

**AN EXPLORATION INTO BARRIERS TO USE OF WASTE GLASS IN
INTERIOR SPACES IN NAIROBI**

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DECLARATION

This Thesis is my original work and has not been presented to any other examination body.

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DEDICATION

To a generous stranger who asked little and gave a great deal making possible a young man's career and dream.

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The errors, idiosyncrasies, idiocies, and inconsistencies remain my own.

ABSTRACT

Interior Design has been hitherto associated with attractive expensive décor materials, finishes and products. But the scope of design reaches far beyond this association. Interior Designers are trained to solve interior space problems with focus on user needs in addition to social, environmental and sustainability considerations. This study focuses on sustainable design as one of interior design approaches that exhibits increased awareness of the environmental, raw materials and production systems with the view to preserve the world for future generations. Waste glass was selected for investigation because it is one of wastes that offer greater opportunities in solving interior space design problems.

A qualitative research approach was employed for this study. Data collection techniques included non-participant observation, informal and formal interviews and semi structured interview guides. Data analysis was undertaken using descriptive methods including narrative. Tables, pie charts and photographs were presented to support some of the issues that are unearthed. The research findings show that although there are vast opportunities for use of waste glass in interior spaces such as interior finish material; there exist various barriers that hinder exploitation of those opportunities such as cost of implementation and lack of enough time to source for and use waste glass in interior spaces. In the context of this research therefore, it is established that local interior space designs are not exploiting opportunities for use of recycled waste such as glass in solving interior design problems.

This thesis is divided into six chapters. Chapter one covers the background to the study, research objectives and questions, the significance of study and the scope. Chapter two critically reviewed existing literature in line with the objectives of the study. The methodology applied in the study is discussed in chapter three. Data analysis and presentation is provided in chapter four. Chapter five synthesized and interpreted the findings of the data analyzed. Finally chapter six summarized the findings, the conclusions and gives recommendations arising from the study.

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CHAPTER ONE:

1.0 INTRODUCTION

1.1 Background of the Study

Environmental sustainability is becoming a major concern within the interior design field lately. This is due to the extensive resources needed for interior use (Ruff & Olson, 2009). Much of sustainable interior design focuses on the materials used in creating an indoor space. Recycled waste materials could form an important part of sustainable interior design. Used glass, plastic, paper, and fabric can now be turned into nearly any interior product, from tablecloths and doormats to desks and insulation (ETCSCP, 2009).

Wastes are materials that are not prime products for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Waste falls into one of two categories: either biodegradable or non-biodegradable (Glossary of Statistical Terms, 2003).

Biodegradable waste comprises of streams which originate from plants, animals and other living organisms that can break down into natural components and be recycled into the life cycle naturally. It can be commonly found in municipal solid waste and includes but is not limited to green waste, food waste, paper waste, biodegradable plastics / phyto plastics (special plastics that break down when exposed to the sun after some time), human waste, manure, sewage, and slaughterhouse waste. Non biodegradable waste is waste that does not break down into natural components and exists in the environment for a long time. Examples are tyres, plastics, electronic components, metals, among others. Non-biodegradable waste can be further segregated into: Toxic waste – old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish; Soiled – hospital waste such

as cloth soiled with blood and other body fluids; and Recyclable waste – plastics, paper, glass, metals, and so on (Environment Protection Agency, 2012).

It is estimated that the total amount of municipal solid waste generated worldwide reached 1.84 billion tons in 2004, a 7 per cent increase on the 2003 total (Global Waste Management Market Report 2004). It is further estimated that, between 2004 and 2008, worldwide generation of municipal waste rose by 31.1 per cent, representing an annual rate of increase of some 7 per cent. Data from the City Council of Nairobi indicate that the average tonnage of solid waste generated in Nairobi is estimated at 1850 ton/day (JICA et al, 2010). The integrated solid waste management survey for Nairobi city report by JICA et al (2010) states that solid waste recovery and recycling is carried out by many of Nairobi's poor who engage in waste picking as a means of income generation. The estimated quantity of recovered and recycled items ranges from 20 to 30 tons per day.

Waste glass recycling in Nairobi is dominated by Central Glass Industries (CGI), a subsidiary of Kenya Breweries Ltd (KBL). CGI uses about 720 tons of clear glass and 1260 tons of green/amber glass per month (about 66 tonnes glass /day) (Karanja, 2005). Karanja (2005) opines that recycling of especially broken glass is on the decline as the reprocessing of broken glass was found to be too costly and unprofitable due to high maintenance costs of the imported precision equipment. Power constraints (shortages resulting in rationing), economic conditions and increasing competition from lighter and more durable aluminum cans, plastics and Tetra-pack containers from the early 2000's were also attributed as likely contributing factors. With an estimate 2% waste glass composition in Nairobi's current waste stream, equal to about 62 tons/day of glass, it would seem that CGI's capacity was once sufficient to reuse a substantial amount of the waste glass available but has since declined due to high costs of broken glass recycling.

According to the USA Environment Protection Agency (2013), glass, especially glass food and beverage containers, can be recycled over and over again. In fact, 90 percent of recycled glass is used to make new containers. Recycled glass can also be used in kitchen tiles, counter tops, and wall insulation. Glass recycling has grown considerably in recent years through increased collection through curbside recycling

programs and glass manufacturers' increased demand for recycled glass. Americans generated 11.5 million tons of glass in the municipal solid waste (MSW) stream in 2011. About 28 percent of the glass was recovered for recycling in form of design products such as furniture, counter tops and tiles. Glass recycling increased from 750,000 tons in 1980 to more than three million tons in 2011. In the United Kingdom, 752,000 tons of glass are now recycled annually (Big British bottle bank birthday | UK | Reuters, 2013). Locally, there are no specific figures on the rates of use of recycled glass in interior spaces.

Globally, interior designers have exploited glass as a popular interior design material for a variety of uses in both contemporary and traditional looks. The use of glass as a decorative interior design material gained popularity in America during the Art Nouveau movement in the late 1800s, with the help of artists like Louis Comfort Tiffany, son of the founder of Tiffany & Co. Tiffany was famous for his stained glass lamp and window designs, glass mosaics, and blown glass interior art. Over time, modern manufacturing practices have allowed endless possibilities for glass use in interior design. Today, waste glass is used in tile, sinks, panels and cabinets, countertops and tabletops, light fixtures, hardware, mirrors, and in a variety of decorative items and applications (Center for Sustainable Building Research, 2002). Glass tile is a popular way to incorporate accent colors, interesting shapes, and clean patterns into a kitchen or bathroom. Glass tiles and mosaics look great used alone or incorporated into a natural stone design. Sleek solid glass countertops or unique crushed recycled glass countertops add an eye-catching element to modern interiors. Cabinetry with glass panels and glass vessel sinks are both beautiful and trendy (Celeste, 2010).

Some international manufacturers are now transforming materials taken from refuse and scrap into exciting new building materials like recycled glass surfaces. The up-cycling of glass waste from bottles, jars, architectural glass, traffic signals and beverage containers is just one way to celebrate and display sustainable initiatives by design. As Partner and Interior Director of Interior Design for sander architects, LLC of Venice California, Catherine Holliss (2013) states that *“We love to work with recycled glass counter materials because they are not only green, they are gorgeous*

and practical. It also doesn't hurt that for our clients, that the pricing is comparable to other options and they will have an interesting story to tell their friends."

Glass counters, wall surfaces and fireplace surrounds made from recycled glass shards embedded in a cementitious surface tell a story about materials and sustainability while creating a durable indoor and outdoor surface. Locally, Kitengela Hot Glass is best known for transformation of recycled waste glass into unique interior design objects. Hundreds of different objects from furniture and floors to sculptures and shelves are designed and made here by a skilled team of artisans, from individual glass artworks to entire collections custom designed for restaurants, hotels, lodges, camps and other corporate clients throughout Africa.

"Repurposing factory-made glass is quite tricky because it's not designed for hand work; it's originally made for a machine. And then there's the colouring factor. If you're working with various sources of glasses, you need strong colouring agents which we achieve by running different colours through our furnaces to produce unique results." (A. Croze, personal communication, November, 2012).

While numerous opportunities abound for use of recycled glass in interior spaces, there is a dearth of literature on exploitation of these opportunities within the local context; the study sought to engage the debate on these opportunities in Kenya and in particular investigate on barriers that interior designers encounter in using recycled waste glass.

1.2 Profiles of the Case Studies

1.2.1 Kitengela Hot Glass

Bordering the Nairobi National Park, on the cusp of a ridge called Kiserian ("The Blessed" in Maa, the Maasai language), Kitengela Hot Glass was started and is owned by Anselm Croze. In 1991, he trained in Holland with glass masters Willem and Bernard Heesen. Called a "*dream merchant*" for his creations, Anselm now employs 35 people full time. From the city centre, a visitor can take Uhuru Highway and turn right onto Langata Road at Nyayo Stadium and drive till Bomas of Kenya and turn left onto Magadi Road. Just before getting to Ongata Rongai, one will have to turn left

onto the road leading to Africa Nazarene University, and follow the Kitengela Glass signs. The tarmac road surface ends at the University, where the road turns into a rough bumpy ride all the way to Kitengela Glass. Anselm Croze was born in Cumbria in Northern England to an American zoologist father, Harvey Croze , and a stained-glass artist mother, Nani Croze. He came to Kenya with his parents and underwent home-schooling in a tent in Tanzania; later, Anselm went to study in France and Holland with master glass blowers. On the heels of these apprenticeships, he returned to East Africa in the early '90s. Anselm then decided to further explore his calling in glass blowing.

