic waste was classified according to the production process, differentiating them by the use of red or white ceramic pastes. However, the use of white paste is more frequent and much higher in volume (Tabak et al., 2012).

The ceramics industry is comprised of the following subsectors: wall and floor tiles; sanitary ware; bricks and roof tiles; refractory materials; technical ceramics; and ceramic materials for domestic and ornamental use (Subedi et al., 2020).

A large quantity of waste is generated in the production stage. Some authors (Senthamarai and Devadas, 2005) have estimated that about 30 per cent of the daily manufacturing volume in the ceramic industry goes to waste. In the ceramic industry, several types of waste are generated. Cement and concrete production can consume a substantial percentage of the total generated waste materials, which can alleviate the acute environmental impact of these materials and also partly help to achieve the much-needed sustainability in cement and concrete production (Cristiano, 2014).

2.1.2 Processing of Ceramic Waste

The term “recycling” brings up images of curb side collection programs for glass bottles, aluminium cans, plastic jugs, and old newspapers. These “post-consumer” waste items have garnered a lot of attention, but ceramic waste recycling has got considerably less attention until lately.

2.1.2.1 Re-use

Reuse of waste means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived [10]. Unwanted tiles that are clean and in good condition may be purchased for resale and reuse on other

projects. For medium to large quantities of clean ceramic tiles, reuse services exist which will purchase them for resale [11].

2.1.2.2 Recycling into useful products

Recycling of waste is defined as any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes [12]. Ceramics can be crushed and recycled into a range of useful products, diverting waste from landfill and decreasing emissions and toxic outputs used in the production process. Redirecting this waste can also help avoid costly landfill charges. Recycled ceramics can be made into useful products such as drainage materials, rock base for driveways and paths or as composite material for aggregates. Many recycling yards that accept bricks and concrete will also accept ceramics. Some commercial recyclers will provide bins for on-site collection. Used ceramics from the construction and demolition industry will be collected and then crushed. The degree of crushing will depend on its end use as range of product such as drainage material or rock base for driveways [11].

2.1.2.3 Energy Generation

Increasing demand and resource overuse has prompted the exploration of spent secondary materials as a primary raw material for a variety of applications, leading to a more sustainable environment. Spent electric grid ceramic insulator, one of the waste materials of ceramic industry, has a good hardness and strength. It can be reused as value-added material in the Abrasive Water Jet Machining (AWJM) industry.

The present work deals with the generation of cost-effective replacement material for abrasive water jet machining from electric insulator rejects (EIR). Mechanical crushing method is opted to generate the abrasive grit for the machining process. It can be used as an alternative abrasive in the abrasive jet machining process. Cost

analysis and recycling ability predict the economical usability of the newly generated abrasives (Palaniyappan et al., 2022).

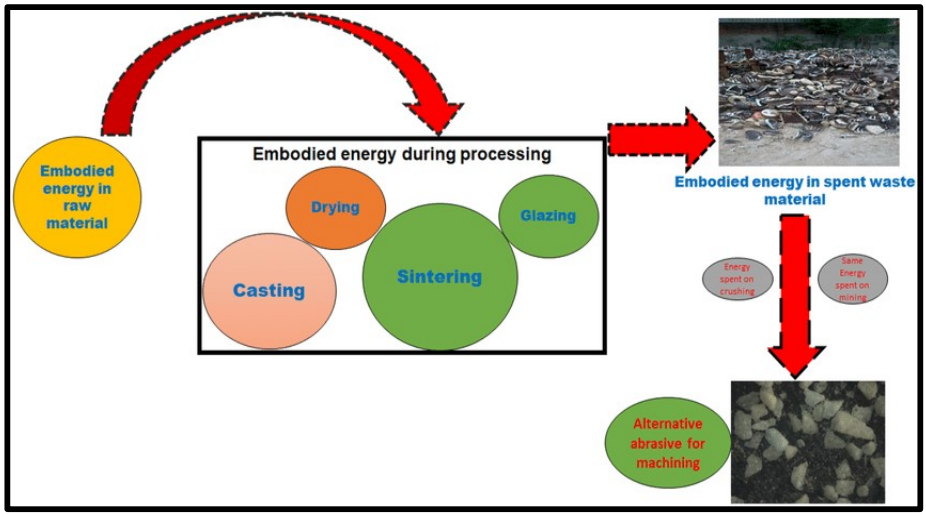


Figure 2: Energy Embodiment Chart of Ceramic Waste (Palaniyappan et al., 2022)

2.1.3 Significance and Usage of Ceramic Waste

Ceramic is one of the most popular materials used all around the world. Being used so commonly all over the world, the waste generated from the use of the element is enormous. This waste, if not managed properly, has numerous ill effects on the environment and living beings. Hence, ceramic waste management is very important. Ceramic waste management refers to managing the ceramic waste generated and processing it to make it reusable [13]. Sanitary wares such as toilet bowls, wash basins, urinals, and bathtubs are used regularly by humans. Even though they are suitable for the remote future, their retirement cannot be an option. This may be due to wavering market-fit and low maintenance as they are pre-dominantly used for household purposes. After primary use, improper disposal of sanitary wares causes a slew of environmental issues. Generally, industrial recycling programmes do not care about ceramics because it is a tedious process. The option of transportation and segregation of this solid waste is unsuitable due to extra cost. Instead, the residues can be crushed with crushers and used for any

enhanced services resulting in reduced costs (Palaniyappan et al., 2022).

2.1.3.1 Usage of Ceramic Waste

The theoretical product recovery hierarchy is defined by repair or reuse efficiency at end-of-life. Reuse is the highest product recovery or end-of-life option in the hierarchy (Amelia et al., 2009). Often, damaged components must be replaced with new components in order to reuse a product. This process is called re-manufacturing and occupies the second place in the product recovery hierarchy (Ostlin et al., 2009). The next step in the hierarchy is recycling, which implies the construction of new product out of the old or changing the product in such a way that gives it a useful second life (Lambert & Gupta, 2004). The next potential step in the hierarchy of operations is energy recovery (incineration), i.e., the use of waste to produce energy for beneficial purposes. Burial in a landfill is the least desirable option (Saman & Blount, 2006).

Ceramic Waste has various uses and therefore is an incredible reuse material. Ceramic waste that has been recovered can be turned into a variety of new products. There is a vast array of objects that can be repurposed from industrial waste materials, construction and demolition site, and renovation work, including sanitary ware and old tiles. It may be used on any surface in the home, from the walls to the floors. It may also be transformed into eco-friendly concrete, as well as sustainable building material and mortar, used as partial replacement of natural coarse aggregates, used as partial cement substitute, and in various industrial sectors. In addition, ceramic waste resources may also be used to make designer ceramic tiles and other décor articles.

2.1.3.2 Significant benefits of using Ceramic Waste

Utilizing ceramic waste has a number of benefits in addition to aiding in environmental protection, such as reducing the need for other raw materials and promoting a natural resource economy.

- Ceramic waste can be used in concrete to improve its strength and other durability factors.
- Ceramic waste can be used as a partial replacement of cement to achieve different properties of concrete.
- It reduces permeability which prevents from ground water recharge.
- If ceramic waste has been utilized in the concrete than it is environment and eco-friendly to our eco system.

Ceramic waste has various advantages such as cost-saving, energy saving and reduces the hazards materials cause to the environment. Ceramic waste can be used in concrete to increase the compressive strength and physical and chemical properties of concrete (Sundhan & Sharma, 2022).

Utilization of ceramic waste and its application are used for the development of the construction industry. By the use of waste material such as ceramic waste, usage of concrete industry's waste products is increased by 20 per cent (Rani, 2016).

The utilisation of waste ceramic particles was shown to contribute to sustainable development and a cleaner environment by producing a green mortar from the recycling of industrial wastes (Samadi et al., 2020).

The use of fine recycled aggregates from ceramic waste in masonry mortar manufacturing could be a viable alternative that would help increase the recycling rate of construction and demolition waste and support sustainable development in the building sector (Jiménez et al., 2013).

2.2 Empirical Studies

2.2.1 Research Studies Conducted outside India

Jiménez et al., (2013) conducted a study on "Use of fine recycled aggregates from ceramic waste in masonry mortar manufacturing". The objective of the study was to evaluate the performance of fresh and

hardened masonry mortar manufactured using fine recycled aggregate from ceramic partition wall rubble in Córdoba, Spain. Five mortars were prepared replacing 0%, 5%, 10%, 20%, and 40% of the natural sand by fine recycled aggregate. The study concluded that the bulk density of fresh mortar decreased as the replacement ratio increased. The dry bulk density of hardened mortar decreased as the replacement ratio increased. The compressive and flexural strength of hardened mortar showed similar behaviour over time. The water absorption due to capillary action of hardened mortar decreased slightly for replacement ratios below 10 per cent and increased for replacement ratios of up to 20 per cent. The replacement ratio of natural sand with up to 40 per cent fine recycled aggregate from ceramic waste by volume did not significantly affect the properties of fresh and hardened low strength mortar, with the exception of density and workability.

Halicka et al., (2013) conducted a study on “Using ceramic sanitary ware waste as concrete aggregate”. The objective of the study was to examine concrete with alumina cement and ceramic sanitary ware wastes as aggregate in 1000° Celsius temperature and to present a method for reusing ceramic sanitary ware waste as the only concrete aggregate in Poland, Europe. The findings of the study revealed that waste from ceramic sanitary ware can be utilised as concrete aggregate since its characteristics are similar to those of conventional natural aggregate, particularly high strength and a low crushing ratio are present. The aggregate enables the creation of practical concrete mixtures that, when strengthened, provide concrete with high strength values. High performance concrete can be produced with sanitary ceramic aggregate. Concrete containing alumina cement and ceramic sanitary ware aggregate maintained its shape and good strength after heating to 1000° Celsius. In contrast to concrete types comprising other aggregates, concrete specimens constructed with sanitary ceramics were cohesive 30 days after heating; in tests conducted immediately after heating, their strength increased.

Al Bakri et al., (2013) conducted a study on “Strength of Concrete with Ceramic Waste and Quarry Dust as Aggregates”. The objective of the study was to find the suitability of the ceramic industrial wastes and quarry dust as a possible replacement for conventional crushed stone coarse and fine aggregate. The sources of ceramic waste and quarry dust were obtained from the industrial area in Malaysia. The study revealed that the ceramics waste coarse aggregate satisfied the aggregate requirements used for concrete. Fresh ceramic waste coarse aggregate and quarry dust fine aggregates concrete are more cohesive and workable than conventional concrete because of high water absorption of ceramic waste and quarry dust aggregates. The properties of ceramics waste coarse aggregate are within the range of the values of concrete-making aggregate and they are not significantly different from those of conventional concrete.

Matias et al., (2014) conducted a study on “Lime mortars with ceramic wastes: Characterization of components and their influence on the mechanical behaviour”. The research aimed to find out the way to characterize seven ceramic waste products collected from ceramics factories in the central region of the Portuguese Mainland, Europe to determine their mineralogy, dimensional features and pozzolanicity and to incorporate waste materials in air lime mortars as aggregates or binder and analyse their influence in the mechanical behaviour of mortars. The study found that waste materials designated W1, W3, W6, and W7 had considerably high specific surfaces that may enhance pozzolanic reactivity. For the purpose of identifying minerals, silica and alumina compounds were found. Additionally, limestone was found in wastes made from bricks, pottery, and roof tiles. Regardless of the substitution percentage, particle size distribution, or kind of ceramic waste used, the mechanical strength of mortars made with W1, W6, and W7 wastes was higher than that of the reference mortar without wastes. Mortars with larger substitution percentages of milled ceramic wastes (both dust and granular particles) than river sand showed higher mechanical strength. Reddish ceramic wastes can be used to colour air

lime mortars, which can be especially useful for preservation and rehabilitation efforts and ultimately eliminate the need for aesthetic painting systems.

Reig et al., (2015) conducted a study on “Use of ceramic sanitaryware as an alternative for the development of new sustainable binders” in Spain. The objective of the research was to investigate the pozzolanic activity of ceramic sanitary-ware waste, together with its potential to form new binders by alkali activation. The study reflected that new binders can be successfully developed by the alkali-activation of ceramic sanitary-ware waste and its use as a partial replacement of Portland cement. Ceramic waste contains almost 90 wt. per cent of SiO2 and Al2O3, and part of the material is in an amorphous state. These properties make it a good candidate to develop more sustainable binders. The reactivity of ceramic waste with the Portlandite originated during Portland cement hydration increased with curing time.

Khan et al., (2016) conducted a study on “Industrial ceramic waste in Pakistan, valuable material for possible applications”. The objective of the research was to determine the chemical composition of ceramic waste by energy dispersive X-rays spectroscopy (EDX) and to observe the effect of chemical composition in the variation of physical properties of the materials. A market survey was done for the research where ceramic waste samples were collected from three different ceramic industries located in the North-West region of Peshawar in Pakistan. The market research revealed that the ceramic waste is made up of some normal and some transition metal oxides, according to the chemical compositions examined using EDX. Ceramic waste was discovered to have the lowest weight loss and the greatest thermal stability up to 700° Celsius. The materials showed dielectric properties pointing to the possibility of using waste ceramics in capacitors. The waste adopted dye absorption efficiency from waste water in the range of 30 to 60 per cent. Based on these characteristics, it is suggested that ceramic waste be used for strong membranes, embedded capacitors, high temperature sensors, and protective coatings.

Subası et al., (2017) conducted a study on “Utilizing of waste ceramic powders as filler material in self-consolidating concrete” in Düzce, Turkey. The study aimed to know the usability of granulated waste ceramic powder as filler material in self-consolidating concretes. Results of the studies show that the flowability of the fresh concrete was improved with the increase of WCP ratio. Compressive strength results of SCC mix including WCP substitution were decreased gradually. Use of WCP as filler material in the SCC mix improved the fresh state properties of SCC, additionally a dramatic decrease was not observed at strength values of hardened concrete. Waste ceramic powders have some potential to use in self-consolidating concretes as cement replacement up to 15 per cent due to their positive effects on fresh state properties on SCCs.

Dai et al., (2018) conducted a study on “Potential of using ceramics wastes as a solid catalyst in biodiesel production”. The study aimed to determine that ceramics wastes (CWs) are suitable raw materials for preparing a solid-base catalyst for biodiesel production in Taichung, Taiwan. The findings of the study revealed that from ceramic wastes, a potent CWL-800-2 catalyst was successfully synthesised, and it demonstrated catalytic activity for triglyceride transesterification. It was discovered that using a methanol to oil molar ratio of 30 and adding 4 per cent of catalyst results in a 99.3 per cent yield of biodiesel. Waste materials can be used to make low-cost solid-base catalysts, which have a number of positive economic and environmental effects. To create novel composite materials is the goal. Materials can be recycled in whole or in part, including catalysts and some inputs like methanol.

El-Dieb et al., (2018) conducted a study on “The Use of Ceramic Waste Powder (CWP) in Making Eco-Friendly Concretes”. The objective of the study was to investigate the effect of using CWP in making eco-friendly concretes, with a particular focus on using CWP as a partial cement replacement in conventional-vibrated concrete (CVC) and self-compacting concrete (SCC), and the production of zero-cement alkali-activated concrete (AAC). The findings of the study revealed that using

CWP as an ingredient in making CVC is viable. CWP improves the workability retention of the CVC mixtures. The inclusion of CWP will reduce the early-age strength and slowed the strength development. Significant improvement of CVC durability can be achieved by including high content of CWP. SCC with improved fresh performance and optimized strength can be produced using 40 per cent CWP as partial cement replacement. The production of AAC using CWP should consider the aggregate content of the mixture, the use of super plasticizer admixtures and the use of an alkali solution composed of NaOH and KOH. High-performance concrete can be produced by including CWP as partial cement replacement.

Huseien et al., (2019) conducted a study on "Evaluation of alkali-activated mortars containing high volume waste ceramic powder and fly ash replacing GBFS". The objective of the research was to investigate the impacts on sustainability of waste ceramic tile powder (WCP) based alkali-activated mortars (AAMs) incorporating fly ash (FA) as a replacement of ground blast furnace slag (GBFS), which were exposed to various hostile environments. The findings of the study revealed that freezing-thawing resistance increased and better durability was displayed by increasing the FA content in WCP based AAMs. Furthermore, AAMs with high FA content led to enhance the performance in terms of sulphate and acid environments and elevated temperatures. Apart from the increased durability, replacing GBFS with FA also resulted in decreased energy consumption, AAMs cost, and CO2 emission.

Samadi et al., (2020) conducted a study on "Waste ceramic as low cost and eco-friendly materials in the production of sustainable mortars". The objective of the study was to investigate the long-term performance, mechanical properties, and durability of a mortar comprising ceramic waste as supplementary cementitious material and ceramic particles as fine aggregates in Johor, Malaysia. The study discloses that the utilisation of waste ceramic particles contributes to sustainable development and a cleaner environment by producing a green mortar

from the recycling of industrial wastes. The inclusion of ceramic particles as both a cement replacement and fine aggregates in the mortar was highly effective in improving the durability performance and could be considered environmentally-friendly, as the reuse of ceramic waste could significantly reduce CO2 emissions, save energy, reduce the total consumption of electricity, and reduce fuel consumption, thereby resulting in the worldwide availability of a sustainable and low-cost construction material.

Sohail et al., (2021) conducted a study on "Towards the development of stable and efficient novel waste ceramics composites". The study aimed to examine the incorporation of industrial ceramic wastes in polymer matrix as composite materials to investigate their potentials for various applications. Ceramic wastes were collected from the premises of ceramic producing industries located at Peshawar, Pakistan. The findings of the study revealed that both the constituent materials (ceramic and polymer) have a synergistic effect on each other. At one hand, ceramic wastes support and enhance the thermal and mechanical properties of the polymer in composites and the polymer in turn beautify the wastes with good dielectric and electrical properties. High ac conductivity and mechanical strength were seen in the materials. Based on their properties, the low cost and environmentally friendly novel composites could be used for various applications such as semi-conductors, capacitors and microwave devices.

Ray et al., (2021) conducted a study on "Use of ceramic wastes as aggregates in concrete production: A review". The objective of the study was to present an assembled and up-to-date review of the physical, mechanical, durability, and other notable functional properties of ceramic aggregate concrete in Bangladesh. According to the results of the study, ceramic aggregate concrete has mechanical and durability attributes that are comparable to those of ordinary concrete. The outcomes demonstrate that ceramic aggregates can be used in place of natural aggregate to generate medium and high strength concrete. The fact that the compressive strength, permeability properties, bond strength, etc. of

the ceramic aggregate concrete met the requirements set by various international standards and codes is also evident from the results, which supports the possibility of using ceramic waste as an effective alternative to natural aggregates in structural concrete.