1.2.2 Tonney Mugo of Kuona Trust

Kuona Trust is a not-for-profit organisation founded in 1995 at the National Museum of Kenya to serve visual artists and has since worked with over one thousand five hundred artists giving them skills and opportunities to advance themselves while increasing the profile and role of the visual arts in Kenya. Kuona later moved to the GoDOWN Art Centre and in late 2008, Kuona Trust moved from the GoDown to a new premises of about 2 ½ acres of land located off Dennis Pritt Road in the Kilimani area of Nairobi, where we are currently based. The Kuona Trust is a centre for visual arts in Kenya. It offers a contemporary art space for Kenyan artists. With exhibitions, artists' studios, outreach programs, events, international exchange etc. The Centre is a collection of about 20 studios where visual artists and sculptors are able to work in a creative environment. The centre offers a library of good quality Art books to inspire and motivate the artists. The Kuona Trust is open to the public and it's a great chance to buy directly from the artists.

One of the resident artists is Tonney Mugo who designs and fabricates his work to architectural specifications incorporating techniques which in addition to traditional lead work include – sandblast carving and etching, wheel and flexible drive engraving, glass painting and fusing, laminating and mosaic. He designs on glass seeks to reflect and enhance the architectural setting while expressing a meaning for aesthetic that goes beyond mere decoration. They provoke thought inspire interest and challenges tradition. Having worked with glass since 1991 Tonney seeks to make a meaningful contribution to society while adding value, drawing from his experience, education, training background and the working environment at large.

1.2.3 Max Wathiani of Maxicrafts Wrought Iron Designs

Maxicrafts is another established company based at Gikuyu Close, Racecourse Nairobi Kenya which undertakes any aspect of stained glass fabrications for customers throughout East Africa. At Maxicrafts, the workforce measures and provides on-site expert custom designs, fabrication and fitting of ornamental works for both residential and commercial interior design premises for stained waste glass finishes. The firm is owned and operated by Max Wathiani who learnt waste glass design by default.

1.3 Problem statement

Although most interior designers are familiar with the use of recycled products in interior design, rarely is there a discussion of the vast opportunities and benefits that can be achieved from use of recycled materials in interior spaces such as waste glass. It is evident that globally, recycled waste glass has been enormously exploited as an interior design element in terms of décor and finishes (Celeste, 2010). Locally, interior designers always pay attention to color schemes, materials and finishes, furniture and furnishings but have not fully exploited the vast opportunities arising from use of waste glass in interior design. Local interior designers may encounter barriers when using recycled waste glass in interior spaces and therefore the double benefit of solving interior design problems while saving the environment is hardly realized.

1.4 Objectives of the study

- i. To establish opportunities for use of recycled waste glass in interior spaces,
- ii. To investigate barriers to use of recycled waste glass in interior spaces.
- iii. To propose appropriate methods to integrate recycled waste glass into interior spaces.

1.5 Research Questions

- i. What opportunities are available for use of recycled glass in interior spaces locally?
- ii. What barriers may local interior designers encounter when using recycled waste glass in interior spaces?
- iii. How could waste glass be integrated into design of interior spaces?

1.6 Scope of the Study

The research confined itself to the interior design profession. It sought to establish whether there are opportunities for use of recycled glass in interior spaces in Kenya. It also delved into barriers interior designers are likely to encounter when using recycled waste glass in interior spaces. The study referred mainly to concepts of interior design that aims at enhancing eco-performance in interior spaces through use of recycled waste glass. The problem was approached from the interior design standpoint with recycled waste glass being used only as a tool to solve interior space design problems. The research was based and limited to Nairobi and its environs in Kenya with three case studies being referred.

1.7 Justification of the study

Considering that interior designers globally are focusing on environmentally responsible interior space designs, the justification of this study cannot be over emphasized. It is of increasing importance for interior designers and interior space users to gain a comprehensive understanding of eco friendly interior finishes and products. Having such knowledge will enable them to have a more powerful repository of evidence-based design solutions. The study of concepts of interior design that aims at enhancing eco-performance from the interior design standpoint will be a learning paradigm in the University of Nairobi especially at the design level. For the students, the study will serve as their reference or guide in enhancing their knowledge and design skills as well on materials that contribute to eco friendly interiors. This study will be a significant endeavor in promoting good management of wastes with an aim of preserving the environment through removal of waste glass from the landfills and other spaces where wastes are discarded haphazardly.

1.8 Limitations

Having a lean budget and limited time restricted the research to few case studies in the interior design sector on opportunities for use of waste glass and barriers to use of waste glass as the nature of the research required in-depth information. Information on research methods for design related studies such as the one undertaken here was also not readily available. It was therefore necessary to rely on methods generally recommended for this kind of research.

1.9 Definition of Terms

For the purpose of this research, the following definition of terms were adopted and used in the context defined thereof;

Exploration: The act of searching for the purpose of discovery of information or resources. (<http://dictionary.reference.com>, 2012)

Interior Design: Describes a group of various yet related projects that involve turning an interior space into an effective setting for the range of human activities that are to take place there. (Pile, J, 2003, Interior Design, 3rd edn, Pearson, New Jersey, USA)

Opportunity: Exploitable set of favorable or advantageous circumstances. (<http://designjournalsos.blogspot.com>, 2012)

Recycling: A series of activities including collection, separation and processing by which products or materials are recovered from the solid waste stream for use in the form of raw materials in the manufacture of new products (National Council for Interior Design Qualification, Inc., 2004)

Up-cycling: A process in which disposable or discarded items are repurposed to make them valuable, useful, or simply aesthetically pleasing. Up-cycling is designed to work in opposition to consumer culture, encouraging people to think of new and innovative ways to use things, instead of simply buying new consumer goods. It also benefits the environment, by promoting reuse over discarding whenever possible. (Environmental Protection Agency, 2009, Wastes - Resource Conservation - Reduce, Reuse, Recycle)

Waste Glass: Wastes Glass are materials that are not prime products for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. (The United Nations Statistics Division: Glossary of Statistical Terms, 2003)

CHAPTER TWO

2.0 LITERATURE REVIEW

Interior design is not always about expensive branded items. At times, it is about human ingenuity which surprises us occasionally by finding use in what appears useless. - Anonymous

2.1 Introduction

The current environmental movement is currently influencing and altering the world of interior design. As people become more environmentally sensitive, they are choosing new materials for their interiors (Center for Sustainable Building Research, 2002). Designers are now paying more attention to green and sustainable interior design which involves the use of certain materials and building practices to reduce environmental damage such as use of low-pollution, recycled, or sustainable materials (Van Der Ryn and Cowan, 1995). This chapter aims to review literature regarding design with bias towards interior design, glass in interior design and barriers to sustainable interior design with an aim of laying ground work towards establishing barriers interior designers are likely to encounter when using recycled waste glass in interior spaces.

2.2 Design

The definitions of design are many, differ widely and the understanding of the word design has evolved through the years. During the renaissance the artists in Italy used the word *designo* in its narrowest sense to refer to the drawings used as guidelines for painting. In its wider meaning the word *designo* was used to imply the creative idea in the mind of the artist. Thus Baldinucci defines it as '*a visible demonstration by means of lines of those things which man has first conceived in his mind and pictured in the imagination, and which the practiced hand can make appear*'(Osborne 1970).

Supporting this is the standard dictionary definition of the word design which explains design as a mental plan, a scheme of attack end in view, adaptation of means to ends (Oxford 2005). Bryan Lawson (2006), from a preliminary analysis of design, notes that design is both a noun and a verb and can either refer to the end product or to the process.

Victor Papanek (1972) defines design as the planning and patterning of any act towards a desired, foreseeable end. The important part is the translation of the idea, though design's ability to spark the idea in the first place shouldn't be overlooked. Design has also been described as a method of solving problems. Adrian Forty (1986) describes design as a problem solving activity that involves a trial-and – error process for making meaningful order. The problem solving is multidisciplinary and takes the user needs, aspirations and abilities and its starting point and focus (EU, 2009). This problem solving involves research, information queries, and feasibility studies up to the obtaining of prototypes ready for production. Design as a method of solving problems may be used in all disciplines; in sciences and mathematics, in the arts and music, in commerce and marketing, in communication and information technology and even in simply day to day life (Seymour, 2002). Design, as a basic methodology solves problems in products, services and systems.

What is common in all these definitions is that design entails the conception of ideas intended as a plan for producing a thing. Design can further be seen as an activity aimed at establishing the multi-faceted qualities of objects, processes and their systems in whole life cycles. Design therefore takes into account issues such as global sustainability and environmental protection. On the whole, design is an activity that involves a wide spectrum of professions such as products, interiors, graphics, services and architecture (www.icsid.org 2006).

Of particular interest to this study, is the definition of interior design. Interior design is a multi-faceted profession in which creative and technical solutions are applied within a structure to achieve a built interior environment. These solutions are functional, enhance the quality of life and culture of the occupants and are aesthetically attractive. Designs are created in response to and coordinated with the building shell and acknowledge the physical location and social context of the project. Designs must adhere to code and regulatory requirements, and encourage the principles of environmental sustainability. The interior design process follows a systematic and coordinated methodology, including research, analysis and integration of knowledge into the creative process, whereby the needs and resources of the client are satisfied to produce an interior space that fulfills the project goals (National Council for Interior Design Qualification, 2004).