2.2.2 Research Studies Conducted in India

Raval et al., (2013) conducted a study on “Ceramic Waste: Effective Replacement of Cement for Establishing Sustainable Concrete”. The study aimed to replace the (OPC) cement by ceramic waste powder accordingly in the range of 0%, 10%, 20%, 30% 40%, and 50% by weight of M-20 grade concrete in Vidyanagar, Gujarat, India. The study shows that when up to 30 per cent of the cement weight is replaced by ceramic powder, the compressive strength of M-20 grade concrete increases; however, when more cement is replaced with ceramic powder, the compressive strength drops. Utilizing ceramic waste and putting it to use are important for the advancement of the building industry and material sciences. It is a potential alternate method for disposing of ceramic waste safely.

Rani (2016) carried out research on “A Study on Ceramic Waste Powder”. The objective of the study was to replace ordinary Portland cement by ceramic waste powder accordingly in the range of 0%, 10%, 20%, 30%, 40%, and 50% by weight for M-40 grade concrete and to calculate the compressive strength of the material in Kakinada, Andhra Pradesh, India. The study concluded that the ceramic tile powder can be used as a replacement material for cement up to 10 per cent. The chemical compositions of ceramic tile powder are comparable with that of cement. The compressive strength of M-40 grade concrete increases when the replacement of cement with ceramic waste is up to 10 per cent by weight of cement, and further replacement of cement with ceramic powder decreases the compressive strength but the cost of the concrete is reduced, hence it is more economical without compromising concrete strength. By the use of waste material such as ceramic waste, usage of concrete industry’s waste products is increased by 20 per cent.

Nayana et al., (2018) carried out research on “Strength and durability study on cement mortar with ceramic waste and micro-silica” in Coimbatore, India to investigate mechanical and durability properties for different mortar mixes produced by replacing a fraction of cement by 5% and 10% with micro-silica and sand by 15%, 30% and 50% with ceramic waste. The result of the study shows that the crushed ceramic material can be used for the production of good quality mortar. Higher compressive strength of cement mortar was obtained with 15 per cent replacement of sand with ceramic waste, and cement with 10 per cent micro-silica. Inclusion of ceramic waste in the cement mortar improves the acid detention property. The microstructure study shows good compressive strength and durability properties.

Siddique et al., (2019) conducted a study on “Sustainable utilisation of ceramic waste in concrete: Exposure to adverse conditions”. The objective of the study was to utilise fine bone china ceramic aggregate (FBA) as fine aggregate at different levels of replacement (20%, 40%, 60%, 80% and 100%) in Jaipur, Rajasthan, India. The study disclosed that fine bone china ceramic waste could be used as aggregate to create concrete that is strong and resilient. FBA has a larger percentage of voids due to its rough and angular structure, the depth of wear from abrasion is reduced. Concrete exhibited superior resistance to freeze and thaw action as a result of FBA. The addition of FBA to the concrete increased its resilience to exposure to drying and wetness. The FBA concrete has greater resistance to chloride penetration than the control concrete and its tortuosity served as a defence mechanism against the start of corrosion. The mixtures with FBA contents of 40 and 60 per cent were discovered to have the lowest embodied energy and carbon dioxide emission.

Gautam et al., (2022) conducted a study on “Recycling of bone china ceramic waste as cement replacement to produce sustainable self-compacting concrete”. The study aims to examine the incorporation of bone china ceramic waste (BCCW) in self-compacting concrete (SCC) as a partial substitution for cement in Jaipur, Rajasthan, India. The study

concluded that incorporating up to 10 per cent BCCW in SCC enhanced the compressive and flexural strength. Moreover, superior ultrasonic pulse velocity and better resistance to water absorption were found on the inclusion of up to 20 per cent BCCW in SCC. Ultimately, the inclusion of up to 10 per cent BCCW in SCC increases the fresh and hardened characteristics of concrete and can be effectively used in the concrete industry as a substitute material for natural sources.

Meena et al., (2022) conducted a study on “Use of waste ceramics to produce sustainable concrete: A review”. The study aimed to discuss and analyze fresh properties, hard properties, durability properties, and other properties of concrete with Waste Ceramic in Jaipur, Rajasthan, India. The results of the study show that using WC in the production of concrete is advantageous in terms of creating cheap and sturdy concrete and resolving environmental issues. Due to the large specific surface area and surface differences, WC particles cause more friction during mixing, which can reduce slump and limit workability in concrete. Mechanical characteristics will enhance with the WC replacement cement. Concrete's tensile strength is increased with the addition of WC. Chloride ions are less likely to penetrate WC concrete than control concrete. It also demonstrated better resilience to sulfate attack than their respective control mixes. Ceramic aggregates positively affect the material's resistance to abrasion. Given that WC is an insulating power material, WC concrete exhibits greater electrical resistivity than RC.

Meena et al., (2022) conducted a study on “Sustainable self-compacting concrete containing waste ceramic tile aggregates: Fresh, mechanical, durability, and microstructural properties” in Jaipur, Rajasthan, India. The objective of the research was to examine the fresh properties, mechanical strength, durability and microstructure of SCC containing waste ceramic tile (WCT). In order to conduct the research, six SCC mixes were prepared using crushed WCT as a substitution of natural river sand (NRS). The study concluded that the integration of WCT in SCC mixtures found increase in the compressive, flexural and split tensile strength at 60 per cent substitution and further substitution led to

reduction in all strength of SCC. The superior ultrasonic pulse velocity values and higher impermeability characteristics of waste ceramic based SCC mixtures were found till 100 per cent incorporation of WCT, when compared to the reference SCC mix.

Jain et al., (2022) conducted a study on “A literature review on the effect of using ceramic waste as supplementary cementitious material in cement composites on workability and compressive strength”. The objective of the study was to evaluate the effect of ceramic waste on fresh and mechanical properties of various cement composites like cement paste, cement mortar, hardened concrete and self-compacting concrete in Jaipur, Rajasthan, India. The findings of the study revealed that the consumption of ceramic waste at smaller replacement levels displays suitable workability. With regard to mechanical properties, compressive strength of the mixes up to a substitution level of 10 to 20 per cent is either higher or nearly equal to reference mix. White ceramic waste has shown better pozzolanic properties when compared to red ceramic waste. Utilization of ceramic waste beyond the 20 per cent level led to the dilution of CSH forming compounds and hence retardation in setting and hardening of the cement composites.

Sundhan et al., (2022) conducted a study on “To Investigate the Mechanical Properties of Concrete by Partial Replacement of Cement with Ceramic Tiles Waste Powder and Addition of Jute Fiber” in Patankot, Punjab, India. The objective of the study was to make sustainable concrete through partial replacement of cement by ceramic tiles waste powder by percentages of 0%, 15%, 20%, 25% and 30% with expansion of Jute Fiber at different rate as 0%, 0.25%, 0.50%, 0.75% and 1.0%. The findings of the study revealed that the compressive strength is increased by partially substituting the powdered waste from ceramic tiles with cement and jute fibre. The split tensile strength and the flexural strength or rupture modulus showed similar characteristics to compressive strength or toughness strength. Additionally, the strongest flexure was observed when by replacing the waste powder from ceramic

tiles with cement and jute fibre, increasing the strength after 28 days. Both aid in boosting power during low volume replacement.

Conclusion of Review of Literature

The literature review emphasizes that efforts have been made in the research area of “Utilizing Ceramic Waste” with different methods and purposes in India and outside India. The researchers conducted were focusing on effective recycling of ceramic waste, degradation of ceramic waste, uses of ceramic waste in the construction industry, efficient ceramic waste management, and assessment of reusing and recycling ceramic wastes.

An overview of the research highlighted that most of the studies conducted in India are on “Effective Recycling of Ceramic Waste, Efficient Use of Ceramic Waste, and Management of Ceramic Waste.” While researches from outside India highlighted “Waste Management Practices and Strategies, Up-cycling: Re-Use and Recreating Functional Waste Materials, Waste Generation and Utilization, Using of Reclaimed Ceramic in Manufacturing of Modern Construction Materials, Creative Designing of Home Decoration by Ceramic Waste, and Design and Development of Innovative Products from Ceramic Waste” had been undertaken. However, the researcher did not come across many studies conducted in India on “Development of Designer Tiles”. This motivated the researcher to conceptualize the study on “Developing Designer Tiles from Ceramic Waste for Interior Decoration.”

METHODOLOGY

CHAPTER III

METHODOLOGY

The purpose of the research was to know the opinion of the respondents regarding the development of designer tiles from ceramic waste for interior decoration. The research design, operational definition of different terms used in the study, tools used for data collection, sampling technique used are precisely explained in this chapter. In order to facilitate systematic presentation, it was divided into various sections which are explicitly described here:

3.1 Research Design

3.2 Operational Definitions

3.3 Locale of the Study

3.4 Unit of Inquiry

3.5 Sample Selection Criteria, Size and Sampling Procedure

3.6 Selection, Construction and Description of the Tool

3.7 Establishment of Content Validity of Tool

3.8 Establishment of Reliability

3.9 Phases of Product Development

3.10 Data Collection

3.11 Data Analysis

3.1 Research Design

Since the present study assessed the opinion of the homemakers, interior designers and the students of interior design specialization, about selected existing parameters namely size, quality, durability, proportion, convenience of use, colour combination and aesthetic value of the designed ceramic waste tiles, Descriptive Research design was used for the present study.

3.2 Operational Definitions

3.2.1 Ceramic Waste – For the present study, ceramic waste was referred as the used or scrap ceramic objects collected from the ceramic shops and residential working sites from Vadodara city which can be used for developing designer tiles for interior decoration.

3.2.2 Designer Tiles – For the present study, designer tiles were referred as the tiles developed with the base material of medium-density fibreboard (type of wood) and cement grouting, having small artistic arrangement with the help of used ceramic waste objects, which can be used as a decorative tile in combination with various tiles for interior decoration in various residence spaces.

3.2.3 Opinion Scale for the homemakers, interior designers and the students of interior design specialization – For the present study, the opinion of the homemakers, interior designers and the students of interior design specialization for the aesthetic aspects and functional aspects was defined as their views regarding, what they perceive about selected existing parameters namely size, quality, durability, proportion, convenience of use, colour combination, and aesthetic value of the developed designer tiles from ceramic waste. Five-points 'Likert scale' was used to measure the opinion of the homemakers, interior designers and the students of interior design specialization, namely: "Strongly Agree", "Agree", "Undecided", "Disagree", and "Strongly Disagree" where the scores were ascribed as 5,4,3,2,1 for positive and vice a versa for negative statements i.e., 1,2,3,4,5.

3.3 Locale of the study

The present study was conducted in Vadodara city of Gujarat, India.

3.4 Unit of Inquiry

For the present study, the unit of inquiry were the homemakers, interior designers and the students of interior design specialization residing in various areas of Vadodara city who were involved in homemaking and interior designing activities.

3.5 Sample Selection Criteria, Size, and Sampling Procedure

3.5.1 Sample Selection Criteria

For the present study, the sample selection criteria set for the respondents was, only those homemakers, interior designers and students of interior design specialization from Vadodara city were selected who were involved in homemaking and interior designing activities.

3.5.1.1 Inclusion Criteria

- The present study was limited to ceramic waste available from ceramic shops and residential working sites that gave ceramic waste at minimal cost or free of cost.
- The present study was limited to 60 respondents (20 homemakers, 20 interior designers and 20 students of interior design specialization) from Vadodara city.

3.5.1.2 Exclusion Criteria

- Those respondents who did not give consent to participate in the study were excluded.

3.5.2 Sample Size

The sample size for the present study was restricted to 60 respondents (20 homemakers, 20 interior designers and 20 students of interior design specialization) from the Vadodara city of Gujarat, India.

3.5.3 Sampling Procedure

For the present study, purposive sampling technique was used to select the respondents from Vadodara city as only those homemakers, interior designers and students of interior design specialization were selected who were involved in homemaking and interior designing activities, and were willing to participate in the research study.

3.6 Selection, Construction, and Description of the Tool

The exhaustive review of literature helped the researcher to select and prepare the required tool to facilitate data collection for the present study.

3.6.1 Selection of Tool

For the present study, the research was conducted using the following tool.

- **Interview Schedule:** for the present study a interview schedule will be used to know the opinion of the homemakers, interior designers and the students of interior design specialization regarding what they perceive about selected existing parameters namely size, quality, durability, proportion, convenience of use, colour combination, and aesthetic value of the developed designer tiles as it gives accurate data and it offers flexibility which increases the understanding between the respondent and the researcher.

3.6.2 Description and Development of Data Collection Tool

The interview schedule was constructed in compliance with the objectives of the study and statements were divided into two sections as follows:

Section I: Background Information of the respondents

This section contains questions regarding the background information of the respondents like name, age, marital status, educational qualifications, occupational status, and family monthly income of the respondents.

Section II: Opinion of the homemakers, interior designers and the students of interior design specialization for ceramic waste tiles

The present section comprises a set of questions regarding the product's quality, size, design, product's convenience, and its use. A five-point scale “Strongly Agree”, “Agree”, “Undecided”, “Disagree” and “Strongly Disagree” was used to know the opinion of the respondents regarding the developed designer tiles from ceramic waste. A total of 69 statements were developed, from which 42 were positive statements and 27 were negative statements.

Area	No. of Statements
Living Room	11
Kitchen	12
Dining Area	12
Bedroom	12
Bathroom	11
Staircase Area	11
Total	**69**

3.7 Establishment of Content Validity of Tool

To establish content validity, the developed tool was given to the panel of judges comprising experts from the Department of Family and Community Resource Management, Faculty of Family and Community Sciences, and Interior Designers from Vadodara city. The judges were requested to judge the clarity and relevance of the content for each scale. They were also requested to state whether each statement fell in the category of “Relevant”, “Clear” and “Ambiguous”. A total of 69 positive and negative statements were developed, from which 42 were positive statements and 27 were negative statements. The judges were requested to give

suggestions for the developed tool. There were no changes made in the tool, as no changes were suggested.

3.8 Establishment of Reliability

A pre-test was carried out with 30 respondents (10 homemakers, 10 interior designers and 10 students of interior design specialization) to establish the reliability of the data collection tool. To measure the opinion of the respondents regarding developed designer tiles, a set of 69 positive and negative statements was developed and, a five-point continuum scale, “Strongly Agree”, “Agree”, “Undecided”, “Disagree” and “Strongly Disagree” was used to know the opinion of the respondents regarding the developed designer tiles from ceramic waste.

Scale	Reliability Coefficient
Opinion of Homemakers, Interior Designers and Students of Interior Design Specialization	0.93

The reliability coefficient was found through the following formula:

$$r\ rel = 2r/\ 1 + r$$

Where r rel = reliability coefficient &

r = correlation coefficient

3.9 Phases of Product Development

The product development was carried out in three phases during the study:

Phase 1: The researcher procured ceramic waste from the ceramic shops and residential working sites that gave ceramic waste at minimal cost or free of cost.

Phase 2: The researcher created drawings of ceramic tiles using AutoCAD 2018 software. The prepared drawings of the ceramic tiles were used for

the development of the product, which was done by fixing and moulding the ceramic parts with cement and tools and then the final finishes were done.

Phase 3: Cost estimation of the products was done on the basis of material cost, labour cost and profit. A catalogue was prepared by mentioning the product description, namely product name, type of ceramic waste used, size of the product, and costing of the developed ceramic waste tiles.

3.10 Data Collection

The interview schedule was administered to know the opinion of the homemakers, interior designers, and the students of interior design specialization regarding the aesthetic aspects and functional aspects of selected developed designer tiles from ceramic waste. The products were displayed in the Department of Family and Community Resource Management, Seminar Room, on 9th February 2023. The researcher collected feedback where the respondents were asked to analyse the developed tiles according to the existing parameters namely, size, quality, durability, proportion, convenience of use, colour combination, and aesthetic value of the designed ceramic waste tiles developed by the researcher then the opinion of the respondents was noted on the opinion scale “Strongly Agree”, “Agree”, “Undecided”, “Disagree” and “Strongly Disagree” by the researcher.

3.11 Data Analysis

The data was analysed by calculating the weighted mean, frequency, and percentage.

3.11.1 Categorization of Data

The categorization of age (in years), marital status, educational qualification, occupational status, and family monthly income (in ₹) were as follows:

Section I: Background Information

1. **Age of the respondents (in years)**
   - 18 – 29
   - 30 – 41
   - 42 – 53
   - 54 – 65
2. **Marital Status**
   - Married
   - Unmarried
3. **Educational Qualification**
   - Secondary
   - Higher Secondary
   - Graduation
   - Post - Graduation
   - Ph.D.
4. **Occupational Status**
   - Unemployed
   - Employed
   - Self – Employed
5. **Family Monthly Income (in ₹)**
   - Less than 1,00,000
   - 1,00,001 – 2,00,000
   - 2,00,001 – 3,00,000

Section II: Opinion Scale for the homemakers, interior designers and the students of interior design specialization and pattern of response

To gather the information regarding the opinion of the homemakers, interior designers and the students of interior design specialization regarding the selected parameters, namely size, quality, durability, proportion, convenience of use, colour combination, and aesthetic value of the developed designer tiles from ceramic waste. The response pattern of the scale used is given below:

Opinion Scale

Response	Score
Strongly Agree	5
Agree	4
Undecided	3
Disagree	2
Strongly Disagree	1

Opinion of the respondents regarding developed designer tiles from ceramic waste for interior decoration

To measure the opinion of the respondent regarding designed ceramic waste tiles, a scale of 69 positive and negative statements was developed. Altogether 30 products were designed for six areas, namely Living Room, Kitchen, Dining Area, Bedroom, Bathroom, and Staircase Area. The minimum and maximum scores under each aspect were obtained and a range of scores was developed based on the equal interval method to take the opinion of the homemakers, interior designers and the students of interior design specialization for the developed ceramic waste tiles. The responses were measured on a five-point continuum, i.e., “Strongly Agree”, “Agree”, “Undecided”, “Disagree” and “Strongly Disagree” and ascribed scores were 5 to 1. To obtain the category of opinion followed the weighted mean (5 - 1) and the range of scores was divided at equal intervals.

3.11.2 Tabulation

The data was tabulated from the excel sheets to a tabular form for arriving at the frequency, percentages, and weighted mean.