The profession of interior design is not clearly defined and projects undertaken by an interior designer vary widely. Interior design implies that there is more of an emphasis on planning, functional design and effective use of space involved in this profession. An interior designer can undertake projects that include arranging the basic layout of spaces within a building as well as projects that require an understanding of technical issues such as acoustics, lighting, and temperature (Lees-Maffei, 2008). An interior designer may wish to specialize in a particular type of interior design in order to develop technical knowledge specific to that area. Types of interior design include residential design, commercial design, universal design, exhibition design, spatial branding, and so on.

Interior design includes a scope of services performed by a professional design practitioner, qualified by means of education, experience and examination, to protect and enhance the health, life safety and welfare of the public. These services include selection of materials and finishes to appropriately convey the design concept and to meet socio-psychological, functional, maintenance, lifecycle performance, environmental, and safety requirements (National Council for Interior Design Qualification, 2004). From definitions discussed in this section, interior design is seen as a process of solving problems and a multidisciplinary activity. This study adopts the view that interior design can be viewed from the point of reference of selection of materials that solve interior spaces problems by encouraging environmental sustainability through use of recycled waste materials in interior spaces such as waste glass.

2.3 Sustainable Design

For thousands of years people have been creating structures that, out of necessity, have been specific to a given region and its climate. They were by nature "sustainable" within their local landscapes. Design strategies had to work with climate conditions as well as within the limitations of local materials. In the past century, advances in technology have enabled a shift from this model, allowing nature to be simply overpowered. As widespread concern is raised over the limitations of natural resources, as well as the planet's finite ability to absorb pollutants, the role of technology is being reconsidered. Technology is increasingly being employed to augment natural processes rather than out-do them, and materials are utilized with

more efficiency and more in harmony with the earth's ecology. So what does it mean to design according to "sustainable" principles? One commonly accepted definition was developed in 1987 by the World Commission on Environment and Development, which described sustainable development as that *"Which meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Brown and DeKay, 2001).

The first generation of sustainable design was based on small-scale experiments (Van Der Ryn & Cowan, 1995). Energy efficiency, alternative building materials, conservation, and recycling have been widely adopted in piecemeal fashion. The second generation of sustainable design began to realize that the integration of all the factors can produce the best results for sustainable design. This includes the synthesis of all the various ideas and strategies of past into complete and large-scale sustainable design theories and practices. The term sustainable design for the built environment is used interchangeably with green design. However, there is a subtle difference. The Green Design Education Initiative (2003) states that green design often implies an interest in design that protects people's health and well-being while sustainable design also protects the global environment and the world's ecosystems for future generations. These two terms, often used interchangeably, reflect the concept of creating buildings that can be constructed and operated in ways that enhance the impact of the buildings on the environment and occupants. The U.S. Green Building Council (2003) defines *"green design"* as design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas: site, water, energy, materials and resources, and indoor environmental quality.

Sustainable design evolved from a variety of concerns, experiences, and needs: energy efficiency gained importance during the 1970s oil crisis; recycling efforts in the U.S. during the 1970s became commonplace and came to the attention of the building industry; in the 1980s, the *"sick building syndrome"* concept emerged and concern for worker health and productivity became an issue. The concern for toxic material emissions also became an issue that needed to be addressed; and projects in water-scarce areas began to focus on water conservation (U.S. Green Building Council, 2003). Typical buildings consume more resources than necessary, negatively

impact the environment, and generate a large amount of waste. The challenge is to build intelligently, so that buildings use a minimum of nonrenewable energy, produce a minimum of pollution and wastes, and cost a minimum of energy money, while increasing the health, safety, and welfare of the people who live and work in them. These are the components of sustainable design.

2.3.1 Interior Design and Sustainability

“Regardless of how efficiently we use resources, if design doesn’t inspire people, it will not last. If we get it right, sustainable design promises to bring art and science together.” - Lance Hosey, sustainable architect and designer, 2013

Interior design doesn’t exist in a vacuum. It is an integral part of any building construction or renovation project. Building interiors are fitted with materials, products and systems from a network of raw materials that stretch around the globe. Occupants of those interiors use energy and other resources in ways that are driven, at least in part, by the design of the space itself. Good interior design, and especially sustainable interior design, must be informed by all these inter-connections and impacts. Buildings, their supporting infrastructure and their associated maintenance represent an enormous proportion of mankind’s direct and indirect impact upon the environment. Buildings and their interiors also are responsible for widespread depletion of natural resources, including the use of land, raw materials and water. The construction, operation, maintenance and renovation of buildings and interiors generate waste and pollution in many forms, creating local and global changes. Sustainable design is a way of thinking that considers the impact of these issues on the environment and on human health in the context of building and construction. By taking an informed approach to the way design decisions are made, beginning with an understanding of how every choice affects the environment; designers can begin to help mitigate these impacts. Interior design is a key aspect of any green building process. It is the design discipline that is most explicitly concerned with how people will experience their built environments and therefore has huge implications for human health, well-being and productivity, all central tenets of sustainable design (www.asid.org).

Sustainable interior design practices can be defined as the balance among interior design practices and the use of Earth's resources that benefit humans and the earth now and in the future (Kang & Guerin, 2009; Loftness, 2007; USGBC). Examples of sustainable design practices include: specifying locally manufactured materials, rapidly renewable materials, and/ or durable, long lasting materials. Winchip (2007) explored sustainable strategies of commercial and residential interiors. Solutions for commercial interiors included designing spaces that can easily adapt to the changes in a spaces activities, employees, and technology while conserving resources, giving occupants access to thermal comfort controls and outdoor views, day lighting, designing for minimal heat gain or loss, including centralized energy management units and energy-efficient light systems, efficiently using space to conserve energy and materials, and specifying low-flow fixtures to conserve water. The numerous approaches to sustainable interior design are evident, and will be unique to each project's criteria. A successful project will blend sustainability into each phase of the design process, its execution and post-occupancy (Winchip, 2007). An Interior designer juggles client concerns, cost factors, time restraints, and technology among other things.

Environmental sustainability is becoming a major concern within the interior design field due to the extensive resources needed for interior use (Ruff & Olson, 2009). Sustainable interior design practices are actions that lessen environmental impact due to site selection, water use, energy use, and material selection (Rider, 2005). With these considerations, interior designers are able to provide a physiologically and psychologically healthy indoor environment (Kang & Guerin, 2009). Overall, environmentally sustainable interior design minimizes negative effects and maximizes positive effects on environmental systems over the life cycle of a building (Kang & Guerin, 2008), by blending solutions of the past with new technology of today (Loftness, 2007). Pilatowicz (1995) defined sustainable interiors as interiors designed in such a manner that they sensibly address the impact of all their functions, parts and elements on the global environment. Pilatowicz (1995) also defined environmentally conscious interior design as professional practice that attempts to create indoor spaces that are environmentally sustainable and healthy for the occupants.

Often the most visible element of sustainable design is the selection of finish materials. This is especially true with interior design, which frequently involves renovation of high turnover lease space. Often materials are removed and discarded before their useful life is over. Dealing with such high rates of remodeling magnifies the overall environmental and health impacts of materials selection. It also creates a unique opportunity to promote Healthy & Sustainable building materials in a visible setting (Mendler et al., 2000). Healthy resources are those that: do not threaten human health and do not negatively impact natural ecosystems. Sustainable resources can be defined as: renewable or regenerative, acquired without ecological damage, and used at a rate that does not exceed the natural rate of replenishment.

In regard to materials, Winchip (2007) recommends durable, adaptable finishes with a long life, and less square footage to reduce the need for unnecessary materials. Sustainable residential interiors should encourage sustainable lifestyles and reuse or refurbish furniture when possible. Sustainable residential interior designers should recommend products that minimize environmental impact during all stages of its life (for example, extraction, manufacturing, transport, use and post-use) (Winchip, 2007) and consider embodied energy. Recyclability and reusability of a project is determined by the choice of materials used (Osmani et al., 2007). According to LEED requirements sustainable materials are materials made from rapidly renewable resources, are highly durable, recyclable, and low emitting (LEED, 2010). Renewable resources and products are grown or naturally replenished at a rate that is greater than humans deplete the resource (Speigel & Meadows, 2006). Selecting materials by considering their entire life from extraction to disposal or reuse and recycling help when deciding about whether or not to specify a certain product or material (Pilatowicz, 1995).

2.4 Sustainable Design Education

Education provides interior designers the base knowledge required to practice within the field. Some suggest the interior design curriculum could include sustainable design principles. Whitemyer (2007) states, “*Education more than anything else is what will push green design into mainstream*” (p. 16). Higher education remains the foundation from which a sustainable society can grow. Second Nature Inc. (2005), a non-profit organization helping higher education develop sustainability programs,

claims “*Higher education plays a profound and pivotal, but often overlooked, role in making this vision of a sustainable future a reality...Higher education plays a critical role in creating and disseminating the knowledge, skills and values for society*”. While Thompson and Lang (1997) state that, higher education in the 21st century has challenged educators to prepare and educate their students about the environmental impact held by each individual, Wheeler and Bijur (2000) argue that education has a vital role in empowering individuals to make better choices through being better informed.

2.4.1 Sustainable Design Education Curricula

Institutes of higher learning are dependent on curricula. “The most direct and lasting impact a college can have on its students is delivered through the curriculum,” as stated by Thompson and Lang (1997, p. xix). Hutchison (1998) feels that schools have the task of “formally instilling” in each new generation the norms and values of the existing culture. However, according to some authors, the current existing culture should not be taught without changes. They felt environmental education should be the core of current teaching methods, allowing students to master textbook facts and master information processing. Sustainable design curriculum should redefine the labels of liberal arts, natural sciences, and social sciences (Thompson & Lang, 1997; Smith & Williams, 1999; Wheeler & Bijur, 2000).

Some believe that a written curriculum alone is not enough. Bainbridge (2000) argues that universities and professional organizations must develop sustainable behaviour and culture in the educational system with emphasis on those in the planning and development of land and buildings. Smith and Williams (1999) state that, school buildings contain as much curriculum as any course taught in regards to sustainability. Chick (2000) states “Any attempts to foster a sense of environmental responsibility through the curriculum would be negated if operational management practices were environmentally unsound” (p. 162). Educational programs in architecture, engineering, and interior design need sustainability to be taught within their curricula. Gould (2002) argues “Schools of architecture, interior design and engineering should rewrite their mission statements, hire and tenure environmental professionals as teachers, pursue campus and regional activism as well as national and international

activities” (p.3). Gould (2002) also claims that the interior design profession needed rational undergraduate training, continuing education opportunities and support to provide research in sustainability.

Stieg (2006) argues that “sustainability gap.” exists between theory and practice: between what we believe to be right and what we know to be right; between how we should practice sustainable design and how we are able to practice”. She further argues that, the acquisition of knowledge is a phase in which academia, the profession and the industry can join forces to address the sustainability gap. She suggested the following guidelines:

- Ensuring that undergraduate programs provide foundational knowledge in environmental science and sustainable design through interdisciplinary efforts within the academy, integration of professional knowledge, and support of industry to provide factual data.
- Developing and supporting rigorous continuing education programs to provide practicing interior designers, who have not been exposed to sustainable design principles in their undergraduate or graduate education, the basic foundational knowledge required to put a sustainable practice in context.
- Distinguishing, realistically, between theory and practice, and providing greater direction in determining what is needed to actualize a sustainable practice.
- Providing details, verifiable data about materials and products and their environmental impacts.
- Advancing knowledge by providing an on-going advanced research on the characteristics of materials and products and their impacts on the environment and/or indoor air quality.
- Providing a forum, or some alternate means to facilitate collaboration among the academy, the profession and industry, in order to work in concert towards a common goal (p. xiii - xiv).

Stieg (2006) goes on to argue that the sustainability gap in the design process lie in two areas: in the redundancy and the contradiction or limitations of design tools and in the ability of the designer to fully understand and effectively use them. She states

that bridging the gap is achieved by providing resources to evaluate, supporting life-cycle assessments of products and process, providing analysis of and illustrating application of the design process, and educating in application processes leading to critical thinking. She emphasizes that the academia, industry and the profession could work together on developing organized programs of continuing education. Such programs could be developed by creating regional continuing education centres, developing professional organization workshops, creating a research forum for educators and professionals and offering better correspondence between academia and the profession about sustainable design. She argues that students and professional designers need to understand the difference between sustainable theory and what our current knowledge base can achieve and suggested that we identify how we should practice sustainable design and then practice it.

2.4.2 Sustainable Design Education at University of Nairobi Department of Architecture Undergraduate Syllabus

Founded in 1956, the Department of Architecture was at first the only Department of the Faculty of Architecture, which later became the Faculty of Art and Architecture of the Royal Technical College of East Africa. In these early days the Qualifying examinations were those of the Royal Institute of British Architects. The East African Institute of Architects (E.A.I.A) kept watch kept watching control in terms of ensuring appropriate professional standards. In 1963, when the Royal College, Nairobi was founded, the Department established its first ever degree course, entry to which was accepted at “O” level. This development was followed by the introduction, for “A” Level candidates of the two degree structure; Bachelor of Arts in Architectural studies and Master of Architecture.

The Building Science component of the Department of Architecture and Building Science of the University of Nairobi first came into existence in 1967 as The Housing Research and Development Unit (HRDU). It was the result of recommendations of the U.N. report on Housing in Kenya, prepared by C. Abrams and Bloomberg in 1965. After evaluating the recommendations arising from the study the Government of Kenya produced Sessional Paper No. 5 of 1966/7 on Housing in which a section stated Government interest in research and education to get the greatest number of

houses built at the cheapest cost possible, research into building techniques and construction cost being of utmost importance. Thus in the development plan 1966-70, which was geared to institution building, the Government established the HRDU at the University to undertake research on various aspects of low-cost housing and community planning in both urban and rural areas. In 2005, the University of Nairobi conducted a restructuring exercise in which several similar or related departments were merged. In this exercise HABRI was merged with the mother department of HRDU days (the Department of Architecture) to form the Department of Architecture and Building Science in a move that was seen necessary in order to bring synergy to research and training activities of both organizations. Hence the mandate of HRDU or HABRI is still being executed by the Department of Architecture and Building Science; under the Building Science component. One of this mandates is Environmental Design and Sustainability under which Sustainable design seeks to reduce negative impacts on the environment, and the health and comfort of building occupants, thereby improving building performance.

The basic objectives of teaching sustainability are to reduce consumption of non-renewable resources, minimize waste, and create healthy, productive environments. Courses offered under sustainable design at the undergraduate level include; Applied Design Studio in building Technology, Environmental Thermal, Community Design, Design for Conservation, History of Architectural Design and Real Estate Studies (<http://architecture.uonbi.ac.ke/node/1155>).

2.4.3 Sustainable Design Education at University of Nairobi School of The Arts and Design Undergraduate Syllabus

The School of the Arts and Design (StAD) was established in January, 2006 and it evolved from the previous Department of Design (DoD), in the University, which had been in existence since the mid-1960s. By 1967, a 3 year Bachelor of Arts in Fine Arts and Bachelor of Arts in Design were offered as degree courses. Admissions were by portfolio until 1975. In 2003, the Department took another leap in response to the dynamic professional and development needs of the country, by creating a School that would work towards the development of an Industrial State by 2030. The School

offers courses in the key design specializations of graphics, product, textile and Interiors. The syllabus is currently under review in response to the market dynamics.

Design is an accelerating factor which plays an important role side by side with productivity and management. The aims and objectives of the four year Bachelor of Arts degree course in design are based on professional education for national development. Design education entails making the students aware of the economic, commercial, industrial and technological factors on design activities. Among others, professional design education as offered at The School of the Arts and Design at the University of Nairobi include; Promotion of interdisciplinary integration of artistic, scientific, socio-political, environmental and technological knowledge, creativity in problem-solving processes in areas pertaining to human, communication and needs, encouraging and promoting research, the awareness of the role and need for team work with production, management and other decision makers, attainment of professional standards, skills and draftsmanship, and finally taking into account national objectives of education and economic development such as visual communication and literacy, culture, self-technological needs and trends.

Sustainable design is taught at the school under the concept of materials with special reference to structures of materials, behaviour of materials relative to various forms of energy, uses of materials and their properties. Also tackled is the analysis of sustainable traditional materials and their function; renewable and non-renewable materials, disposal of waste materials through application in design. Traditional and contemporary methods with emphasis on local and recycled materials are also taught to promote environmental conservation. In terms of landscape design, plantology is taught which looks at various types of plants emphasizing on rapidly renewable ones to promote sustainability (<http://arts-design.uonbi.ac.ke/node/40>)

2.4.4 Suggested Sustainable Design Curriculum Requirements

An interior design curriculum that incorporates sustainability content offers students an additional instrument to use within the design process. Bainbridge (2002) states “Incorporating ecology in education is both possible and essential.” Students and design professionals need to understand the whole to improve the parts, [they should be] learning that actions have effects, and that problems can’t be solved in isolation, [while] teaching the skills of ecological footprint analysis, life cycle cost assessment,

and environmental management systems should be a normal part of every curriculum,” (p. 3). That curriculum should understand the stable natural systems with their complexity, circularity and diversity (Battisto, 2001; Gould, 2002; Bergman & Doering, 2007). This recommendation of incorporating sustainability into a curriculum can only be achieved if educators are well informed about sustainability. Many have recommendations for the topics a sustainability-inclusive curriculum should embrace Stieg’s (2006) recommendations for areas of study include:

- The relationship of buildings to their immediate environment.
- Building infrastructure and its relation to the interior environment.
- Means of designing for space and resource efficiency.
- Daylighting and energy efficient lighting design
- Materials and their physical characteristics and properties appropriateness to design, code and universal design requirements, environmental impacts, and effect on indoor air quality.
- The development of collaborative team building skills (p. xviii - xix). Boyer and Mitgang (1996), in their *Building Community: A New Future for Architecture Education and Practice*, commonly called the “Boyer Report,” provided the following recommendations for an educational program:
 - An enriched mission
 - Diversity with dignity
 - Standards without standardization
 - A connected curriculum
 - A climate for learning
 - A more unified profession
 - Service to the nation

Similarly, Prentice (2002) prepares a list of effective subjects that include:

- Engaging and discussing in practical workshops
- Demonstrate learned knowledge and ideas
- Give creative connections to current research
- Maximize approach
- Engage in discussions
- Imaginative use of materials and resources

2.5 Glass

Glass is a combination of sand and other minerals that are melted together at very high temperatures to form a material that is ideal for a wide range of uses from packaging and construction to fibre optics. A form of glass occurs naturally within the mouth of a volcano when the intense heat of an eruption melts sand to form Obsidian, a hard black glassy type of stone. Glass, chemically, is actually more like a liquid, but at room temperature it is so viscous or 'sticky' it looks and feels like a solid. At higher temperatures glass gradually becomes softer and more like a liquid. It is this latter property which allows glass to be poured, blown, pressed and moulded into such a variety of shapes. Glass is made by melting together several minerals at very high temperatures. Silica in the form of sand is the main ingredient and this is combined with soda ash and limestone and melted in a furnace at temperatures of 1700°C. Other materials can be added to produce different colours or properties. Glass can also be coated, heat-treated, engraved or decorated. Whilst still molten, glass can be manipulated to form packaging, car windscreens, glazing or numerous other products. Depending on the end use, the composition of the glass and the rate at which it is allowed to cool will vary, as these two factors are crucial in obtaining the properties the glassmaker is seeking to achieve (British Glass Manufacturers' Confederation, 2011).