FINDINGS
AND
DISCUSSION

CHAPTER IV

FINDINGS AND DISCUSSION

Finding and discussion is the most important chapter in a dissertation as well as other types of research reports. The present chapter describes the analysis of data collected during the research using interview schedule, followed by relevant discussion and interpretations. For a systematic presentation, the chapter has been divided into the following sections;

Section I

4.1 Designing and Development of Designer Tiles from Ceramic Waste for Interior Decoration

Phase 1: Procuring of Ceramic Waste

Phase 2: Designing and Development of Ceramic Waste Tiles

Phase 3: Preparation of Catalogue and Cost Estimation of Ceramic Waste Tiles

Section II

4.2 Background Information of the respondents

Section III

4.3 Opinion of the homemakers, interior designers and the students of interior design specialization regarding the designed Ceramic Waste Tiles

Conclusion

Section I

4.1 Designing and Development of Designer Tiles from Ceramic Waste for Interior Decoration

This section describes the phases of designing and development of the designer tiles from ceramic waste along with the cost estimation of the products.

Phase 1: Procuring of Ceramic Waste

For procuring ceramic waste, ceramic shops and residential working site were identified and were approached by the researcher. The ceramic waste that was procured from the ceramic shops and residential working site was china mosaic, ceramic tile and backsplash tile. The procured ceramic waste was obtained free of cost from construction site and ceramic shop.

Phase 2: Designing and Development of Ceramic Waste Tiles

A. Designing of ceramic waste tiles on AutoCAD software by the researcher

B. Development of designer tiles from ceramic waste by the researcher

C. Value addition to the ceramic waste tiles

A. Designing of ceramic waste tiles on AutoCAD software by the researcher

The researcher had designed altogether 30 ceramic waste tiles by using the AutoCAD 2018 software. All articles were developed from available ceramic waste.

List of Developed Ceramic Waste Tiles

- Living Room Tiles
- Kitchen Tiles
- Dining Area Tiles
- Bedroom Tiles
- Bathroom Tiles
- Staircase Area Tiles

Note: All the tiles were divided according to their design and the colour combination that would best suit an area.

Drawings of Developed Ceramic Waste Tiles

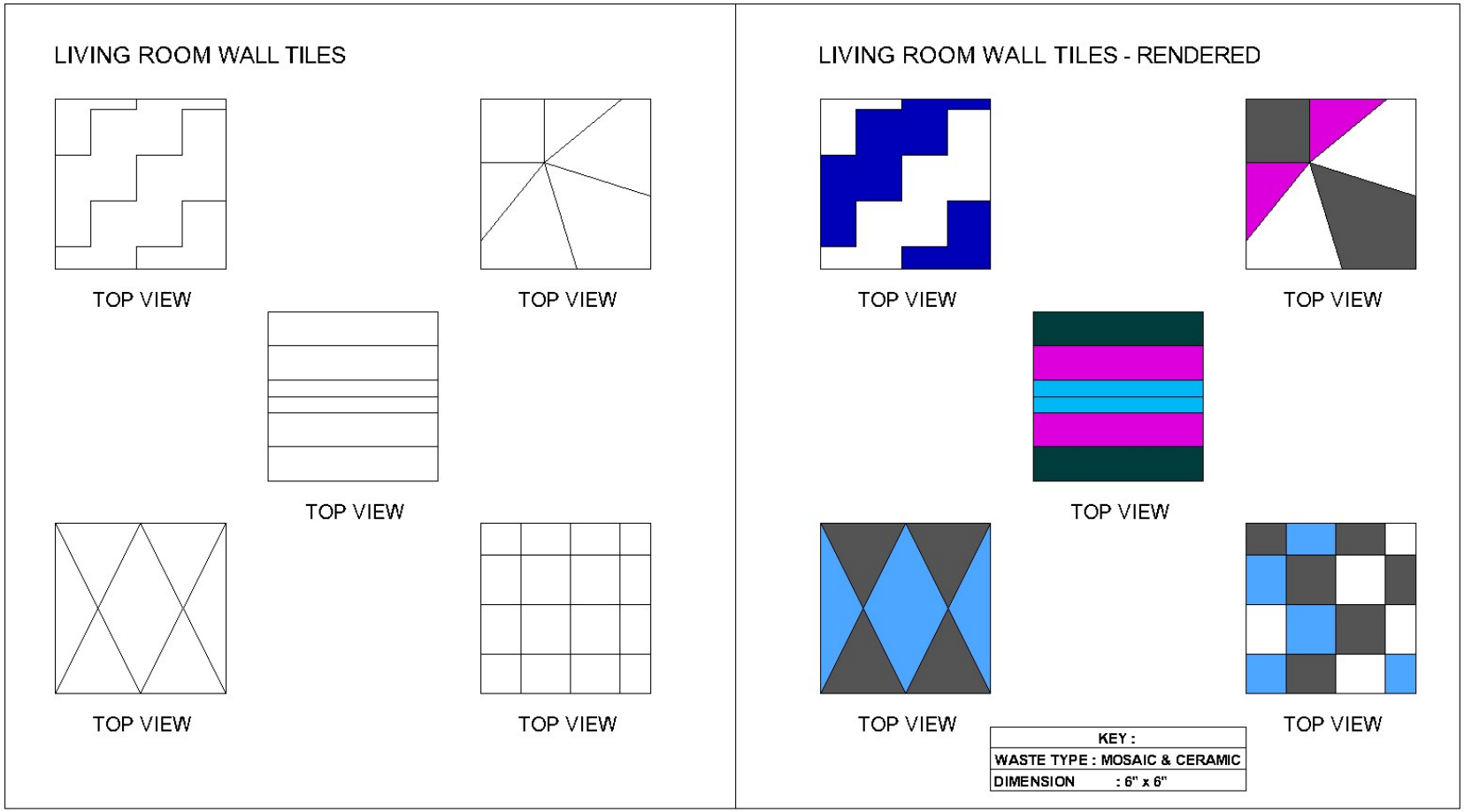


Plate 1: 2D Plan – Living Room Tiles

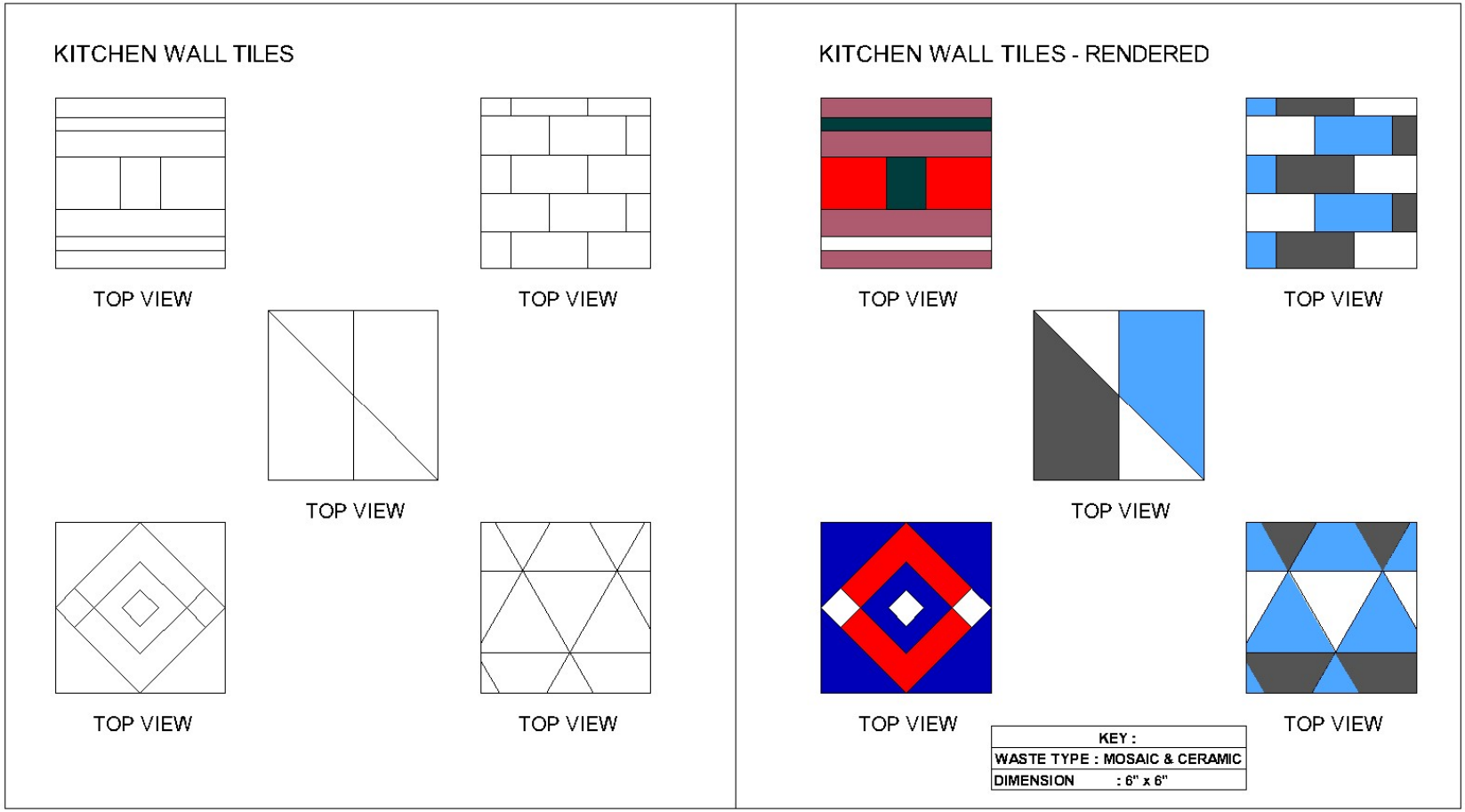


Plate 2: 2D Plan – Kitchen Tiles

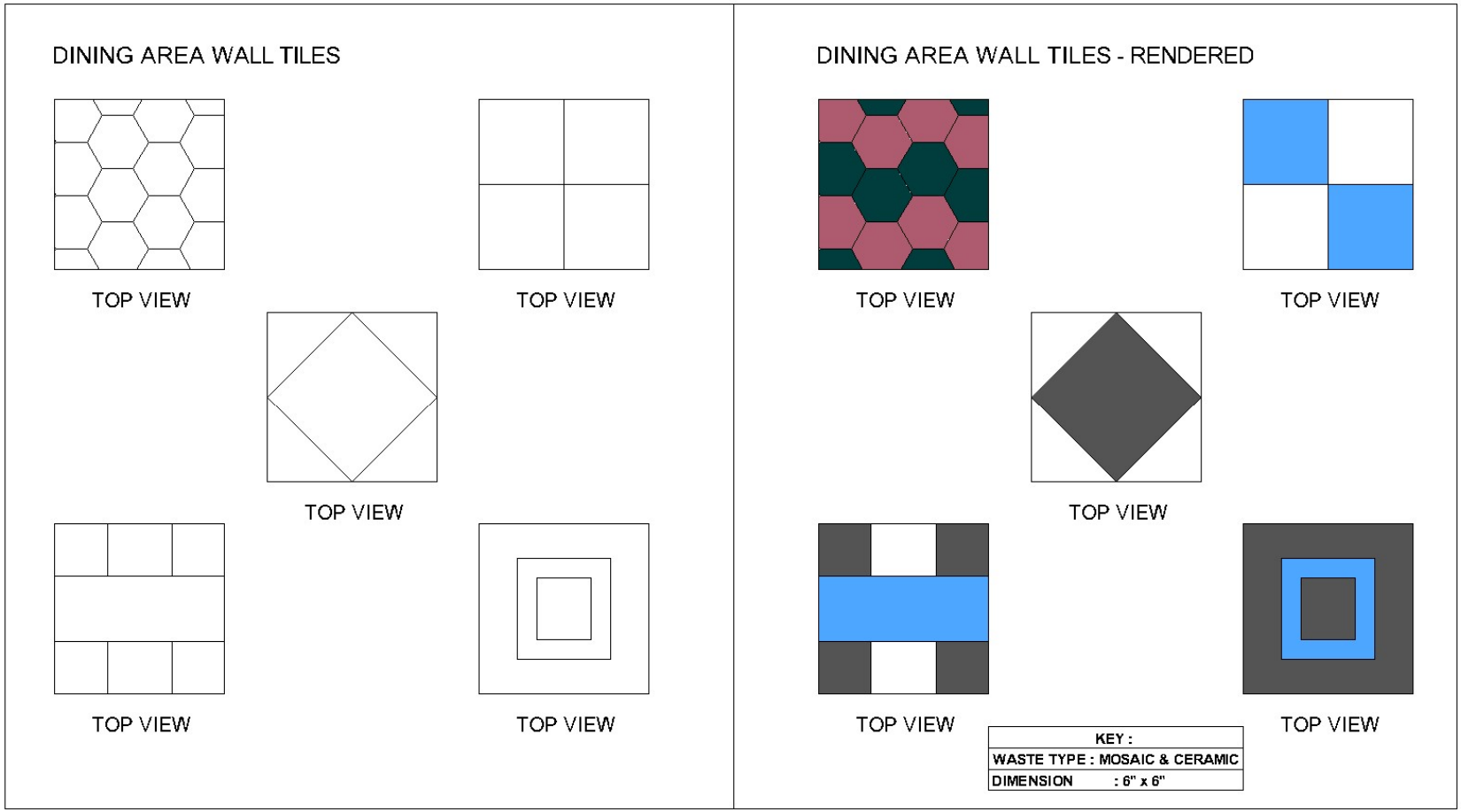


Plate 3: 2D Plan – Dining Area Tiles

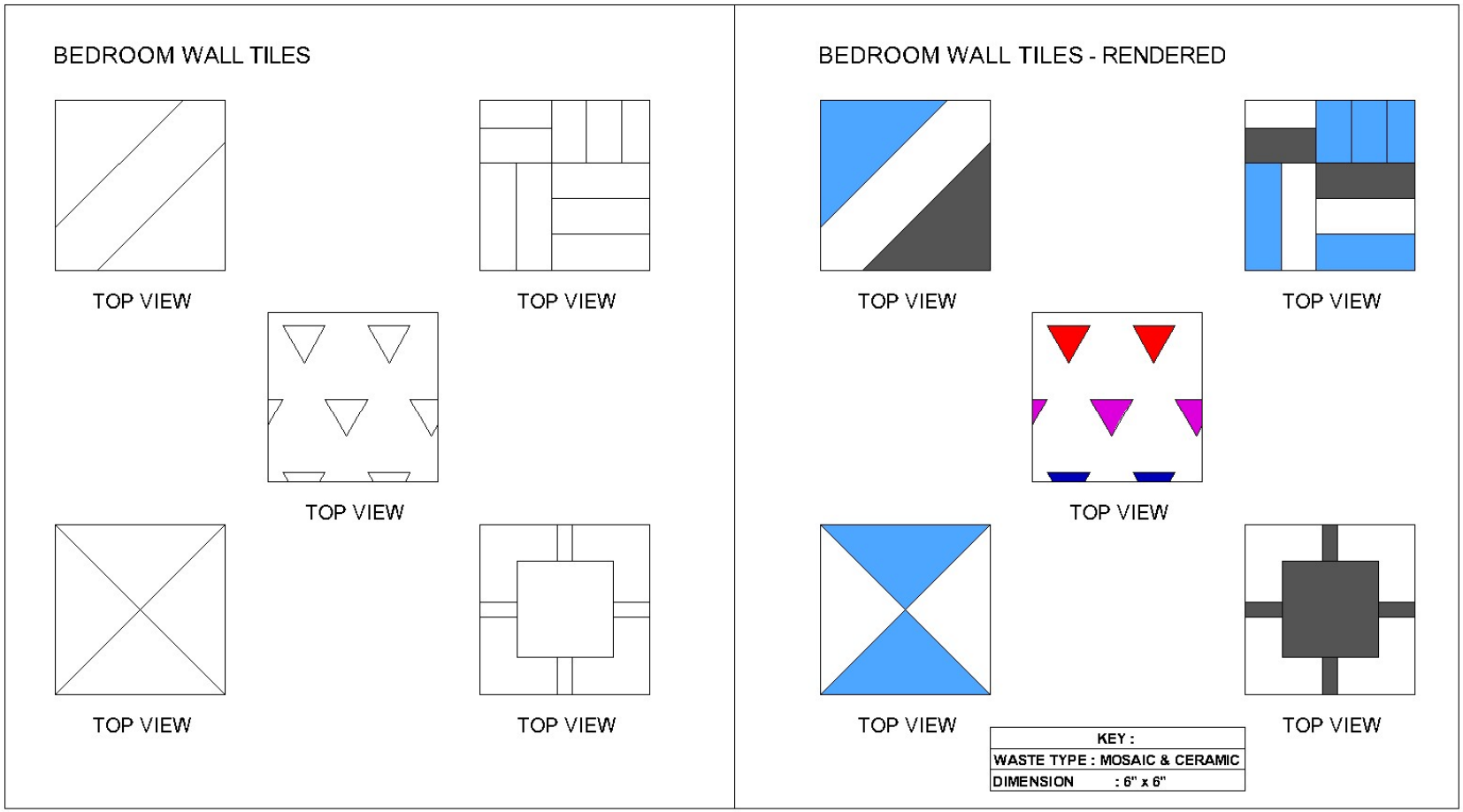


Plate 4: 2D Plan – Bedroom Tiles

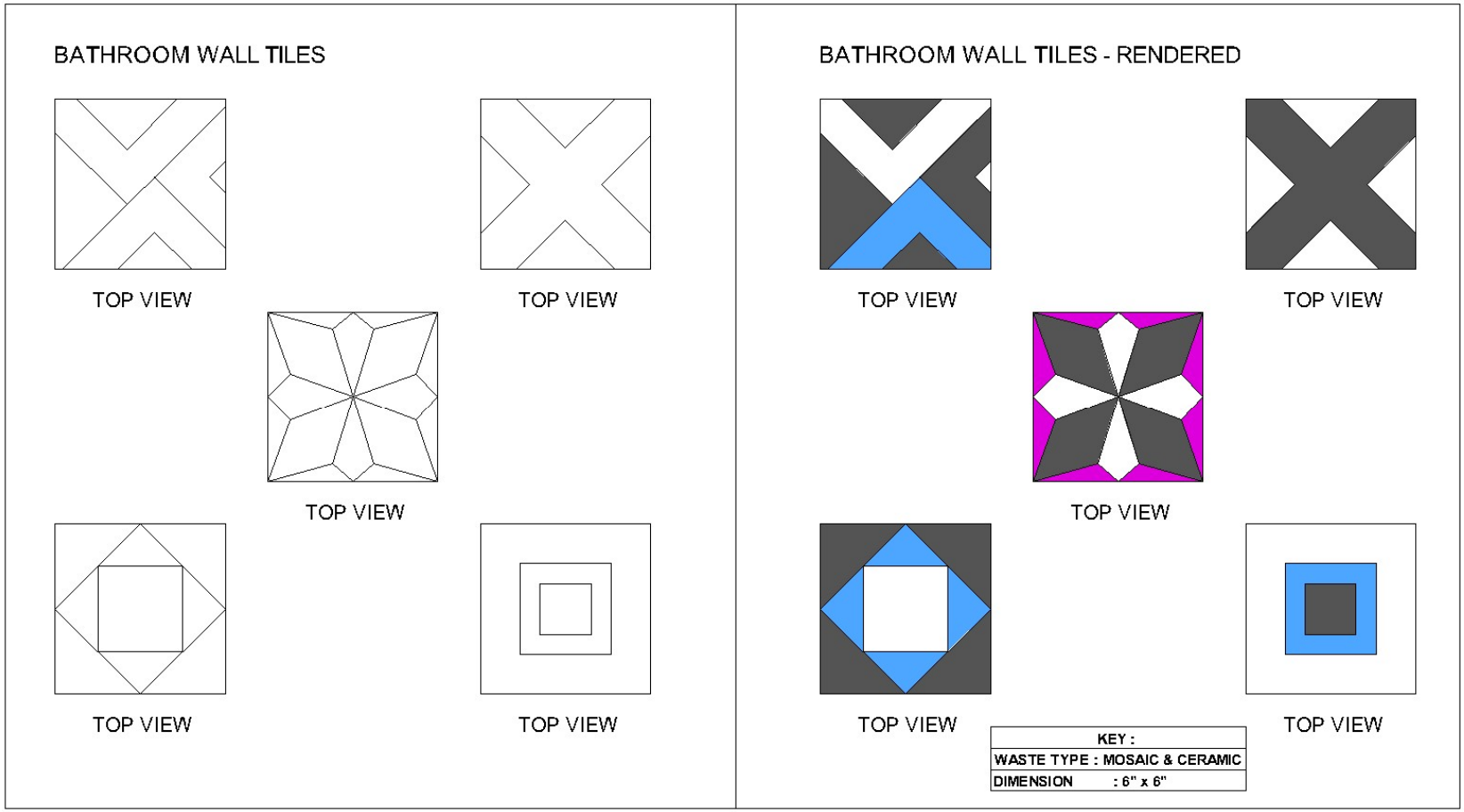


Plate 5: 2D Plan – Bathroom Tiles

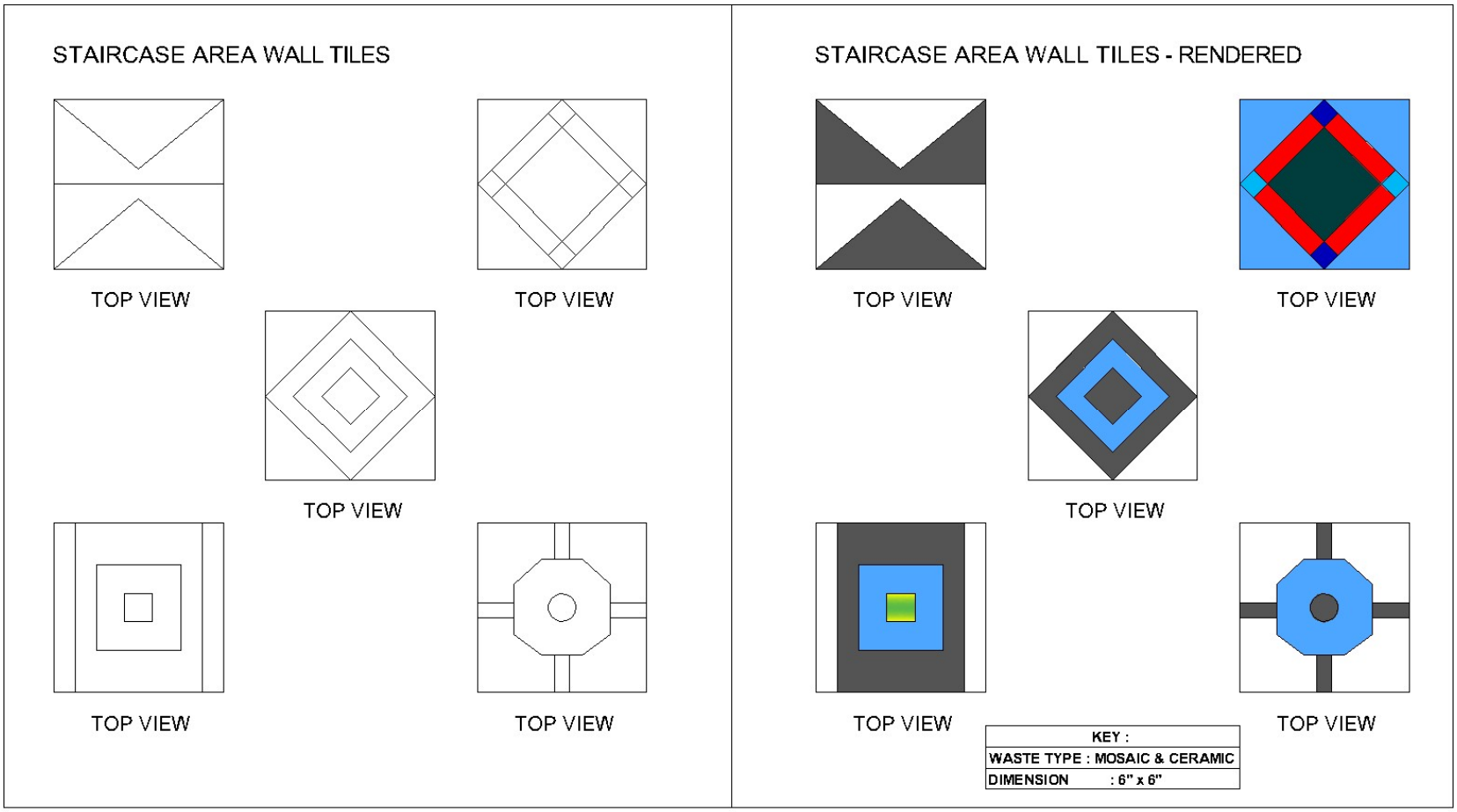


Plate 6: 2D Plan – Staircase Area Tiles

B. Development of designer tiles from ceramic waste by the researcher

The prepared drawings of the ceramic waste tiles were used by the researcher for the development of tiles. The number of ceramic waste tiles were developed according to the ceramic waste procured from the ceramic shops and residential working site.

General steps for the development of ceramic waste tiles

Step 1: The drawing of the tile was prepared in AutoCAD 2018 and the designs were laser cut onto the medium density fibreboard (MDF) which was used as a base.

Step 2: Using the markings on the MDF as a guide, the researcher arranged appropriate ceramic waste pieces according to the measurements, size, and requirements of the design.

Step 3: The correct pieces were then glued onto the board using fevicol and left to dry for a few hours.

Step 4: After drying, all the tiles were outsourced to a construction worker for filling cement between the gaps of the waste pieces.

Step 5: Different type of cement (white, brown, and dyed) was mixed with water and made into a paste and then filled into the gaps of the tiles and left for drying for a day.

Step 6: Finally, the edges and the excess cement on top was cleaned with a damp cloth.

C. Value addition to the ceramic waste tiles

To give value addition to the developed ceramic waste tiles, the researcher had selected the designs and colour combination, and according to that divided the tiles amongst different areas of a space.

Plates for the Process of making Ceramic Waste Tiles

Plate 7: Process of making Living Room Tiles

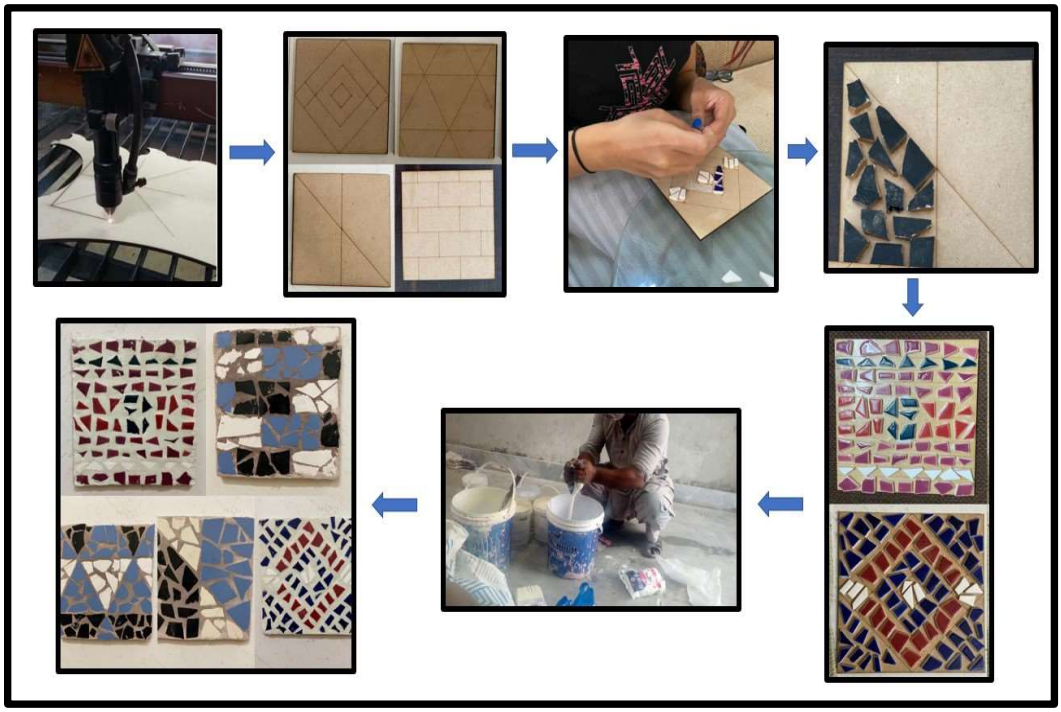


Plate 8: Process of making Kitchen Tiles

Plate 9: Process of making Dining Area Tiles

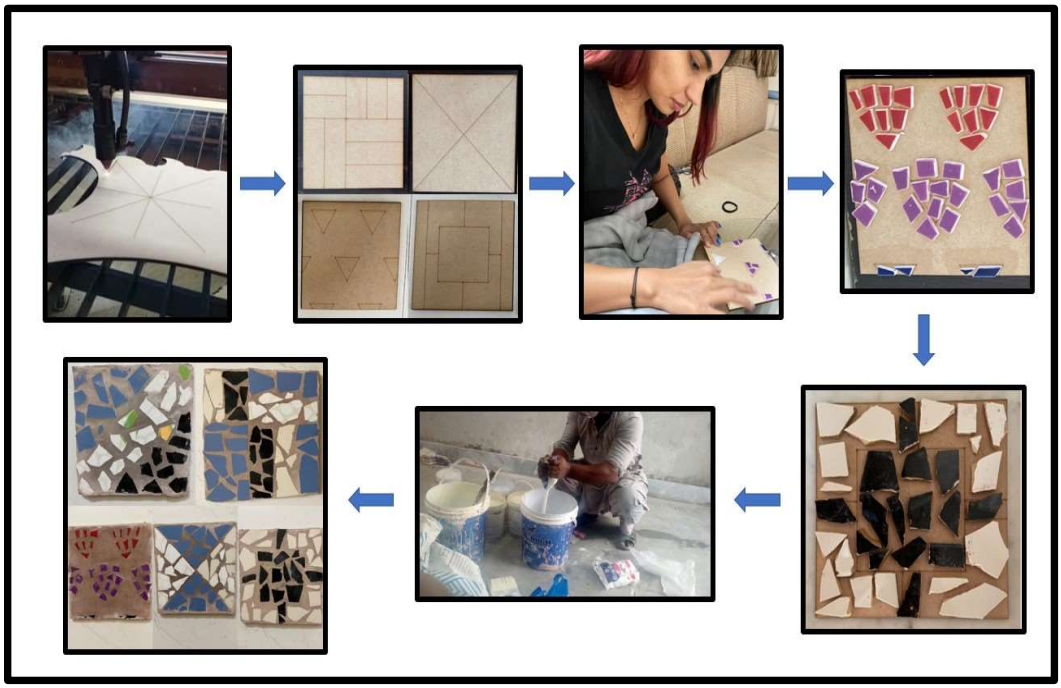


Plate 10: Process of making Bedroom Tiles

Plate 11: Process of making Bathroom Tiles

Plate 12: Process of making Staircase Area Tiles

Phase 3: Preparation of Catalogue and Cost Estimation of Ceramic Waste Tiles

Cost estimation was done on the basis of material costs, labour charges and profit for the developed ceramic waste tiles. A catalogue was prepared mentioning the product description namely product name, type of ceramic used, size of the product and price of the developed ceramic waste tiles.

Table 1: Material costs and labour charges for the developed designer tiles from ceramic waste for interior decoration.

Sr. No.	Name of the Space	Ceramic Waste Type	Material & Labour Cost (in ₹)	Profit (in ₹)	Selling Price (in ₹)
1	Living Room	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
2	Kitchen	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
3	Dining Area	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
4	Bedroom	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
5	Bathroom	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
6	Staircase Area	China Mosaic Tile	190	60	250
		Backsplash Tile	240	60	300
		Total	**2580**	**720**	**3300**

Note:

- *Material cost includes cost of laser cut, mdf, glue, different types of cement, and other materials used for the development of the ceramic waste tiles.*
- *The material cost was calculated according to the market price of January 2023 and the labour charges were decided according to the making time of a product.*

Section II

4.2 Background Information of the respondents

This section shows the background information of the respondents which is divided into two parts i.e., personal information and family information. Personal Information included age, marital status, educational qualification, and occupational status of the respondents. Whereas, family information included family monthly income (in ₹).

4.2.1: Personal Information of the respondents

Personal Information contained information regarding age (in years), educational qualification, marital status, occupation of the respondents.

Table 2: Frequency and percentage distribution of the respondents according to their personal information.

Sr. No.	Personal Information	Respondents (n=60)	
i. Age of the respondents (in years)		**f**	**%**
1.	18 - 29	34	**56.67**
2.	30 - 41	8	13.33
3.	42 - 53	15	25.00
4.	54 - 65	3	5.00
	Total	**60**	**100**
	Mean Age	**32 years**	
	S.D.	**12.78**	
ii. Marital Status of the respondents		**f**	**%**
1.	Married	30	**50.00**
2.	Unmarried	30	**50.00**
	Total	**60**	**100**
iii. Educational Qualification		**f**	**%**
1.	Secondary	1	1.67
2.	Higher Secondary	3	5.00
3.	Graduation	32	**53.33**
4.	Post - Graduation	21	35.00

Sr. No.	Personal Information	Respondents (n=60)	
5.	Ph.D.	3	5.00
	Total	**60**	**100**
iv. Occupational Status of the respondents		**f**	**%**
1.	Unemployed	34	**56.67**
2.	Employed	17	28.33
3.	Self - Employed	9	15.00
	Total	**60**	**100**

i. Age of the respondents:

It was found that 56.67 per cent of the respondents were in the age group of 18 to 29 years with the weighted mean of 32 years. Whereas, 25 per cent of the respondents were from the age group of 42 to 53 years. In contrast, very few, i.e., 5 per cent of the respondents were in the age group of 54 to 65 years. (Table 2, Figure 3)

ii. Marital Status of the respondents:

Regarding marital status, it was found that 50 per cent of the respondents were married and 50 per cent of the respondents were unmarried (Table 2, Figure 3)

iii. Educational qualification of the respondents:

The data revealed that 53.33 per cent of the respondents were qualified up to graduation level and 35 per cent of the respondents were qualified up to post - graduation level. Whereas, 5 per cent of the respondents were qualified up to higher secondary and Ph.D. respectively. Whereas, very less 1.67 per cent of the respondents were qualified up to secondary. (Table 2, Figure 3)

iv. Occupational status of the respondents:

The data revealed that more than half (56.67 per cent) of the respondents were unemployed. In contrast, 28.33 per cent of the respondents were

employed and very few 15 per cent of the respondents were self - employed. (Table 2, Figure 3)

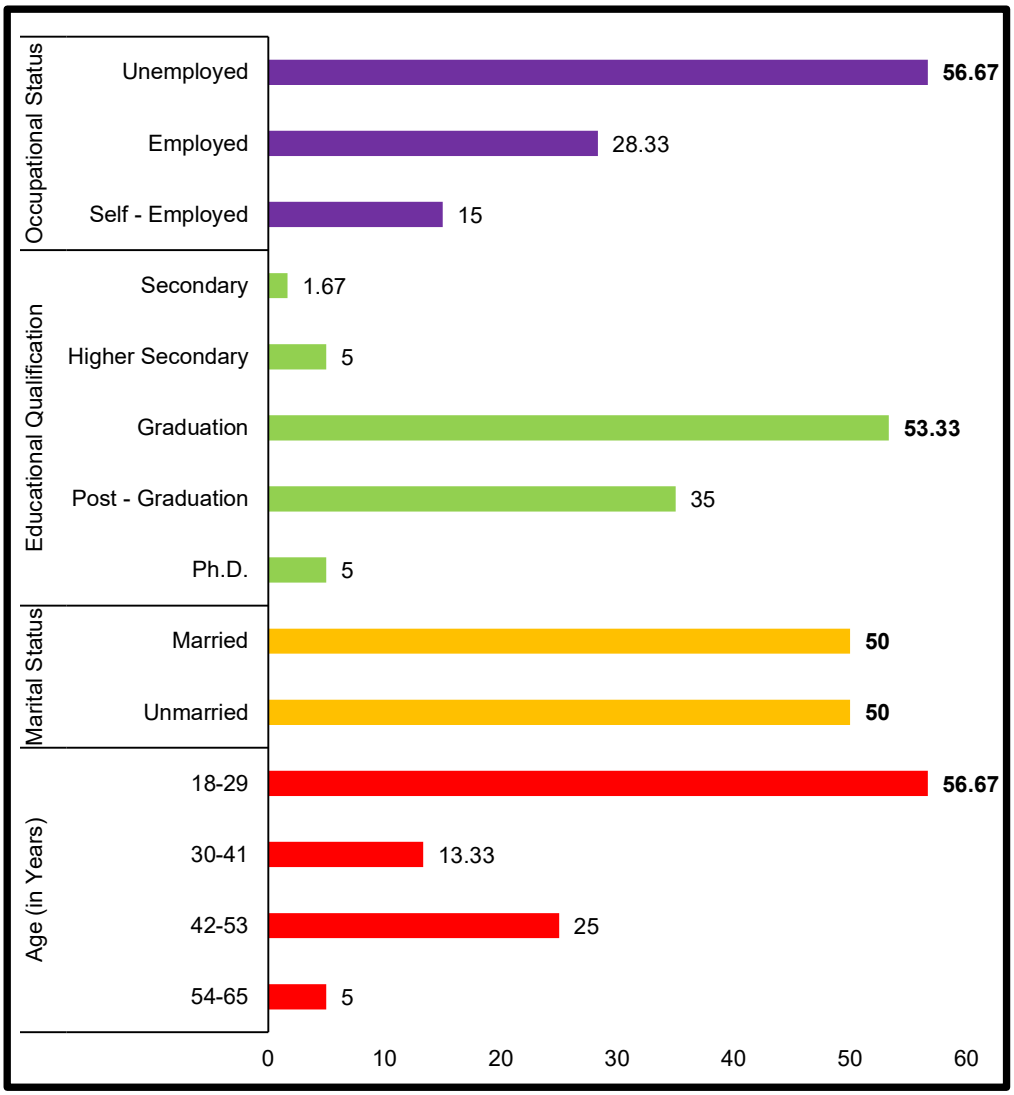


Figure 3: Percentage distribution of the respondents according to their Personal Information

4.2.2: Family Information of the respondents

This section contains information regarding family monthly income of the respondents.