2.5.0 History of Glass

2.5.1 Early Glass Making (2000 B.C. – 500 A.D.)

People first made glass before 2000 B.C. in Mesopotamia (now Iraq and northern Syria) and created small objects by casting the glass in molds or shaping it with simple tools. In the 16th century B.C., craftsmen started making hollow vessels by gathering molten glass around a temporary core. For centuries, glass working techniques were so labor-intensive that only wealthy customers could afford to buy glass objects. Then about 50 B.C., glassmakers on the Syro-Palestinian coast, then part of the Roman Empire, discovered that they could more easily form objects by inflating a gob of glass on the end of a hollow tube. This rapid process made glass affordable and widely available for ordinary household use. However, the Romans also produced some of the most lavish luxury glass ever made (Lilyquist, 1993).

Ancient glass sculpture is very rare. The one shown in image 1 below is one of the earliest known glass portraits. It probably shows the head of Amenhotep II, who was ruler of Egypt about 60 years before Tutankhamen. The craft of glassmaking may have been introduced into Egypt during Amenhotep's reign. Cast in blue glass, the sculpture is now tan in color due to its long burial (Wilde, 2003).



Image 2.1: Portrait of King Amenhotep II (probably) Egypt; about 1450-1400 B.C.
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.2: Cage cup Roman Empire; about 300 A.D., Arthur Rubloff Residuary Trust (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Cage cups as the one shown above are the most exclusive luxury glasses made in the later Roman Empire. They date from about A.D. 250 to the mid-fourth century. Cutting and grinding a single thick-walled blank was a laborious and risky process. If

just one mesh of the cage was broken, the entire vessel had to be scrapped. For this reason, cage cups were exceptional objects. They were often owned by the most privileged members of Roman society. Some cage cups are shaped like beakers and inscribed with toasts such as “*Drink! May you live for many years!*” Others, including the example shown above in image 2, are shaped like bowls. The metal fittings indicate that this object was meant to be suspended. It is possible that bowl-shaped cage cups were hanging lamps rather than drinking vessels (McCray, 2007).



Image 2.3: Vase - Egypt, 18th Dynasty; about 1400-1300 B.C.

(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

The technique of core forming, which was introduced around the middle of the 16th century B.C., was used to fashion some of the first glass vessels such as the one in image 3 above. Core forming involves the application of glass to a removable core supported by a rod. Not all scholars agree about how this was accomplished. Some believe that the glassmaker wound trails (strands) of molten glass around the core or dipped the core into molten glass. Others suggest that a paste of powdered glass was applied to the core and fused with heat. After forming, the object was removed from the rod and annealed (slowly cooled to room temperature). When the object had been annealed, the core was removed by scraping. These small vessels may have held perfume, unguents, or makeup.

From the seventh to third or second centuries B.C., a broad range of glass head pendants was produced. Traditionally, these objects have been attributed to Phoenician glassmakers, based on the large numbers of finds in or near that region.

The pendants were made in such forms as bearded male heads, demonic masks, and rams' heads as shown in image 4 below. Glassmakers wound hot glass around the end of a metal rod coated with a separating agent. Details were fashioned with blobs and trails of colored glass. A suspension ring was added at the top so that the pendants could be strung together as necklaces or used individually. At least 10 different types of heads are known, but the similarity of their manufacture suggests a common origin. Because these pendants were widely distributed, scholars are divided on where they were made (Douglas, 1972).



Image 2.4: Pendant with Head of Man, Probably Lebanon, about 400-250 B.C.

(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.5: Morgan Cup Roman Empire, probably Italy; 1st half of 1st century, Gift of Arthur A. Houghton, Jr. (Source: <http://www.britglass.org.uk/history-of-glass>,

2012)

Within less than a hundred years of the Roman invention of glass-blowing, craftsmen created extremely fine luxury vessels that required great knowledge, time and skill. The most elaborate and rarest glasses of the early Roman Empire are cameo glasses. These objects were inspired by relief-cut gems of banded semi-precious stones such as onyx. Glassmakers cased (covered) objects of one color with one or more layers of glass of different colors, opaque white on translucent deep blue being the most popular combination. The layered “blank” was given to a lapidary for carving, cutting, and polishing. This cameo vessel shown above in image 5, the Morgan Cup (it was once owned by J. Pierpont Morgan), depicts a religious ceremony at a rural shrine. One side shows a female approaching a statue of Silenus. Women who wanted to become pregnant sometimes invoked the help of the god Dionysus, for whom Silenus, his tutor, here acts as proxy (Hoover and Hoover, 2007).



Image 2.6: Mosaic Glass Bowl - Probably Eastern Mediterranean; Late 2nd-1st century B.C. (Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

Perhaps the most famous Hellenistic mosaic glass vessels are hemispherical bowls such as the one shown in image 6 above made of multicolored canes with spiral or star designs. The bowls were probably formed by fusing slices of the canes (sometimes called *murrine*) into a disk and slumping the disk over a mold. Most of these objects have rims that were fashioned by spirally twisting threads of different colors to produce a striped effect. Later, this technique was employed in Roman workshops. The earliest of the Hellenistic hemispherical bowls may have been made in the second half of the third century B.C., but most were produced a century later. The source of these colorful bowls is unknown. They have been found in many

locations, including Greece, Italy, Egypt, and Syria. Mosaic glass bowls were a typical product of glass workshops in the eastern Mediterranean and this example may well have been made there (Amalananda, 1990).

2.5.2 Medieval and Islamic Glass (500-1450)

After the Roman Empire collapsed in 476 A.D., tastes in glass changed. Cutting, engraving, and enameling disappeared. In Frankish glass, the most sophisticated techniques that survived into the Middle Ages were performed at the furnace. However, beginning in the seventh century, Muslims conquered lands extending from central Europe to Spain. Glassmaking flourished through the region. Islamic glassmakers revived Roman techniques and developed new forms and types of ornament (Fleming, 1999).



Image 2.7: Hedwig Beaker - Origin unknown, 12th-early 13th century

(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

The above image 7 above is a typical example of a puzzling group of glasses known as Hedwig beakers. They are unlike any other medieval objects of glass or rock crystal from the Islamic world, Byzantium, or western Christendom. These colorless or nearly colorless glasses are decorated in slant-cut relief with a variety of motifs, including lions, eagles, griffins, and the tree of life. The group is named after Saint Hedwig of Silesia (d. 1243), who is traditionally associated with three of the beakers. Most of the complete Hedwig beakers were found in church treasuries, and fragments of six others were uncovered at archeological sites, all in Europe. The earliest datable

examples belong to the 12th or early 13th century. Scholars have argued variously that the beakers were made in the medieval Islamic world, Byzantium, and southern Italy. However, there is no decisive evidence in favor of any one of these locations (Stern, 1999).



Image 2.8: The Corning Ewer, Possibly Western Asia; possibly Egypt; about 1000
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

The Corning Ewer shown in image 8 above is an outstanding example of Islamic relief-cut cameo glass. A layer of transparent light green glass was applied to a layer of colorless glass. Most of the outer layer was then cut away, leaving the decoration in relief. Although the Romans made cameo glass, scholars believe that this technique did not continue into the Islamic period. It was probably rediscovered in Western Asia or Egypt in the ninth century. The decoration of the Corning Ewer shows two horned animals with crossed forelegs, each of which has a bird of prey perched on its rump and pecking at the back of its neck. At the edges of the panel are two parrot-like birds standing on foliage. What makes this design of unparalleled elegance and subtlety even more distinctive is that it was accomplished on walls of eggshell thinness (Toner, 2009).

The most recognizable and intriguing glass vessels of the Early Middle Ages, also known as the Dark Ages, are the claw beakers like the one shown in image 9 below. This form originated with a group of beakers made at Cologne in the Late Roman period. These vessels had cracked off rims and were decorated by dropping a small gob of hot glass on the wall of the vessel and pulling part of the wall out and down

forming a hollow projection, just like a claw. Typical Frankish claw beakers are footed and have trailing under a rounded rim and near the base. These beakers were made in the fifth and sixth centuries in the Rhineland, near Cologne, and near Namur in Belgium (Price, 2000).



Image 2.9: Russelbecher (Claw Beaker), Probably Rhineland; 5th-6th century A.D.