Table 3: Frequency and percentage distribution of the respondents according to their family's monthly income.

Sr. No.	Family Monthly Income of the respondents (in ₹)	f	%
1.	≤ 1,00,000	40	**66.67**
2.	1,00,001 – 2,00,000	15	25.00
3.	2,00,001 – 3,00,000	5	8.33
	Total	**60**	**100**
	Min.	**50,000**	
	Max.	**3,00,000**	
	Mean	**1,12,167**	
	S.D.	**65,847.58**	

i. Family Monthly Income of the respondents (in ₹):

A range obtained family monthly income was classified into three categories, 66.67 per cent of the respondents had their family monthly income ranging less than or equal to ₹1,00,000 with the mean income of ₹1,12,167. While, 25 per cent of the respondents had their family monthly income ranging between ₹1,00,001 to ₹2,00,000. Whereas, in contrast a few (8.33 per cent) respondents' families' monthly income was ranging from ₹2,00,001 to ₹3,00,000. (Table 3, Figure 4)

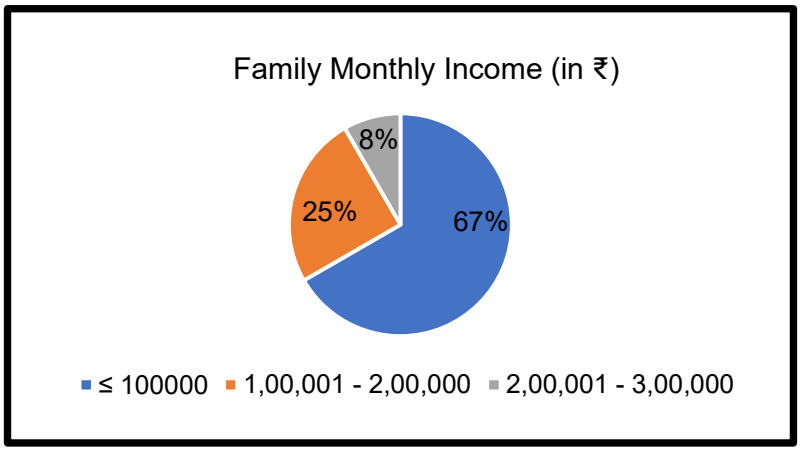


Figure 4: Percentage distribution of the respondents according to their Family Monthly Income

Section III

4.3 Opinion of the homemakers, interior designers and the students of interior design specialization regarding the designed Ceramic Waste Tiles

This section describes the respondents (homemakers, interior designers and students of interior design specialization) opinion regarding what they perceive about selected existing parameters namely “size”, “quality”, “durability”, “proportion”, “convenience of use”, “colour combination” and “aesthetic value” of the developed designer tiles from ceramic waste for the Living Room, Kitchen, Dining Area, Bedroom, Bathroom, and Staircase Area designed for interior decoration.

A. Ceramic Wall Tiles for Living Room

1. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

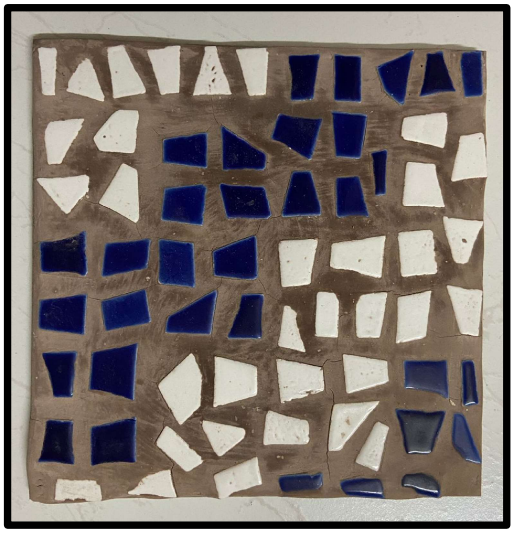


Plate 13: Living Room Tile – 1

2. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 14: Living Room Tile – 2

3. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 15: Living Room Tile – 3

The data from Table 4 revealed that, 60 per cent of the respondents agreed that the design of the product created rhythm and 56.67 per cent of the respondents agreed that the colour combination was harmonious. While, 51.67 per cent of the respondents strongly agreed that the product added aesthetic value while serving the purpose and 40 per cent of the respondents agreed that the size of the product was proportionate for its use. In contrast, 33.33 per cent of the respondents agreed that the finish of the product was satisfactory.

Therefore, based on the weighted mean score of 4.43, it was concluded that the respondents agreed that the product added aesthetic value while serving the purpose.

A. LIVING ROOM WALL TILES (Aesthetic Aspects)

Table 4: Frequency and percentage distribution of the respondents according to their opinion for the Living Room Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The design of the product creates rhythm.	24	40.00	36	**60.00**	00	00	00	00	00	00	4.40
2.	The finish of the product is not satisfactory.	4	7.02	8	14.04	12	21.05	19	**33.33**	14	24.56	2.47
3.	The colour combination is harmonious.	23	38.33	34	**56.67**	3	5.00	00	00	00	00	4.33
4.	The product adds aesthetic value while serving the purpose.	31	**51.67**	25	41.67	3	5.00	1	1.67	00	00	4.43
5.	The size of the product is disproportionate for its use.	00	00	8	13.33	12	20.00	24	**40.00**	16	26.67	2.28
Total Weighted Mean Score												**3.58**

4. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 16: Living Room Tile – 4

5. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 17: Living Room Tile – 5

The data from Table 5 revealed that, 60 per cent of the respondents agreed that the finish of the product was appropriate for day to day cleaning and 59.32 per cent of the respondents agreed that the overall quality of the product was satisfactory. While, 54.24 per cent of the respondents answered undecided for the product could not be cleaned well with common cleaning agents. In contrast, 46.55 per cent of the respondents agreed that the product was durable for its use. Also, 36.21 per cent of the respondents strongly agreed that the overall product was functional.

Therefore, based on the weighted mean score of 4.22, it was concluded that the respondents agreed that the price of the product was acceptable and the overall quality of the product was satisfactory.

A. LIVING ROOM WALL TILES (Functional Aspects)

Table 5: Frequency and percentage distribution of the respondents according to their opinion for the Living Room Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product cannot be cleaned well with common cleaning agents.	4	6.78	6	10.17	32	**54.24**	12	20.34	5	8.47	2.83
2.	The finish of the product is appropriate for day to day cleaning.	6	10.00	36	**60.00**	13	21.67	5	8.33	00	00	3.72
3.	The product is not durable for its use.	3	5.17	5	8.62	16	27.59	27	**46.55**	7	12.07	2.43
4.	The price of the product is acceptable.	20	33.90	32	**54.24**	7	11.86	00	00	00	00	4.22
5.	The overall product is functional.	21	36.21	29	**50.00**	7	12.07	1	1.72	00	00	4.18
6.	The overall quality of the product is satisfactory.	19	32.20	35	**59.32**	4	6.78	1	1.69	00	00	4.22
Total Weighted Mean Score												**3.60**

B. Ceramic Wall Tiles for Kitchen

1. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 18: Kitchen Tile – 1

2. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 19: Kitchen Tile – 2

3. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 20: Kitchen Tile – 3

The data from Table 6 revealed that, 60.34 per cent of the respondents agreed that the colour combination was harmonious. While 56.67 per cent of the respondents strongly agreed that the product added aesthetic value while serving the purpose. In contrast 45.76 per cent of the respondents agreed that the design of the product reflected unity. Also, 32.76 per cent of the respondents answered undecided for the product did not adequately serve the purpose for which it was designed.

Therefore, based on the weighted mean score of 4.50, it was concluded that the respondents strongly agreed that the product added aesthetic value while serving the purpose.

B. KITCHEN WALL TILES (Aesthetic Aspects)

Table 6: Frequency and percentage distribution of the respondents according to their opinion for the Kitchen Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The size of the product is proportionate for its use.	22	36.67	29	**48.33**	7	11.67	2	3.33	00	00	4.18
2.	The colour combination is harmonious.	20	34.48	35	**60.34**	3	5.17	00	00	00	00	4.27
3.	The product does not adequately serve the purpose for which it is designed.	2	3.45	6	10.34	19	**32.76**	16	27.59	15	25.86	2.32
4.	The design of the product does not reflect unity.	5	8.47	4	6.78	7	11.86	27	**45.76**	16	27.12	2.18
5.	The product adds aesthetic value while serving the purpose.	34	**56.67**	22	36.67	4	6.67	00	00	00	00	4.50
Total Weighted Mean Score												**3.49**

4. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 21: Kitchen Tile – 4

5. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 22: Kitchen Tile – 5

The data from Table 7 revealed that, 61.02 per cent of the respondents agreed that the price of the product was acceptable and 56.67 per cent of the respondents agreed that the product was durable for its use. While, 45.76 per cent of the respondents strongly agreed that the overall quality of the product was satisfactory. In contrast, 38.33 per cent of the respondents answered undecided for the product was not easy to clean with a damp cloth and 25.42 per cent of the respondents agreed that the product could be cleaned well with common cleaning agents.

Therefore, based on the weighted mean score of 4.45, it was concluded that the respondents strongly agreed that the overall quality of the product was satisfactory.

B. KITCHEN WALL TILES (Functional Aspects)

Table 7: Frequency and percentage distribution of the respondents according to their opinion for the Kitchen Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product is not easy to clean with a damp cloth.	13	21.67	5	8.33	23	**38.33**	14	23.33	5	8.33	3.07
2.	The product cannot be cleaned well with common cleaning agents.	8	13.56	10	16.95	22	**37.29**	15	25.42	4	6.78	2.98
3.	The finish of the product is appropriate for day to day cleaning.	20	33.33	32	**53.33**	8	13.33	00	00	00	00	4.20
4.	The product is durable for its use.	25	41.67	34	**56.67**	1	1.67	00	00	00	00	4.40
5.	The price of the product is acceptable.	19	32.20	36	**61.02**	3	5.08	1	1.69	00	00	4.23
6.	The overall product is functional.	24	40.68	31	**52.54**	1	1.69	3	5.08	00	00	4.28
7.	The overall quality of the product is satisfactory.	27	45.76	32	**54.24**	00	00	00	00	00	00	4.45
Total Weighted Mean Score												**3.95**

C. Ceramic Wall Tiles for Dining Area

1. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 23: Dining Area Tile – 1

2. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 24: Dining Area Tile – 2

3. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 25: Dining Area Tile – 3

The data revealed from Table 8 that 64.41 per cent of the respondents agreed that the product added aesthetic value to the space and 61.02 per cent of the respondents agreed that the design of the product created rhythm. While, 57.89 per cent of the respondents agreed that the finish of the product was satisfactory and 41.48 per cent of the respondents agreed that the design of the product was appropriate for its use. While, 41.38 per cent of the respondents strongly agreed that the colour combination was harmonious.

Therefore, based on the weighted mean score of 4.28, it was concluded that the respondents strongly agreed that the product added aesthetic value to the space.

C. DINING AREA WALL TILES (Aesthetic Aspects)

Table 8: Frequency and percentage distribution of the respondents according to their opinion for the Dining Area Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product is not solving the purpose for which it is designed.	2	3.51	6	10.53	7	12.28	23	**40.35**	19	33.33	2.07
2.	The product adds aesthetic value to the space.	19	32.20	38	**64.41**	2	3.39	00	00	00	00	4.28
3.	The finish of the product is not satisfactory.	00	00	7	12.28	1	1.75	33	**57.89**	16	28.07	1.97
4.	The design of the product creates rhythm.	19	32.20	36	**61.02**	2	3.39	2	3.39	00	00	4.22
5.	The design of the product is inappropriate for its use.	5	8.62	6	10.34	4	6.90	24	**41.48**	19	32.76	2.15
6.	The colour combination is not harmonious.	4	6.90	9	15.52	3	5.17	18	31.03	24	**41.38**	2.10
Total Weighted Mean Score												**2.80**

4. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 26: Dining Area Tile – 4

5. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 27: Dining Area Tile – 5

The data revealed from Table 9 showed that 62.07 per cent of the respondents agreed that the product was durable for its use and 57.63 per cent of the respondents agreed that the overall quality of the product was satisfactory. Also, 56.90 per cent of the respondents agreed that the price of the product was acceptable and that the overall product was functional. Whereas, 39.66 per cent of the respondents agreed that the finish of the product was appropriate for day to day cleaning.

Therefore, based on the weighted mean score of 4.35, it was concluded that the respondents strongly agreed that the overall quality of the product was satisfactory.

C. DINING AREA WALL TILES (Functional Aspects)

Table 9: Frequency and percentage distribution of the respondents according to their opinion for the Dining Area Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product is easy to clean with a damp cloth.	19	32.20	23	**38.98**	15	25.42	2	3.39	00	00	3.98
2.	The finish of the product is inappropriate for day to day cleaning.	2	3.45	8	13.79	9	15.52	23	**39.66**	16	27.59	2.25
3.	The product is durable for its use.	19	32.76	36	**62.07**	3	5.17	00	00	00	00	4.25
4.	The price of the product is acceptable.	19	32.76	33	**56.90**	2	3.45	4	6.90	00	00	4.13
5.	The overall product is functional.	20	34.48	33	**56.90**	00	00	5	8.62	00	00	4.13
6.	The overall quality of the product is satisfactory.	23	38.98	34	**57.63**	2	3.39	00	00	00	00	4.35
Total Weighted Mean Score												**3.85**

D. Ceramic Wall Tiles for Bedroom

1. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 28: Bedroom Tile – 1

2. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 29: Bedroom Tile – 2

3. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 30: Bedroom Tile – 3

The data revealed from Table 10 showed that 53.33 per cent of the respondents agreed that the size of the product was proportionate for its use and 50.85 per cent of the respondents agreed that the design of the product reflected unity. While, it was observed that 44.83 per cent of the respondents agreed that the colour combination was harmonious and 41.38 per cent of the respondents agreed that the finish of the product was suitable for its use. While it was observed that, 40.68 per cent of the respondents strongly agreed that the product added aesthetic value while serving the purpose.

Therefore, based on the weighted mean score of 4.27, it was concluded that the respondents strongly agreed that the design of the product reflected unity.

D. BEDROOM WALL TILES (Aesthetic Aspects)

Table 10: Frequency and percentage distribution of the respondents according to their opinion for the Bedroom Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The finish of the product is not suitable for its use.	5	8.62	5	8.62	6	10.34	24	**41.38**	18	31.03	2.18
2.	The product does not add aesthetic value while serving the purpose.	2	3.39	7	11.86	9	15.25	17	28.81	24	**40.68**	2.05
3.	The design of the product reflects unity.	23	38.98	30	**50.85**	6	10.17	00	00	00	00	4.27
4.	The size of the product is proportionate for its use.	19	31.67	32	**53.33**	7	11.67	2	3.33	00	00	4.13
5.	The colour combination is not harmonious.	5	8.62	8	13.79	3	5.17	26	**44.83**	16	27.59	2.25
Total Weighted Mean Score												**2.98**

4. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 31: Bedroom Tile – 4

5. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 32: Bedroom Tile – 5

The findings from Table 11 revealed that 62.71 per cent of the respondents agreed that the price of the product was acceptable and 56.67 per cent of the respondents agreed the overall quality of the product was satisfactory and 52.54 per cent of the respondents agreed that the product was durable for its use. While, it was observed that 48.33 per cent of the respondents strongly agreed that the overall product was functional. In contrast, 35.09 per cent of the respondents answered undecided for the product could not be cleaned well with common cleaning agents.

Therefore, based on the weighted mean score of 4.42, it was concluded that the respondents strongly agreed that the overall product was functional.

D. BEDROOM WALL TILES (Functional Aspects)

Table 11: Frequency and percentage distribution of the respondents according to their opinion for the Bedroom Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product is not easy to clean with a damp cloth.	2	3.51	6	10.53	15	26.32	18	31.58	16	**28.07**	2.23
2.	The product cannot be cleaned well with common cleaning agents.	2	3.51	6	10.53	20	**35.09**	11	19.30	18	31.58	2.32
3.	The finish of the product is appropriate for day to day cleaning.	21	35.59	28	**47.46**	7	11.86	3	5.08	00	00	4.12
4.	The product is durable for its use.	22	37.29	31	**52.54**	3	5.08	3	5.08	00	00	4.22
5.	The price of the product is acceptable.	17	28.81	37	**62.71**	2	3.39	3	5.08	00	00	4.15
6.	The overall product is functional.	29	**48.33**	27	45.00	4	6.67	00	00	00	00	4.42
7.	The overall quality of the product is satisfactory.	23	38.33	34	**56.67**	1	1.67	2	3.33	00	00	4.30
Total Weighted Mean Score												**3.68**

E. Ceramic Wall Tiles for Bathroom

1. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 33: Bathroom Tile – 1

2. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 34: Bathroom Tile – 2

3. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 35: Bathroom Tile – 3

The data from Table 12 revealed that 61.67 per cent of the respondents agreed that the size of the product was proportionate for its use. It was also observed that 44.83 per cent of the respondents agreed that the design of the product reflected unity. While 42.37 per cent of the respondents agreed that the finish of the product was satisfactory. Whereas, 41.38 per cent of the respondents agreed that the product adequately served the purpose for which it was designed and 39.66 per cent of the respondents agreed that the colour combination was harmonious.

Therefore, based on the weighted mean score of 3.87, it was concluded that the respondents strongly agreed that the finish of the product was satisfactory.

E. BATHROOM WALL TILES (Aesthetic Aspects)

Table 12: Frequency and percentage distribution of the respondents according to their opinion for the Bathroom Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product does not adequately serve the purpose for which it is designed.	2	3.45	8	13.79	5	8.62	24	**41.38**	19	32.76	2.10
2.	The finish of the product is satisfactory.	16	27.12	25	**42.37**	14	23.73	3	5.08	1	1.69	3.87
3.	The design of the product does not reflect unity.	00	00	10	17.24	6	10.34	26	**44.83**	16	27.59	2.17
4.	The colour combination is not harmonious.	2	2.45	12	20.69	4	6.90	23	**39.66**	17	29.31	2.25
5.	The size of the product is proportionate for its use.	7	11.67	37	**61.67**	14	23.33	1	1.67	1	1.67	3.80
Total Weighted Mean Score												**2.84**

4. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 36: Bathroom Tile – 4

5. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 37: Bathroom Tile – 5

The findings from Table 13 revealed that 60 per cent of the respondents agreed that the price of the product was acceptable and 55 per cent of the respondents agreed that the overall product was functional. Whereas, 53.33 per cent of the respondents strongly agreed that the overall quality of the product was satisfactory and 41.67 per cent of the respondents strongly agreed that the product could be cleaned well with common cleaning agents. While, 34.48 per cent of the respondents agreed that the finish of the product was appropriate for day to day cleaning and that the product was durable for its use.

Therefore, based on the weighted mean score of 4.52, it was concluded that the respondents agreed that the overall quality of the product was satisfactory.

E. BATHROOM WALL TILES (Functional Aspects)

Table 13: Frequency and percentage distribution of the respondents according to their opinion for the Bathroom Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product can be cleaned well with common cleaning agents.	25	**41.67**	22	36.67	10	16.67	3	5.00	00	00	4.15
2.	The finish of the product is inappropriate for day to day cleaning.	14	24.14	9	15.52	5	8.62	20	**34.48**	10	17.24	2.87
3.	The product is not durable for its use.	3	5.17	10	17.24	7	12.07	20	**34.48**	18	31.03	2.25
4.	The price of the product is acceptable.	18	30.00	36	**60.00**	4	6.67	2	3.33	00	00	4.17
5.	The overall product is functional.	26	43.33	33	**55.00**	00	00	1	1.67	00	00	4.40
6.	The overall quality of the product is satisfactory.	32	**53.33**	27	45.00	1	1.67	00	00	00	00	4.52
Total Weighted Mean Score												**3.73**

F. Ceramic Wall Tiles for Staircase Area

1. Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 38: Staircase Area Tile – 1

2. This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: China Mosaic (Terrace) **Price:** ₹ 250

Plate 39: Staircase Area Tile – 2

3. Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 40: Staircase Area Tile – 3

The findings from Table 14 revealed that 53.45 per cent of the respondents agreed that the design of the product created rhythm. While 50 per cent of the respondents strongly agreed that the product added aesthetic value while serving the purpose. In contrast, 49.12 per cent of the respondents agreed that the finish of the product was satisfactory and 48.28 per cent of the respondents agreed that the design of the product was appropriate for its use. Whereas, 36.21 per cent of the respondents strongly agreed that the product solved the purpose for which it was designed.

Therefore, based on the weighted mean score of 4.37, it was concluded that the respondents strongly agreed that the product added aesthetic value while serving the purpose.

F. STAIRCASE AREA WALL TILES (Aesthetic Aspects)

Table 14: Frequency and percentage distribution of the respondents according to their opinion for the Staircase Area Tiles (Aesthetics).

Sr. No.	Aesthetic Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The design of the product is inappropriate for its use.	5	8.62	8	13.79	3	5.17	28	**48.28**	14	24.14	2.28
2.	The product adds aesthetic value while serving the purpose.	29	**50.00**	25	43.10	2	3.45	2	3.45	00	00	4.37
3.	The design of the product creates rhythm.	20	34.48	31	**53.45**	5	8.62	2	3.45	00	00	4.15
4.	The finish of the product is not satisfactory.	00	00	5	8.77	6	10.53	28	**49.12**	18	31.58	1.95
5.	The product is not solving the purpose for which it is designed.	2	3.45	9	15.52	5	8.62	21	**36.21**	21	**36.21**	2.08
Total Weighted Mean Score												**2.97**

4. Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 41: Staircase Area Tile – 4

5. The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen) **Price:** ₹ 300

Plate 42: Staircase Area Tile – 5

The findings from Table 15 revealed that 57.63 per cent of the respondents agreed that the price of the product was acceptable and 50 per cent of the respondents agreed that the overall quality of the product was satisfactory. While, 50 per cent of the respondents strongly agreed that the overall product was functional. In contrast, 47.46 per cent of the respondents agreed that the finish of the product was appropriate for day to day cleaning. Whereas, 34.48 per cent of the respondents strongly agreed that the product was durable for its use.

Therefore, based on the weighted mean score of 4.47, it was concluded that the respondents strongly agreed that the overall product was functional.

F. STAIRCASE AREA WALL TILES (Functional Aspects)

Table 15: Frequency and percentage distribution of the respondents according to their opinion for the Staircase Area Tiles (Functionalism).

Sr. No.	Functional Aspects for Ceramic Waste Tile	Respondents (n=60)										Wt. Mean (5-1)
		Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree		
		f	%	f	%	f	%	f	%	f	%	
1.	The product can be cleaned well with common cleaning agents.	25	**41.67**	22	36.67	13	21.67	00	00	00	00	4.20
2.	The finish of the product is appropriate for day to day cleaning.	21	35.59	28	**47.46**	10	16.95	00	00	00	00	4.17
3.	The product is not durable for its use.	8	13.79	5	8.62	7	12.07	18	31.03	20	**34.48**	2.32
4.	The price of the product is acceptable.	22	37.29	34	**57.63**	2	3.39	00	00	1	1.69	4.28
5.	The overall product is functional.	30	**50.00**	28	46.67	2	3.33	00	00	00	00	4.47
6.	The overall quality of the product is satisfactory.	27	45.00	30	**50.00**	3	5.00	00	00	00	00	4.40
Total Weighted Mean Score												**3.97**

Table 16: Weighted mean score of aesthetic aspects for developed ceramic waste tiles according to the opinion of the respondents

Sr. No.	Aesthetic Aspects for Developed Ceramic Waste Tiles	Weighted Mean (5-1)
A.	Living Room	**3.58**
B.	Kitchen	3.49
C.	Dining Area	2.80
D.	Bedroom	2.98
E.	Bathroom	2.84
F.	Staircase Area	2.97

According to Table 16, the highest weighted mean score was 3.58 for the living room, followed by the kitchen with the weighted mean of 3.49, from all the products developed for interior decoration.

Table 17: Weighted mean score of functional aspects for developed ceramic waste tiles according to the opinion of the respondents

Sr. No.	Functional Aspects for Developed Ceramic Waste Tiles	Weighted Mean (5-1)
A.	Living Room	3.60
B.	Kitchen	3.95
C.	Dining Area	3.85
D.	Bedroom	3.68
E.	Bathroom	3.73
F.	Staircase Area	**3.97**

According to Table 17, the highest weighted mean score was 3.97 for the staircase area, followed by the kitchen with the weighted mean of 3.95, from all the products developed for interior decoration.

Amongst all the developed products, according to their weighted mean, the staircase area was ranked first, kitchen ranked second and the dining area ranked third.

Conclusion:

From the data collected it was found that for the age of the respondents, 56.67 per cent belonged to the age group of 18 to 29 years with the mean age of 32 years and 50 per cent of the respondents were married while the remaining 50 per cent of the respondents were unmarried. Regarding the educational qualification, it was observed that 53.33 per cent of the respondents completed education up to graduation level and very few, i.e., 5 per cent of the respondents were educated up to higher secondary and Ph.D. level. More than half (56.67 per cent) of the respondents were unemployed. Whereas, 15 per cent of the respondents were self - employed. The family monthly income of 66.67 per cent of the respondents was less than or equal to ₹1,00,000 and 8.33 per cent of the respondents had their family monthly income between ₹2,00,001 and ₹3,00,000.

From the data collected regarding the opinion of the respondents in regards to the existing parameters namely “size”, “quality”, “durability”, “proportion”, “convenience of use”, “colour combination” and “aesthetic value” for the developed designer tiles from ceramic waste for interior decoration, the findings of the study depicted that the staircase area ceramic waste tiles and the kitchen ceramic waste tiles were the most liked products by the respondents. The colour combination of the designs of the developed ceramic waste tiles was liked by the respondents.

Plates for Display of Ceramic Waste Tiles for Data Collection

Plate 43: Display of Ceramic Waste Tiles for Data Collection

Plate 44: Display of Ceramic Waste Tiles for Data Collection

Department of Family and Community Resource Management
Faculty of Family and Community Sciences
The Maharaja Sayajirao University of Baroda
Vadodara

Catalogue of Designer Tiles Developed from Ceramic Waste for Interior Decoration

Developed by: Naitri Shah

PREFACE

Ceramic is an important natural resource and one of the few renewable resources. It is also one of the most sustainable renewable resources. Several ceramic products can be reused or recycled, thus ensuring the supply of ceramic in the future. The majority of ceramic waste can be reused for building materials, transformed into eco-friendly concrete, and used as partial cement substitute. Furthermore, reusing and recycling ceramic reduces the burial in a landfill.

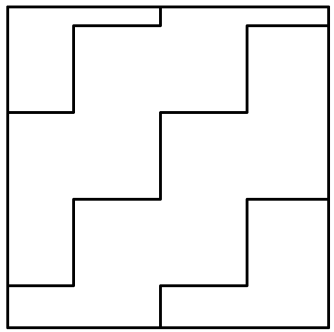
The present catalogue has been prepared under the dissertation work for the partial fulfillment of Master's Degree, on designer tiles developed from ceramic waste for interior decoration, with the cost of each developed article. It is hoped that this catalogue will help the manufacturer and retailer of the ceramic industry, as the design developed can be used as an example for reusing the maximum amount of ceramic waste to create utility and decor articles, other construction materials and tiles from ceramic waste. The developed articles will also benefit interior designing students as they can start their own business by designing similar kinds of handicrafts and creative products based on various themes.

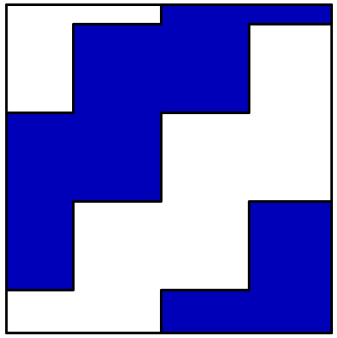
Developed by: Naitri Shah
Sr. M.Sc. Student

CONTENT

*Actual products may vary from the images

LIVING ROOM





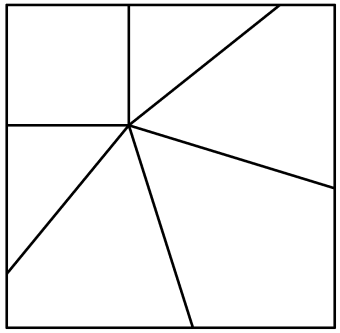
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

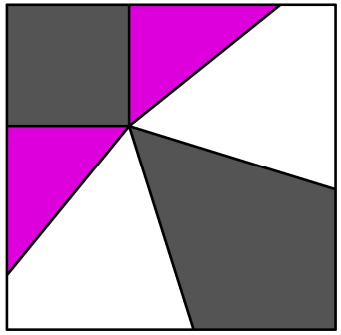
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

LIVING ROOM





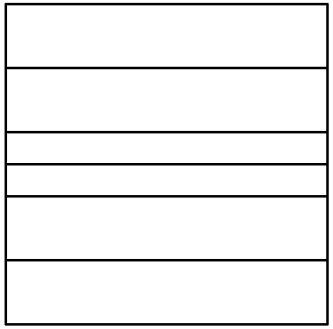
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

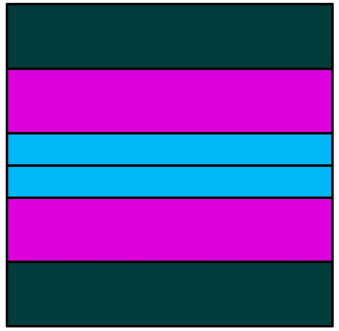
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

LIVING ROOM





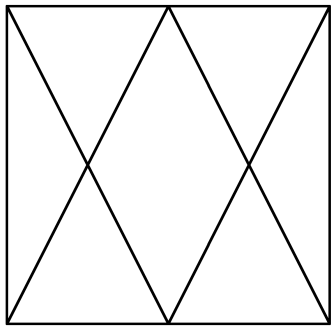
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

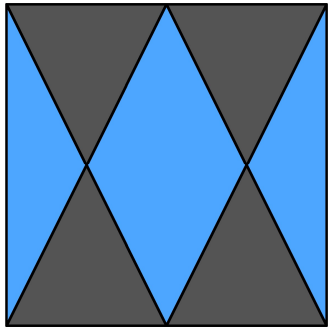
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

LIVING ROOM





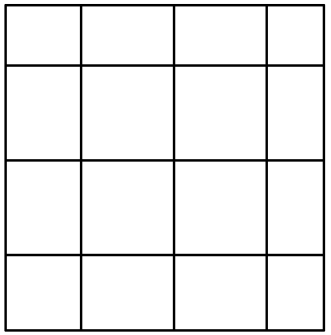
Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

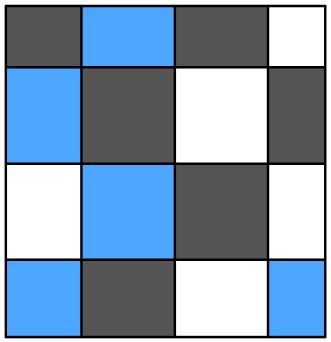
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

LIVING ROOM





Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

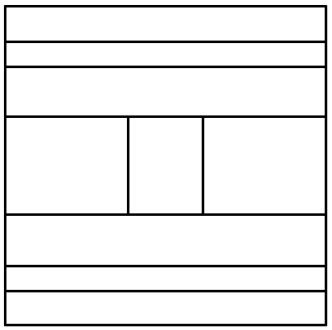
Type of Ceramic: Backsplash Tile (Kitchen)

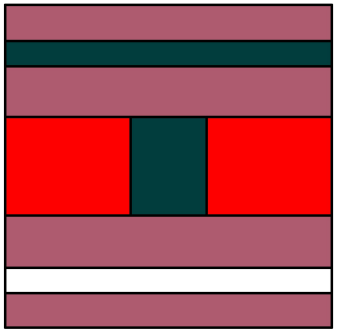
Dimension: 6" x 6"

Price: Rs. 300

LIVING ROOM

This product can provide various uses. It can be used as mirror frame, furniture decoration, key holder, etc.





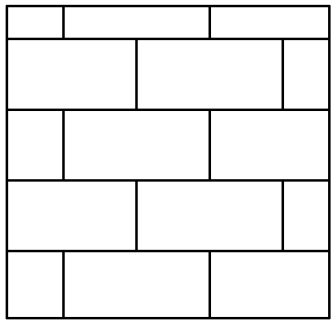
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

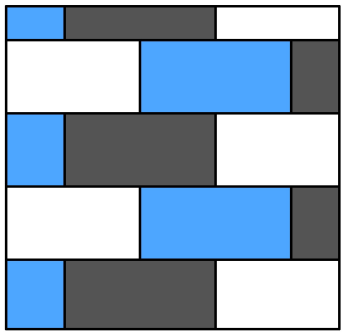
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

KITCHEN





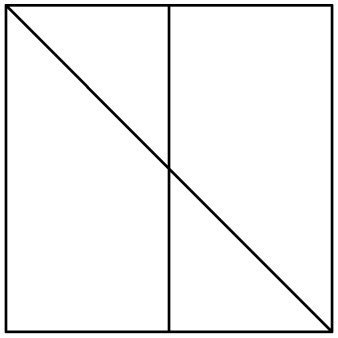
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

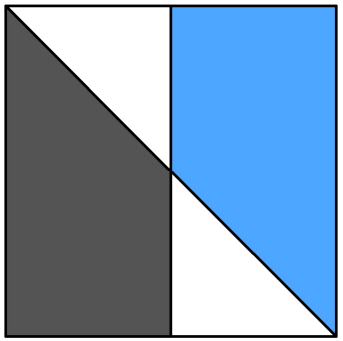
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

KITCHEN





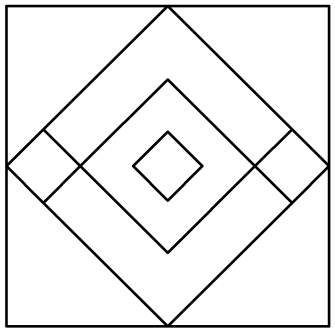
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

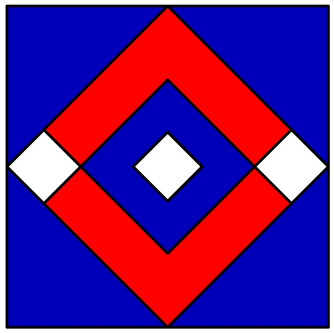
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

KITCHEN





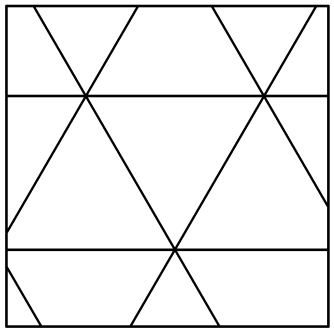
Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

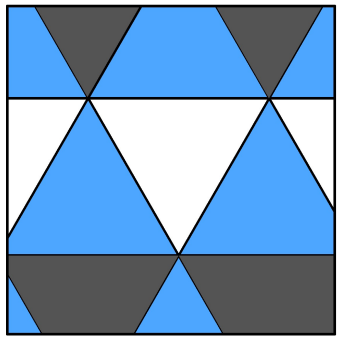
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

KITCHEN





Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

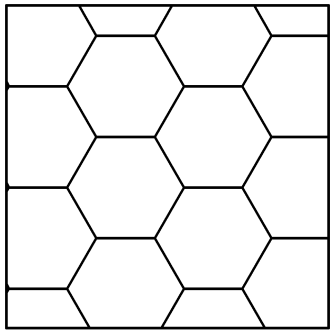
Price: Rs. 300

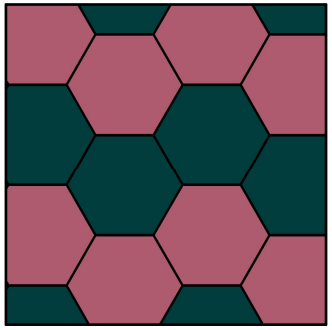
KITCHEN

KITCHEN

This product can provide various uses. It can be used as coaster, tray, centerpiece, etc.