(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

It is also possible that Germanic glassworkers brought this technique to England, where distinctive claw beakers have been found. Glass was made in rural glasshouses of central and northern Europe from the Middle Ages to the 18th century. Some of this glass, which was mixed with potash made from the ashes of trees or ferns, was called *Waldglas*, or forest glass. Its green color comes from the iron impurities in the sand from which it was made. Most of this glass was utilitarian tableware, storage containers, or windowpanes. The prunts, small blobs of glass applied to the beaker, are often seen on *Waldglas* as in image 10 below. In addition to being decorative, they may have also helped grip the vessel, as this was a time when eating utensils were limited and people used their hands more than we do today (Heyworth, 1992).

The first painters of glass in the Islamic world applied a brownish or yellowish metallic pigment on bowls, dishes, and other objects. The decoration usually consists of animal or plant motifs, sometimes accompanied by inscriptions. By applying pigments to both sides of these objects, glassmakers could highlight details or exploit the transparency of the glass to produce subtle shading effects. The object above shown in image 11 is a drinking horn with a large applied handle. Its shape is

obviously derived from the use of animals' horns for drinking. Glass horns were made by the Romans in the first century A.D., and horns of silver and ivory had been created in Iran before that time. However, in the Islamic world, such vessels never became popular in any medium. Only three Islamic glass horns are known, and this is the earliest example (Harden, 1978).



Image 2.10: Beaker - Germany, Mainz; 15th - 16th century (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.11: Drinking Horn - Islamic; probably Egypt; 8th-9th century
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Enameled and gilded glass is the most celebrated type of glass from the Islamic world. Only two candlesticks from the Islamic world decorated in the fashion shown below in image 12 are known. This is one of them. The shape derives from Islamic metalwork. (Bronze candlesticks are relatively common.) The multi-colored enamels and the gilding cover so much of the surface that the underlying honey-colored glass

is barely visible. The main geometric pattern, consisting of elongated hexagons and five-pointed stars, was widely used in Mamluk art of the late 14th and 15th centuries. The inscription is translated, “*Glory to our lord, the sovereign, the learned, the just, the holy warrior, the defender, the protector of the frontiers, the fortified [by Allah], the triumphant, the victorious.*” There is no doubt that this object was dedicated to a Mamluk sultan, but scholars are not sure which one (Bimson, 1978).



Image 2.12: Candlestick - Probably Egypt; about 1340-1365
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

2.5.3 Early European Glass (1450-1700)

During the Renaissance, luxury glassmaking flourished, especially in Italy. By the mid-15th century, Venetian glassblowers on the island of Murano made *cristallo*, a thin, colorless glass that resembled rock crystal. By the 16th century, highly skilled Venetian glassworkers were making elaborate wares, which were exported throughout Europe and the Islamic East. Knowledge of Venetian glass working techniques spread, making identification of objects challenging, so they are referred to as Venetian or *façon de Venise*. Two technological breakthroughs in the last quarter of the 17th century resulted in glass that was more brilliant than ever before. The English achieved this effect by adding lead to the batch, while the Bohemians added chalk. Lead glass dominated the market in northwestern Europe, the Far East, and the American colonies. Another significant achievement of the period occurred in Potsdam, where the chemist Johann Kunckel produced deep red glass by adding gold chloride to the batch (Hamilton, 2007)



Image 2.13: Goblet - Schaffgotsch glasshouse, engraving attributed to Friedrich Winter workshop Silesia, Weißbach, near Schreiberhau (Szkłarska Poreba, Poland)
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

During the mid-late 17th century, in their efforts to imitate rock (quartz) crystal, Bohemian glassmakers invented a potash-lime glass using chalk as a major batch material. This almost colorless, thick walled glass was ideal for cutting and engraving. Intricate designs were created by pressing the glass against copper or stone wheels that were turning rapidly. The above blown goblet shown in image 13 features both *Hochschnitt* (high relief) and *Tiefschnitt* (intaglio) copper-wheel engraving, which is tentatively attributed to Friedrich Winter's workshop in Hermsdorf. The engraved decoration consists of three cartouches, two of which are figural. One appears to be a Native American and the other is possibly a colonist, together representing the continent of America. If so, the goblet would be part of a set four, the others illustrating Europe, Asia and Africa (Kelso, 2006).

The dragon-stem goblet in image 14 below exemplifies the virtuosity of Venetian glassmakers. The complex, colorful stem shows a serpent with a convoluted body, outspread wings, open jaws, and a crest. Known in Italian as *vetri a serpenti*, serpent-stem goblets were very fashionable in the 17th century. The serpent motif is frequently found in the decorative arts of the Baroque period. The high viscosity of the Venetian soda-lime glass was ideal for the creation of such elaborate forms. Substantial numbers of large covered glasses with flat, symmetrical serpent stems were made by Venetian craftsmen in the Netherlands and Germany during the second

half of the 17th century. In the 18th century, many of these glasses were engraved with genre scenes, floral motifs, and inscriptions (Grizzard, 2007).



Image 2.14: Dragon stem goblet - Italy, Venice or façon de Venise, 17th century
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)



Images 2.15: Behaim Beaker - Italy, Venice; probably 1495, Purchased with funds from the Houghton Endowment Fund

(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

The Behaim Beaker above in image 15 is a fine example of Venetian *cristallo*, and it demonstrates how glass from Venice commanded attention abroad. The beaker bears a coat of arms and two panels, each of which contains a figure. The coat of arms belongs to the Behaim family of Nuremberg. One panel depicts the archangel Michael killing a dragon; the other shows Saint Catherine of Alexandria. The unusual combination of Michael and Catherine requires an explanation. It is thought that the

beaker was made for the wedding, on July 7, 1495, of a Nuremberg patrician, Michael Behaim, and Katerina Lochnerin, the daughter of a rich merchant whose firm controlled trade between Nuremberg and Venice. If this explanation is correct, the Behaim Beaker is an outstanding illustration of fine Venetian glassware custom-made for export to Germany. It also demonstrates two of the features of Venetian glass that attracted widespread attention: the excellence of *crystallo* and the brilliance of the gilded and enameled ornament. The Behaim Beaker appears to be the earliest Venetian gilded and enameled glass that can be dated precisely (Edgar, 1980).

Filigree decoration originated at Murano in the 16th century and quickly spread to other parts of Europe. In the covered goblet below in image 16, twisted canes of white glass encased in colorless glass alternate with plain white canes. These canes were arranged in a rectangular form and fused in the furnace to create a sheet of striped glass. The sheet was picked up on a disk of molten glass attached to the blowpipe, rolled up into a cylinder, and closed at the end to form an elongated bubble. This bubble was then divided into separate sections, from which the foot, knop (a small knob in the stem of a glass vessel), bowl, and matching lid were fashioned. A team of skilled craftsmen collaborated on such vessels, which were made in a great variety of twisted cane and network patterns. Filigree glass remained popular for more than 200 years.



Image 2.16: Covered Goblet - Probably Italy, Venice, probably for the Bohemian market, about 1575-1625

(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

During the Renaissance, European craftsmen made small panels composed of thin, flat glass panes that were painted and stained. Especially popular were panels decorated with family crests and images copied from engravings. Most of these objects were built into leaded windows, or suspended from chains or cords in front of them. The panel below in image 17 depicts two coats of arms, one belonging to the Escher vom Glas family of Zurich. The pruned glass beaker in the armorial design refers to the family business, the production and trade of plant ashes used in glassmaking. The panel was probably crafted in the workshop of Lukas Zeiner, one of the most talented glass painters working in Switzerland in the 16th century (Cotter and Hudson, 1957).



Image 2.17: Panel with the Arms of Escher vom Glas - Zeiner, Lukas Switzerland, 1500-1510 (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.18: Goblet with Raven's Head Seal - Savoy Glasshouse; Ravenscroft, George England, London; about 1676–1678 Lead glass
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

In March 1674, the English glassmaker George Ravenscroft applied for a patent to make colorless lead glass. Unfortunately, this glass was prone to crizzling, a chemical instability that results in an attack by atmospheric moisture, producing a network of cracks in the surface. Ravenscroft revised his formula, adding more and more lead oxide to the batch. By mid-1676, he announced that his improved glasses were to be marked with a seal, a custom known from several glasshouses that made lead glass. His stamp featured a raven's head, taken from his family's coat of arms. Corning's rare Ravenscroft goblet shown in image 18 above was made with the new lead formula. It is decorated with mold-blown ribbing that is pinched to form a mesh design on the bowl. This pattern is called "*nip-diamond-waies*." One of the prunts at the bottom of the stem is stamped with a raven's head (Albert, 1965)

2.5.4 European and American (1700-1890)

With the growth of industrialization and the middle class, there was an increasing demand for elegant consumer goods in Europe and America. Glassmakers responded with a wide assortment of high quality glass. The skill of the glass decorators - cutters, engravers, and painters - became as important as that of the glassblowers. In America, there were only a few successful glass factories in the 18th century, but the industry had blossomed by the mid 19th century. The pressing machine, developed in the 1820s, was America's most important contribution to the glass industry. It tripled the production of tableware, which became readily available to the public at greatly reduced prices. European and American glass companies displayed their largest and most elaborate works at world's fairs. More than six million visitors attended the first of these fairs, the 1851 Great Exhibition in London's Crystal Palace, which was in itself an architectural glass wonder (Hoover and Hoover, 2007).