DINING AREA





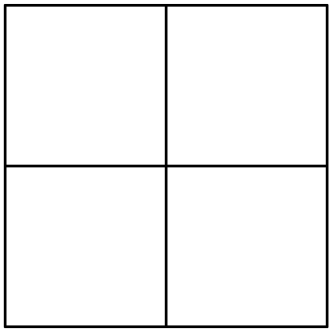
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

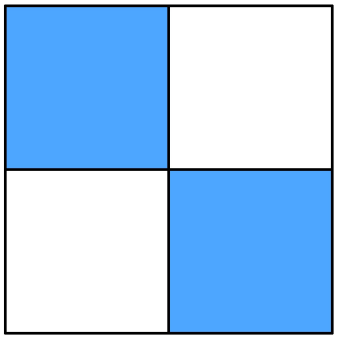
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

DINING AREA





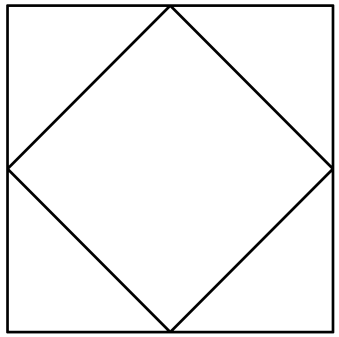
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

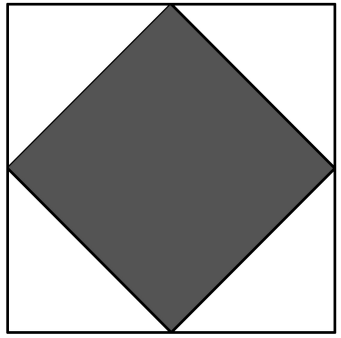
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

DINING AREA





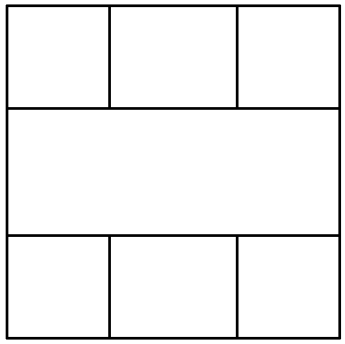
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

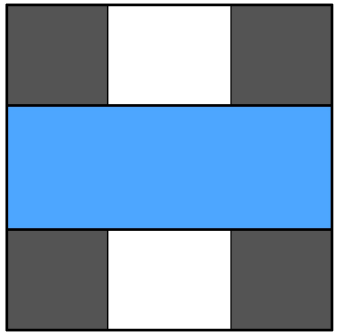
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

DINING AREA





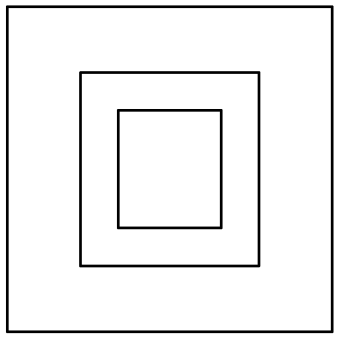
Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

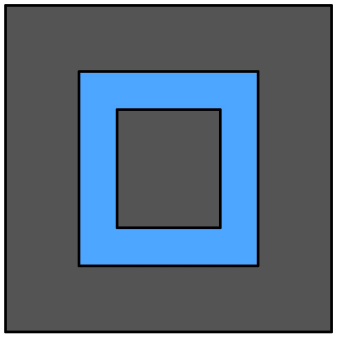
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

DINING AREA





Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

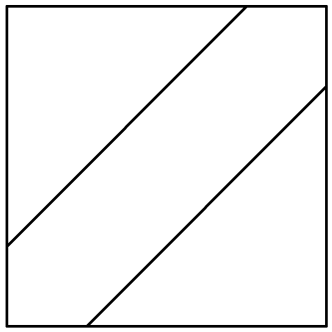
Type of Ceramic: Backsplash Tile (Kitchen)

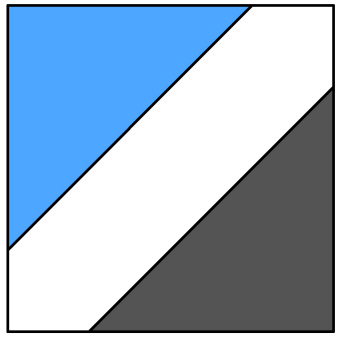
Dimension: 6" x 6"

Price: Rs. 300

DINING AREA

This product can provide various uses. It can be used as decorative frame, coaster, etc.



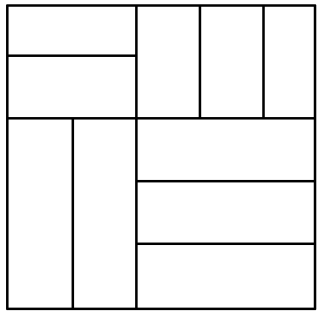


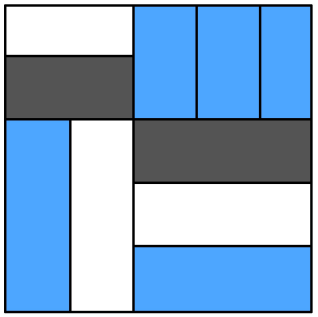
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300



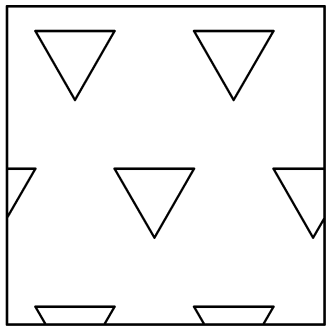


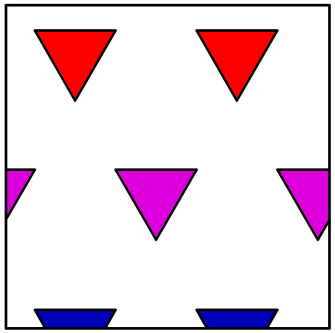
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300





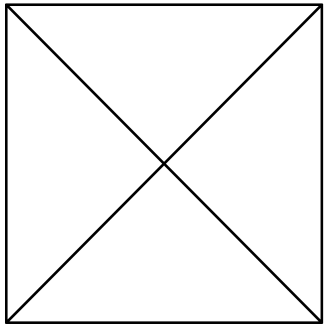
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

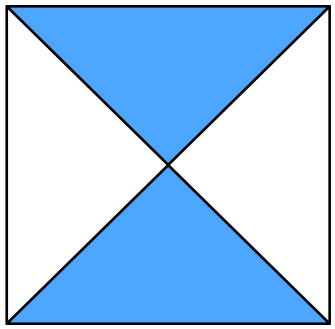
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

BEDROOM





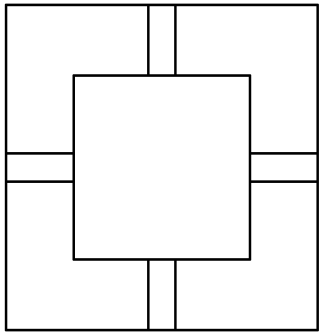
Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

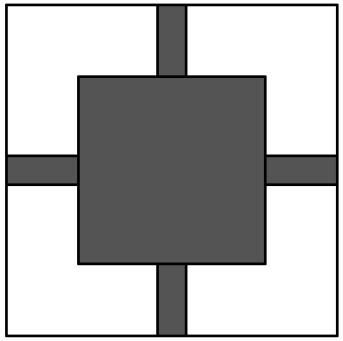
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

BEDROOM





Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

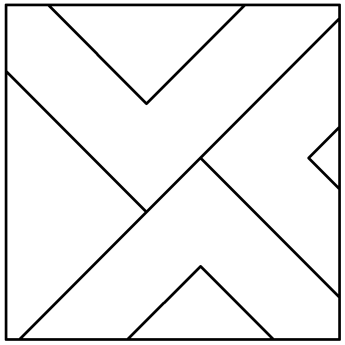
Price: Rs. 300

BEDROOM

BEDROOM

This product can provide various uses. It can be used as mirror frame, furniture decoration, wardrobe or cabinet shutters, etc.

BATHROOM



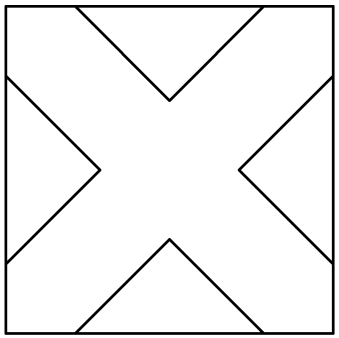
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

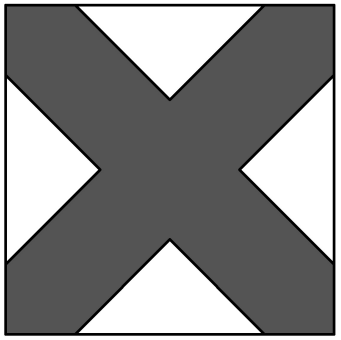
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

BATHROOM





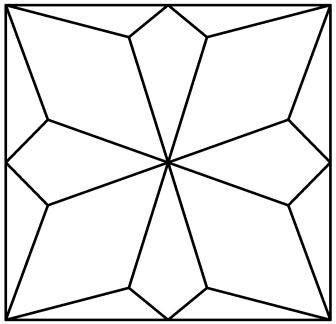
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

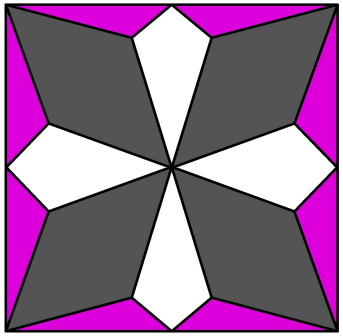
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

BATHROOM





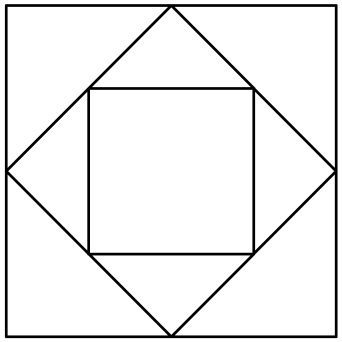
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

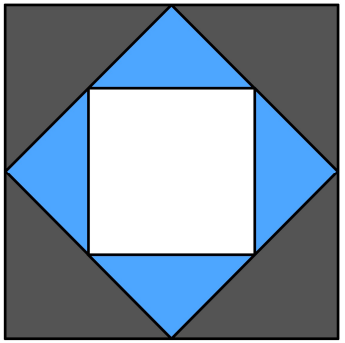
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

BATHROOM





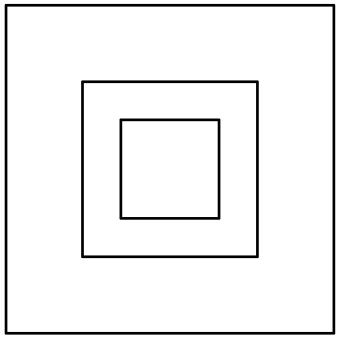
Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

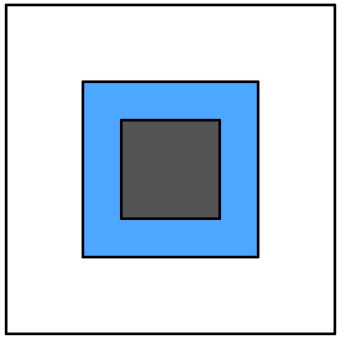
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

BATHROOM





Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

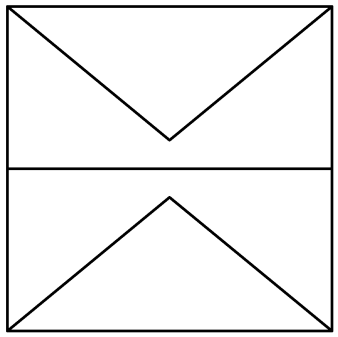
Type of Ceramic: Backsplash Tile (Kitchen)

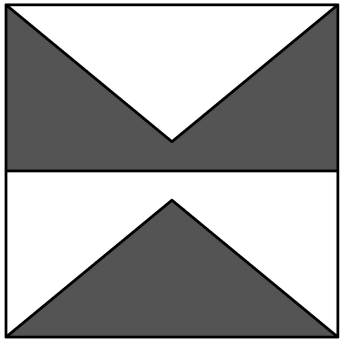
Dimension: 6" x 6"

Price: Rs. 300

BATHROOM

This product can provide various uses. It can be used as furniture decoration, mirror frame, cabinet frame, sink, etc.





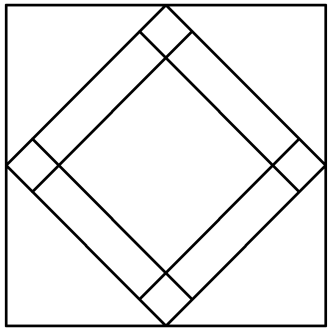
Product Description: Ceramic hand crafted tile with little waste tile pieces that are composed in an artistic arrangement and then finished with dyed white cement. A decoration idea for the home that will give an elegant and minimalist style to the place.

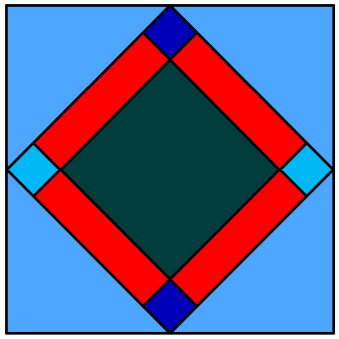
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

STAIRCASE AREA





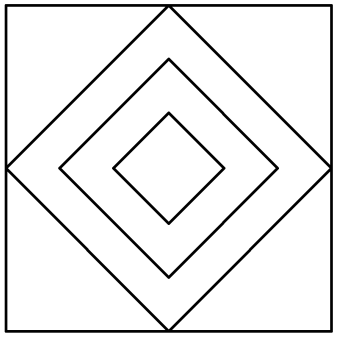
Product Description: This ceramic tile is hand crafted with little waste pieces, composed in an artistic manner and then finished with white cement. This will add to the aesthetical value of the space.

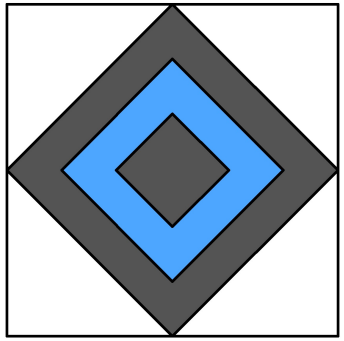
Type of Ceramic: China Mosaic (Terrace)

Dimension: 6" x 6"

Price: Rs. 250

STAIRCASE AREA



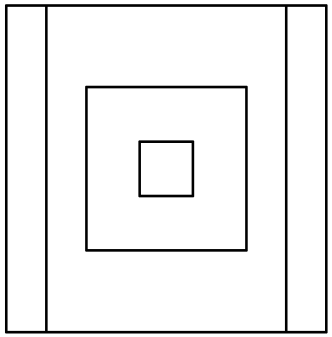


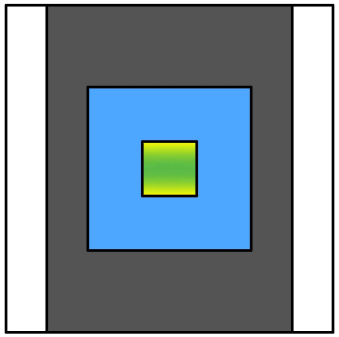
Product Description: Ceramic tile hand crafted with small terrazzo pieces that are arranged in a unique pattern and then finished with dyed white cement. It can be used as wall tile and also in combination with the other tiles to create a beautiful wall piece.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300





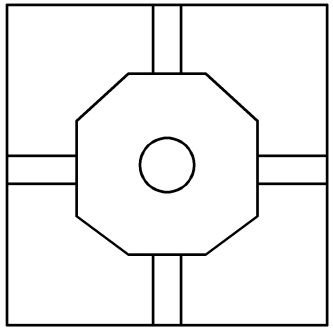
Product Description: Hand crafted ceramic tile arranged with terrazzo waste pieces and then finished with dyed white cement. The design of this product will enhance the beauty of the place where it is kept.

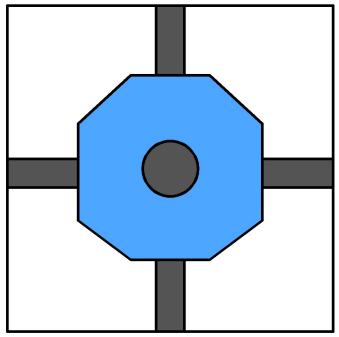
Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

STAIRCASE AREA





Product Description: The designer ceramic tile is handmade with thoughtfully arranged little waste tile pieces and then finished with dyed white cement that can be used on the wall. It is designed beautifully to give a simple and attractive look.

Type of Ceramic: Backsplash Tile (Kitchen)

Dimension: 6" x 6"

Price: Rs. 300

STAIRCASE AREA

This product can provide various uses. It can be used as the riser in steps, decorative piece on the wall, etc.

STAIRCASE AREA

SUMMARY, CONCLUSION AND RECOMMENDATIONS

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary

The ceramic resource is one of the few natural resources that can be renewed. In spite of our best efforts to minimize, reuse, and recycle, we live in a world that is surrounded by waste. Different types of ceramic waste are created as a result of urbanization from various sources, including waste from factories and ceramic waste from previously manufactured products. Ceramic waste has a lot of potential for being recycled into a variety of materials and products. In the manufacturing and end-of-life of ceramic products, large amounts of ceramic waste are generated.

Ceramic offers a variety of benefits in relation to concepts, such as the bio-economy and circular economy. It is a material with natural and renewable origins, biodegradable, and has a wide range of mechanical and thermal properties. Compared to equivalent materials produced from inorganic or fossil raw materials, ceramic is normally less environmentally harmful during the production and end-of-life phases.

Reusing and repurposing precious waste materials can lead to the creation of amazing and useful items. Instead of dumping these waste items in landfills, a variety of unique and creative ideas might be combined to create something new and beneficial. The concept of ceramic waste management has grown in importance during the last decade. Sustainability is still the most important concern in the ceramic processing and manufacturing industry. These industries are figuring out how to better manage their trash to improve long-term social, economic, and environmental sustainability. Vast amounts of ceramic waste are generated each year as a result of the manufacturing process, and typically reusing technologies are incapable of removing all the waste materials. As a result, a creative and less expensive solution to the ceramic waste problem is required.

Today, there are various types of ceramic resources that can be recyclable and reusable in the field of construction and demolition. Using ceramic waste to

reuse these resources should be a reasonable approach. As drainage materials and rock base for driveways and paths, ceramic waste from construction sites and ceramic shops can be reused and redesigned to decorate households, restaurants, theme bars, and commercial places. It can thus maximize the use of ceramic waste and reduce the shortage of ceramic resources at the same time. Reusing the ceramic waste can also help in healing the environment by reducing the damage that is already done. It can also be of great use to hike up the economy of the ceramic industry.

Objectives of the study

1. The study aimed to develop designer tiles from ceramic waste for interior decoration.
2. To assess the opinions of the homemakers, interior designers and the students of interior design specialization, regarding the selected aesthetic aspects and functional aspects of the developed designer tiles from ceramic waste for interior decoration.
3. To prepare a cost estimate and catalogue for the developed designer tiles from ceramic waste for interior decoration.

Delimitations of the study

1. The present study was limited to only those homemakers, interior designers and students of interior design specialization who were involved in homemaking and interior designing activities.
2. The present study was limited to those homemakers, interior designers and students of interior design specialization who gave consent to participate in the study.
3. The study was limited to those ceramic shops and residential working sites that gave ceramic waste at minimal cost or free of cost.
4. The development of designer tiles from ceramic waste was limited to selected areas of house namely:

    A. Living Room

    - Wall

    B. Kitchen

    - Wall

C. Dining Area

- Wall

D. Bedroom

- Wall

E. Bathroom

- Wall

F. Staircase Area

- Wall
- A Step Raiser

Note - The development of the products was subjective to the availability of the ceramic waste and financial considerations.

Methodology

The present study was undertaken to assess the opinion of the homemakers, interior designers and the students of interior design specialization regarding the developed designer tiles from ceramic waste for interior decoration.

Purposive sampling technique was used for the selection of the samples for the present study as only those respondents were purposively selected from Vadodara city that were involved in homemaking and interior designing activities and were willing to participate in the research study.

One of the prime objectives of the present study was to develop designer tiles from ceramic waste and to assess the opinion of the homemakers, interior designers and the students of interior design specialization regarding the developed designer ceramic waste tiles from Vadodara city. Hence, in order to achieve these objectives, the investigator collected data from the respondents through an interview schedule and then analysed the collected data. The interview schedule was divided into two sections, Section I dealt with the background information of the respondents, and Section II dealt with their opinion regarding the developed designer tiles from ceramic waste for interior decoration.

The ceramic waste was collected from ceramic shops and residential working sites that gave ceramic waste at minimal cost or free of cost. According to the

ceramic procured from the ceramic shops and residential working sites, drawings were developed using AutoCAD 2018 software. The prepared drawings were used by the researcher for the development of tiles. Cost estimation of the products was done based on material costs, labour charges and profit. A catalogue was prepared mentioning the product description, namely product name, type of ceramic used, size of the product, and price of the developed ceramic waste tiles.

For the establishment of the reliability and content validity of the prepared tool, the tool was given to a panel of judges containing experts from The Department of Family and Community Resource Management, and Interior Designers. Pre-testing of the tool was done with 30 respondents (10 homemakers, 10 interior designers and 10 students of interior design specialization).

The collected data was analysed by calculating the weighted mean, frequency, and percentage.

Major Findings of the Study

Section I: Background Information of the respondents

- It was found that 56.67 per cent of the respondents were in the age group of 18 to 29 years with the weighted mean of 32 years.
- Regarding Marital Status, it was found that 50 per cent of the respondents were married.
- The data revealed that 53.33 per cent of the respondents were qualified up to Graduation level.
- The data revealed that more than half (56.67 per cent) of the respondents were unemployed.
- The data revealed that the family monthly income of 66.67 per cent of the respondents was less than or equal to ₹1,00,000 with the mean income of ₹1,12,167.

Section II: Opinion of the homemakers, interior designers and the students of interior design specialization regarding the designed ceramic waste tiles

Opinion of the homemakers, interior designers and the students of interior design specialization was collected with the help of an interview schedule and based on the analysis of gathered data, it was found that

- 60 per cent of the respondents agreed that the design of the living room tiles created rhythm.
- 60 per cent of the respondents agreed that the finish of the living room tiles was appropriate for day to day cleaning.
- 60.34 per cent of the respondents agreed that the colour combination of the kitchen tiles was harmonious.
- 61.02 per cent of the respondents agreed that the price of the kitchen tiles was acceptable.
- 64.41 per cent of the respondents agreed that the dining area tiles added aesthetic value to the space.
- 62.07 per cent of the respondents agreed that the dining area tiles were durable for its use.
- 53.33 per cent of the respondents agreed that the size of the bedroom tiles was proportionate for its use.
- 62.71 per cent of the respondents agreed that the price of the bedroom tiles was acceptable.
- 61.67 per cent of the respondents agreed that the size of the bathroom tiles was proportionate for its use.
- 60 per cent of the respondents agreed that the price of the bathroom tiles was acceptable.
- 53.45 per cent of the respondents agreed that the design of the staircase area tiles created rhythm.
- 57.63 per cent of the respondents agreed that the price of the staircase area tiles was acceptable.

Therefore, based on the calculated weighted mean score, it was concluded that the staircase area ranked first, kitchen ranked second and the dining area ranked third.

Conclusion

From the data collected regarding the opinion of the respondents in regards to the existing parameters namely “size”, “quality”, “durability”, “proportion”, “convenience of use”, “colour combination” and “aesthetic value” for the developed designer tiles from ceramic waste for interior decoration, the findings of the study depicted that the staircase area ceramic waste tiles and the kitchen ceramic waste tiles were the most liked products by the respondents. The colour combination of the designs of the developed ceramic waste tiles was liked by the respondents.

Implication of the Study

For the Field of Family and Community Resource Management

As the field of Family and Community Resource Management has Interior Design as a specialization subject and a diploma course in Hotel Interiors, the information collected in the study, such as different uses of ceramic waste, developing designs of tiles to be developed from ceramic waste and cost estimation will provide to be first-hand information for practical applications. The study will benefit other academic institutes offering courses in Interior Design and Architecture.

For Architects and Interior Designers

The study will help Architects and Interior Designers to utilize the ceramic waste from construction and renovation sites and develop new products from it which could be used as décor or utility products for residential and commercial purposes.

For the Manufacturer and Retailer related to the tile and ceramic industry

The findings of the study would also be beneficial to the manufacturer, retailer of the tile, and ceramic industry, as the developed design can be used as an

example for reusing the maximum amount of ceramic waste to create utility and décor articles, other construction materials and tiles from ceramic waste.

Recommendations for future research

- A similar design project can be conducted on designing landscape articles from plastic waste, developing cutlery and pots from ceramic waste, and creating artifacts from wood waste.
- A similar designing research can be conducted on other groups of respondents like Architects, Interior Designers, Product Designers, Furniture Designers, and Manufacturers.
- A study can also be undertaken on different industries that use ceramic waste and manufacture new products.
- A similar study can be conducted on using other household or commercial waste like glass, plastic, wood, cardboard, etc. to turn them into usable ones.

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APPENDICES

APPENDIX I

ETHICAL COMPLIANCE CERTIFICATE

Institutional Ethics
Committee for Human
Research
(IECHR)

FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

Ethical Compliance Certificate 2022-2023

This is to certify that **Ms. Naitri Shah's** study titled, **Developing Designer Tiles from Ceramic Waste for Interior Decoration** has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/M.Sc./2022/08.**

Prof Shagufa Kapadia
Chairperson
IECHR

Prof Mini Sheth
Member Secretary
IECHR

APPENDIX II

DEVELOPING DESIGNER TILES FROM CERAMIC WASTE FOR INTERIOR DECORATION

DATA COLLECTION TOOL

(Interview Schedule)

SECTION - I

BACKGROUND INFORMATION

1. Name: _____

2. Age: _____

3. Marital Status: _____

4. Educational Qualification

- o Secondary
- o Higher Secondary
- o Graduation
- o Post - Graduation
- o Diploma
- o Certification
- o PhD.
- o Any other (please specify) : _____

5. Occupational status

- o Unemployed
- o Employed
- o Self - Employed
- o Retired

6. Family Monthly Income (INR) : _____

SECTION - II

Opinion scale of the homemakers, interior designers and the students of interior design specialization regarding the designed ceramic waste tiles

The following statements are developed to know the opinion of the homemakers, interior designers and the students of interior design specialization regarding the aesthetic aspects and functional aspects of selected developed designer tiles from ceramic waste. The statements will be analysed through a response structure “strongly disagree, disagree, undecided, agree and strongly agree”.

(Key: S.D - Strongly Disagree, D - Disagree, U - Undecided, A - Agree, S.A - Strongly Agree)

Sr. No.	Criteria for Ceramic Waste Tiles	S.D	D	U	A	S.A
A. LIVING ROOM WALL TILES						
Aesthetic Aspects						
1.	The design of the product creates rhythm.					
2.	The finish of the product is not satisfactory.					
3.	The colour combination is harmonious.					
4.	The product adds aesthetic value while serving the purpose.					
5.	The size of the product is disproportionate for its use.					
Functional Aspects						
6.	The product cannot be cleaned well with common cleaning agents.					
7.	The finish of the product is appropriate for day to day cleaning.					
8.	The product is not durable for its use.					
9.	The price of the product is acceptable.					
10.	The overall product is functional.					
11.	The overall quality of the product is satisfactory.					

Sr. No.	Criteria for Ceramic Waste Tiles	S.D	D	U	A	S.A
B. KITCHEN WALL TILES						
Aesthetic Aspects						
1.	The size of the product is proportionate for its use.					
2.	The colour combination is harmonious.					
3.	The product does not adequately serve the purpose for which it is designed.					
4.	The design of the product does not reflect unity.					
5.	The product adds aesthetic value while serving the purpose.					
Functional Aspects						
6.	The product is not easy to clean with a damp cloth.					
7.	The product cannot be cleaned well with common cleaning agents.					
8.	The finish of the product is appropriate for day to day cleaning.					
9.	The product is durable for its use.					
10.	The price of the product is acceptable.					
11.	The overall product is functional.					
12.	The overall quality of the product is satisfactory.					
C. DINING AREA WALL TILES						
Aesthetic Aspects						
1.	The product is not solving the purpose for which it is designed.					
2.	The product adds aesthetic value to the space.					
3.	The finish of the product is not satisfactory.					
4.	The design of the product creates rhythm.					

Sr. No.	Criteria for Ceramic Waste Tiles	S.D	D	U	A	S.A
5.	The design of the product is inappropriate for its use.					
6.	The colour combination is not harmonious.					
Functional Aspects						
7.	The product is easy to clean with a damp cloth.					
8.	The finish of the product is inappropriate for day to day cleaning.					
9.	The product is durable for its use.					
10.	The price of the product is acceptable.					
11.	The overall product is functional.					
12.	The overall quality of the product is satisfactory.					
D. BEDROOM WALL TILES						
Aesthetic Aspects						
1.	The finish of the product is not suitable for its use.					
2.	The product does not add aesthetic value while serving the purpose.					
3.	The design of the product reflects unity.					
4.	The size of the product is proportionate for its use.					
5.	The colour combination is not harmonious.					
Functional Aspects						
6.	The product is not easy to clean with a damp cloth.					
7.	The product cannot be cleaned well with common cleaning agents.					
8.	The finish of the product is appropriate for day to day cleaning.					
9.	The product is durable for its use.					
10.	The price of the product is acceptable.					

Sr. No.	Criteria for Ceramic Waste Tiles	S.D	D	U	A	S.A
11.	The overall product is functional.					
12.	The overall quality of the product is satisfactory.					
E. BATHROOM WALL TILES						
Aesthetic Aspects						
1.	The product does not adequately serve the purpose for which it is designed.					
2.	The finish of the product is satisfactory.					
3.	The design of the product does not reflect unity.					
4.	The colour combination is not harmonious.					
5.	The size of the product is proportionate for its use.					
Functional Aspects						
6.	The product can be cleaned well with common cleaning agents.					
7.	The finish of the product is inappropriate for day to day cleaning.					
8.	The product is not durable for its use.					
9.	The price of the product is acceptable.					
10.	The overall product is functional.					
11.	The overall quality of the product is satisfactory.					
F. STAIRCASE AREA TILES						
Aesthetic Aspects						
1.	The design of the product is inappropriate for its use.					
2.	The product adds aesthetic value while serving the purpose.					
3.	The design of the product creates rhythm.					
4.	The finish of the product is not satisfactory.					

Sr. No.	Criteria for Ceramic Waste Tiles	S.D	D	U	A	S.A
5.	The product is not solving the purpose for which it is designed.					
Functional Aspects						
6.	The product can be cleaned well with common cleaning agents.					
7.	The finish of the product is appropriate for day to day cleaning.					
8.	The product is not durable for its use.					
9.	The price of the product is acceptable.					
10.	The overall product is functional.					
11.	The overall quality of the product is satisfactory.					

APPENDIX III

Estd. 1949

NAAC Accredited "A" Grade

DEPARTMENT OF FAMILY AND COMMUNITY RESOURCE MANAGEMENT

FACULTY OF FAMILY & COMMUNITY SCIENCES

THE MAHARAJ SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

CONSENT LETTER FOR RESPONDENTS

Date: 9th February, 2023

Dear Respondent,

I am Naitri Shah, Sr. M.Sc. student of Department of Family and Community Resource Management at The Maharaja Sayajirao University of Baroda, Gujarat. For the partial fulfilment of my master's degree, I am conducting research on "Developing Designer Tiles from Ceramic Waste for Interior Decoration". The purpose of the study is to "design and develop ceramic waste tiles and to assess the extent of user's satisfaction".

The objective of the study is:

- The study aims to develop designer tiles from ceramic waste for interior decoration.
- To assess the opinions of the homemakers, interior designers and the students of interior design specialization, regarding the selected aesthetic aspects and functional aspects of the developed designer tiles from ceramic waste for interior decoration.
- To prepare a cost estimate and catalogue for the developed designer tiles from ceramic waste for interior decoration.

I am highly interested to know your satisfaction regarding the designed and developed ceramic waste tiles. If you are agreeing to participate in this research study, you will be asked to complete an interview schedule.

Prior to that, I want to stress that your participation in this study is completely voluntary and all efforts to protect your identity and keep the information confidential will be taken. Only the researcher has access to the responses. Your personal identifying information will only be used to contact you and your name will not be associated with any research findings. If for any reason during this study you do not feel comfortable, you may leave the study.

If you have any further questions concerning this study, please feel free to contact me through:

Phone no.: 7046746700 Email ID: naitri16aaa@gmail.com

To participate, please put (✓) tick mark on "I Agree" to complete the interview schedule for the study.

Your participation will be greatly appreciated.

- o I AGREE
- o I DISAGREE

Name & Signature of the respondent:

Research Guide:
Dr. Urvashi Mishra
M: 9825610363
FCRM Department

Research Student:
Naitri Shah
M.Sc. (F.C.Sc.) FCRM Department
FFCSc, MSU

ABSTRACT

ABSTRACT

Ceramic has been utilized by humans since ancient times. Ceramic is a versatile material. Hence, ceramic waste varies widely. Ceramic waste is a precious resource that is abundantly available and can be used either for material replacement or energy production, depending on the quality grade. Ceramic waste is becoming a partial substitute for cement, concrete, and aggregate on an increasingly large scale. The proper utilisation of ceramic waste through reuse will reduce environmental pollution, create wealth and employment, and thereby, fostering the economic development of the country. A significant portion of the ancient world made use of ceramic because of its outstanding qualities and the ability to make a variety of products that satisfy a variety of human needs. In parallel with an increase in ceramic consumption, the ceramic waste produced from end-of-life ceramic-based products also increases. Ceramic waste may be turned into new and functional goods by using it. Many reused products and other environmentally friendly products are produced by using ceramic waste. Using ceramic waste may assist in diverting waste from landfill and decreasing emissions and toxic outputs used in the production process.

With the concept of using ceramic waste, designer tiles were developed for interior decoration. To assess the developed ceramic waste tiles, 20 homemakers, 20 interior designers and 20 students of interior design specialization from Vadodara city who were involved in homemaking and interior designing activities and gave consent to participate in the study were purposively selected as the sample. The first objective of the study was to develop designer tiles from ceramic waste for interior decoration. The second was to assess the opinions of the homemakers, interior designers and the students of interior design specialization regarding the selected aesthetic aspects and functional aspects of developed designer tiles from ceramic waste for interior decoration. The third objective was to prepare a cost estimate and catalogue for the developed designer tiles from ceramic waste for interior decoration. The research design adopted for the study was descriptive in nature. The ceramic waste tiles were developed and the display of all the developed products was done in The Department of Family and Community

Resource Management. The researcher collected feedback from the respondents to assess their opinion regarding the aesthetic aspects and functional aspects of the developed ceramic waste tiles. The data was analysed by applying descriptive statistics, i.e., frequency, percentage, and weighted mean.

The major findings of the study revealed that 56.67 per cent of the respondents were in the age group of 18 to 29 years. 50 per cent of the respondents were married. Regarding the educational qualification, 53.33 per cent of the respondents were qualified up to Graduation level. More than half, i.e., 56.67 per cent of the respondents were unemployed. The family monthly income of 66.67 per cent of the respondents was less than or equal to ₹1,00,000. The developed ceramic waste tiles most liked by the respondents in terms of size, quality, convenience of use, colour combination, and aesthetic value were the staircase area tiles with the weighted mean of 3.97, kitchen tiles with the weighted mean of 3.95 and the living room tiles with the weighted mean of 3.58. Therefore, the top three products amongst all the developed ceramic waste tiles were staircase area ceramic waste tiles, kitchen ceramic waste tiles, and dining area ceramic waste tiles.