During the Northern Baroque period, mirrors were an important aspect of elegant interiors. The example below in image 19 is attributed to the Stockholm workshop of Christian and Gustaf Precht, sons of the well-known woodcarver and furniture maker Burchardt Precht the Elder. It is decorated with ornate and very accomplished reverse painting. In this technique, a design is painted on the back side of the glass but viewed from the front (that is, through the glass). The paint is applied in the reverse of the normal order, beginning with the details and highlights and ending with the

background. The Corning mirror shows a jester dancing under a canopy. This motif was inspired by the published designs of Jean Berain the Elder (1640-1711), royal designer to King Louis XIV of France. In the early 18th century, jesters and mirrors often appeared in allegories of vanity, symbolizing human folly and haughtiness. Mirrors of this type with figural decoration are exceedingly rare (Amalananda,1990).



Image 2.19: Reverse Painted Mirror in Gilded Wood Frame - Precht, Christian and Precht, Gustaf Sweden, Stockholm; about 1720-1730
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.20: Bottle with Seal of Richard Wistar - Wistarburgh Glassworks United States, Salem County, NJ; about 1745-1755, Gift of Miss Elizabeth Wistar
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

The first successful glass factory in the Colonies was established by Caspar Wistar near Alloway, New Jersey, in 1739. Its principal products were window glass and bottles, which were in great demand. More than 15,000 bottles were produced there

each year. Wistar's bottles were made using a typical "Waldglas" formula that had been popular in northern Europe since the Middle Ages. The impure greenish glass such as that shown in image 20 above was fashioned into bottles so closely similar to the European variety that the makers of unmarked examples cannot be identified. This bottle bears the initials of Richard Wistar, eldest son of Caspar Wistar. It is one of only three marked bottles that can be attributed to the Wistar factory (Fleming, 1999).

Before 1800, most of the lamps and candlesticks used in America were made of metal. After that date, glass gradually became the most important medium for lighting devices. Although American pressed glass candlesticks are numerous, the base of the example shown in image 21 below is very rare. The socket is a relatively common pattern made at the Boston & Sandwich Glass Company, which also produced whale-oil lamps with mold-blown fonts and bases. Candlesticks with handles were usually called chamber-sticks because the handle made it easier to carry the candlestick into the bedchamber. The ring handle was difficult to press because the molten glass did not flow easily through the small space required. In addition, the ring is so small that it must have been difficult for an adult to carry the candlestick while it held a lighted candle (Stern, 1999).



Image 2.21: Chamber-stick - Probably Boston & Sandwich Glass Company United States, probably Sandwich, MA; about 1830-1840, Lead glass
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.22: Paperweight - Compagnie des Cristalleries de Saint Louis France, Saint Louis; about 1845-1855

(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

As a result of the increase in letter writing in the mid-19th century, paperweights became popular in affluent households. Two of the most popular techniques used in paperweight making were lampworking and *millefiori* (Italian for “thousand flowers”). The famous Saint Louis “Gingham” overlay shown in image 22 above, the only example of its kind known to exist, is a masterpiece. It was probably designed to demonstrate the skills of the craftsmen, rather than as a commercial work. This weight features a tall bouquet and a double overlay cut in a pattern resembling a gingham fabric. The double overlay was likely achieved by gathering the two overlay colors of glass together and then blowing a bubble. This was folded over the colorless core with the bouquet, enclosing the piece. When the object had been annealed, the opaque overlay colors were cut away with a small wheel to produce the gingham pattern latticework. The weight was then reheated and encased in a layer of colorless glass (Toner, 2009).

By the late 18th century, English manufacturers had taken full advantage of the refractive qualities of lead glass by adding sophisticated cutting to their wares. In 1780, Parliament lifted a 35-year ban on the exportation of Irish glass, and the tax-free Irish glass industry responded by producing large quantities of wares for export. Many English glassworkers moved to Ireland to take advantage of the financial benefits. The styles of English and Irish cut glass became very similar, and this glass is often referred to as “Anglo-Irish.” Luxurious consumer goods, offered in

fashionable London showrooms, included many light fittings. Wax candles were an expensive commodity, and efforts were made to maximize the amount of illumination they could provide. Moses Lafount, a “*lustre-mounter*” in London, patented the design below in image 23 for a candelabrum constructed with ormolu mounts. Festoons of cut drops added a magnificent jewel-like appearance to the elegant neo-classical shape (Price, 2000).



Image 2.23: Candelabrum with Ormolu Mounts - Lafount, Moses (signed) England; about 1800 (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

2.5.5 Modern Glass (1890-1960)

The development of Modernism in the decorative arts is part of the legacy of Art Nouveau. Clean lines, defined color and the absence or judicious use of surface decoration characterize Modernism in glass from 1900 forward. Art Nouveau (New Art) refers to many different artistic styles that emerged in the 1880s, including Arts and Crafts, the Aesthetic movement, and Japonisme. It peaked in 1900 and ended with the onset of WWI (1914-1918). Glass of the period reflects two distinct styles of design. One was inspired by nature and emphasized asymmetry and sinuous lines. The other focused on restrained forms and geometric patterns. The Art Deco style, with many sources of inspiration including the geometric aspects of Art Nouveau, Cubism, and tribal art, dominated design between the two world wars. It emphasized symmetry, angularity and the use of new luxury materials. After 1945, the design of objects for everyday use gained importance for artists and architects who wished to emphasize modern ideals of utility, beauty, and affordability (Hamilton, 2007)



Image 2.24: Gazelle Bowl - Waugh, Sidney, designer; Libisch, Joseph, engraver; Steuben Glass, Inc. United States, Corning, NY; 1935, Lead glass, Gift of Mr. and Mrs. John K. Olsen (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Steuben Glass Works was founded in Corning in 1903 by the English glass designer Federick Carder and the American cut glass manufacturer Thomas G. Hawkes. In 1918, the company was sold to Corning Glass Works. Carder was Steuben's manager until 1932, and Arthur Amory Houghton, Jr. became president of the firm in 1933. The highly refractive glass now characteristic of Steuben was developed in 1930. It inspired Houghton to shift Steuben's production from colored glasses to heavy blown and engraved wares. Scandinavian glass, with its history of integrating art and industry, strongly influenced Steuben during this period. The Gazelle Bowl shown in image 24 above, designed by Sidney Waugh (1904-1963) in 1935, is an icon of American Art Deco. Gazelles, often used by artists in this period, characterize the Art Deco aspects of elegant streamline beauty, agility and speed (Kelso, 2006).

The Viennese architect and designer Josef Hoffmann (1870-1956) deplored the poor quality of mass-produced objects. His preference for well-crafted everyday wares echoed the aims of the earlier Arts and Crafts movement in England. Hoffmann, who belonged to the avant-garde group of Austrian artists known as the *Vienna Sezession*, founded the *Wiener Werkstätte* (Vienna Workshop) in 1903. It produced all kinds of decorative arts, from jewelry to complete room decorations. In glass, Hoffmann's work is characterized by simple, full forms and spare, usually geometric decoration. This set of glasses below in image 25 was probably made at Meyr's Neffe, one of the

Bohemian glass-works that fabricated the Wiener Werkstätte's designs (Grizzard, 2007).



Image 2.25: Tableware Set - Hoffmann, Josef; Wiener Werkstätte Austria, Vienna; 1916 (Source: <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.26: Head I - Libenský, Stanislav and Brychtová, Jaroslava Specialized School for Glassmaking Czechoslovakia, Železný Brod; 1957-1958 (Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

The artistic partnership of Czech glass artists Stanislav Libenský and Jaroslava Brychtová has had a remarkable influence on the development of studio art glass worldwide. The husband and wife team collaborated on large-scale cast glass sculptures. Charcoal studies of the forms were created by Libenský and given to Brychtová for translation into three-dimensional models. The process of conceiving each sculpture - developing the concept, envisioning the form in three dimensions,

and selecting the color of the glass to be used - was shared by the artists. Image 26 of Head I as shown in the previous page was the first example of their work to be displayed in the United States. It was included in “Glass 1959,” an international exhibition organized by The Corning Museum of Glass (Kelso, 2006).

Louis Comfort Tiffany (1848-1933) was the leading proponent of the Art Nouveau style in America. He was influenced by the English Aesthetic movement, which extolled exoticism, and by the Parisian fashion for Japanese art, called *Japonisme*. He was also inspired by the arts of Byzantium, Islam, China, and ancient Egypt, Greece, and Rome. In the late 19th century, ancient tombs were being excavated. The glass that was found often had an attractive rainbow-like, iridescent surface caused by deterioration on the surface of the glass. Glass artists in Europe and America imitated this natural iridescence with artificial techniques. The wonderful iridescent vase shown in image 27 below has a silver gilt mount with *plique-a-jour* enamel decoration and six inset rubies. It was among the first objects commissioned by the famous art dealer and critic Siefried Bing of Paris. The piece was enameled by Eugène Feuillatre, who had previously worked for Renè Lalique. Of the several mounts Edouard Colonna made for Tiffany vases, this is the only one known to have survived (Grizzard, 2007).

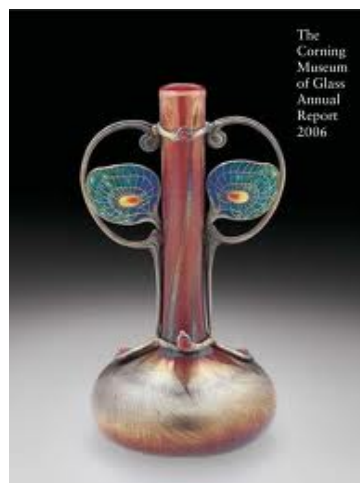


Image 2.27: Vase with Peacock Feathers - Tiffany Studios; Tiffany, Louis Comfort; Feuillatre, Eugène; Colonna, Edouard United States, Corona, NY; 1898-1899 Glass, Silver Gilt Metal, Enamel, Rubies (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

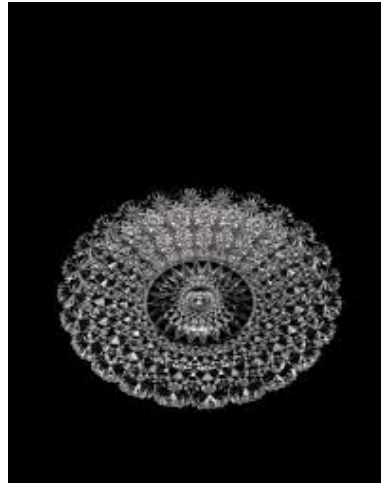


Image 2.28: Plate - T. G. Hawkes & Co.; McDonald, Philip, cutter United States, Corning, NY; about 1906 Lead glass, Gift of T. G. Hawkes & Company
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

In 1863, Thomas G. Hawkes started to work for John Hoare in the cutting shop of the Brooklyn Flint Glass Works. When Hoare opened his cutting firm in Corning, NY, Hawkes became its superintendent. However, in 1880, Hawkes left to start his own shop. A skilled designer and astute businessman, he built the largest cutting shop in the area. Corning, NY, produced so much brilliant lead glass with elaborate cutting and engraving such as the one shown in image 28 above that it became known as the Crystal City. This “rich cut” glass decorated the great homes of the Gilded Age and reached its peak in popularity between 1905 and 1910 (Kelso, 2006).

2.5.6 Studio Glass (1960 – present)

Art glass changed dramatically after 1960. Following experimental workshops led by Harvey K. Littleton and Dominick Labino, artists began to work hot glass in a studio setting. Labino’s design for a small glass furnace made it possible for molten glass to be accessible to artists outside of factories. Today, glass is one of the many materials used in contemporary architecture, sculpture, craft and design. A versatile medium with which artists can express a range of ideas, glass has shifted from being a material of function to a material of metaphor. In April 2005, The Corning Museum of Glass commissioned the artist Josh Simpson to create the world's first 100-pound glass "paperweight," which would be part of Simpson's series of solid glass spheres he calls "planets" or "Mega-planets" (Grizzard, 2007).



Image 2.29: Mega-planet – Paperweight Simpson, Shelburne Falls, MA, USA; 2006
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Like Simpson's other work, the 100-pound Mega-planet shown in image 29 above is inspired both by the natural world and by glass itself. His Mega-planets are made with many layers of luminous glass enclosing vast seascapes and minute terrestrial details, also of glass. Simpson's work reflects his joy of exploration and discovery and it encourages the viewer to appreciate even the smallest details of our complex universe.



Image 2.30: Hopi – Vessels Tagliapietra, Lino United States, Seattle, Washington; 1996 (**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Lino Tagliapietra (born 1934) is a European artist who has made a lasting impact on studio glass, primarily in glassblowing. Working as an assistant and then as an apprentice in the factories on Murano, Venice's famous glassmaking island, he earned the title of maestro at the age of 21. In 1979, he traveled to the United States to teach at the Pilchuck Glass School. This was the beginning of an international career and

collaborations with noted European and American artists working in glass. After working in the United States and abroad for 10 years, Tagliapietra made the difficult decision to change his artistic path from design to the production of unique works. Rethinking his craft, he emerged in the 1990s as an influential artist. Image 30 above of Hopi is inspired by the indigenous art of the American Southwest. Its bold and contrasting colors, broad-shouldered forms, and intricate surface pattern recall the Native American ceramics, basketry, and textiles that Tagliapietra admires (Kelso, 2006).



Image 2.31: Vase - Littleton, Harvey K. United States, Madison, WI; 1965, Johns-Manville #475 fiberglass marbles; silver oxide decoration
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

Harvey Littleton (born 1922), son of the Corning Glass Works scientist Jesse Littleton, was a teaching ceramist before he turned his attention to glassblowing. Inspired by the pioneering work in ceramics of the California potter Peter Voulkos, Littleton to produce vases as that shown in image 31 above; he started experimenting with hot glass in his studio in 1958. His efforts culminated in the 1962 Toledo glassblowing workshops, which he led with Dominick Labino. Littleton then initiated a glass program at the University of Wisconsin in Madison. Glass programs were subsequently introduced into art school curricula nationwide, initially through Littleton's energetic and talented students (Grizzard, 2007).



Image 2.32: Macchia Seaform Group – Sculpture Chihuly, Dale; Moore, Benjamin P.; Morris, William United States, Providence, RI; 1982, Gift of Michael J. Bove III
(**Source:** <http://www.britglass.org.uk/history-of-glass>, 2012)

Dale Chihuly (born 1941) has made an extraordinary contribution to the development of the Studio Glass movement. After studying with Harvey Littleton at Madison, WI, Chihuly established an influential glass program at the Rhode Island School of Design, where he taught until 1983. In 1971, he was a co-founder of the Pilchuck Glass School in Washington State. Chihuly's former study of weaving greatly influenced his glass work, particularly in the early years. Chihuly's work emphasizes the sculptural qualities of blown glass, using the vessel as a means to explore color and form. The sculpture shown in image 32 above is one of the first in his Macchia (from the Italian for "spot") series that combines his interest in weaving and basketry with natural sea forms (Kelso, 2006).

Veřa Liřková was a prominent Czech designer who began her career in the late 1940s designing functional glassware. She later became one of a group of Czech glass artists who pioneered the use of glass as an artistic medium in the 1970s and 1980s. She was the first to use flame working to create large scale sculpture. In image 33 below, she used boro-silicate glass, commonly known in America as Pyrex® and the Czech Republic as Simax, to produce a series of hollow pointed tubes of varying heights. The transparency and open space in her complex and fragile Anthem of Joy create a delicate sense of rhythm and movement (Grizzard, 2007).



Image 2.33: Anthem of Joy in Glass – Sculpture Lišková, Veřa Czechoslovakia, Prague; 1977 Borosilicate Glass, Gift of Art Centrum
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)



Image 2.34: Evening Dress with Shawl – Sculpture LaMonte, Karen Czech Republic, Železný Brod; 2004, Gift in part of the Ennion Society
(Source: <http://www.britglass.org.uk/history-of-glass>, 2012)

Karen LaMonte's subject is the dress, which is always life-size, whether it is for an infant, a young girl, or a woman. She explores a variety of styles of clothing in her work, from stiff and frilly Victorian dresses to idealized classical drapery. Her fashion choices reflect changing notions of beauty, how women view themselves, and how they have been viewed by others. Lamonte is American, but she works in the Czech Republic because the facilities necessary to cast glass on this large scale are not

available in the United States. The sculpture shown in image 34 in the previous page was cast in five sections, three for the dress and two for the shawl (Grizzard, 2007).

2.6 Glass in Interior Design

Among the varied options available for interior spaces décor, glass is one of the most commonly used materials. The use of glass in interior design is regarded as a decorative element as well utilitarian. The most remarkable feature possessed by glass is that it makes the area light, bright and obscure. Glass is a popular interior design material for a variety of uses in both contemporary and traditional looks. The use of glass as a decorative interior design material gained popularity in America during the Art Nouveau movement in the late 1800s, with the help of artists like Louis Comfort Tiffany, son of the founder of Tiffany & Co. Tiffany was famous for his stained glass lamp and window designs, glass mosaics, and blown glass interior art. Over time, modern manufacturing practices have allowed endless possibilities for glass use in interior architecture and design. Today, glass is used in tile, sinks, panels and cabinets, countertops and tabletops, light fixtures, hardware, mirrors, and in a variety of decorative items and applications (Bouret, 2011).

2.6.1 Coloured and Stained Glass

Stained glass is a general term covering all forms of glass used in a decorative manner, primarily for windows, but also for a myriad of secular uses prevalent today. Only glass which has been stained or painted after its initial manufacture is actually 'true' stained glass. Stained glass has a coloured material applied to its surface and it is usually fired in a kiln to ensure a more robust finish. The role that stained glass plays in a building is prominent. It can be put in place to decorate, instruct, inspire, allow in light, block out light, commemorate, hide an unwanted exterior view, memorialize or any of literally hundreds of goals (Stained Glass Association of America, 2012).

From its earliest appearance in Europe, stained glass has been used to tell stories. Few other forms of artistic expression are so well suited or have been so often used to express a story or recount important historical events as stained glass. While the stories told by stained glass panels are regularly associated with church and religion, a forum eminently appropriate for the medium, the use of stained glass is not limited to

ecclesiastical buildings. Stained glass is also used to recount the lessons of literature, music, the arts, science and myriad other fields; from fairy tales to genetics to corporate logos — or simply to decorate with light and color. Stained glass can serve as a focal point in a room or as an accent within an interior. Used in an exterior window, wall or entryway, it will beautify the interior space by allowing an exterior view and daylight to enter as it controls and enhances this imagery. When used in home or business environment, stained glass will give a room a brilliant and ever-changing element that will complement the interior decor. Stained glass can express a favorite theme or avocation of the homeowner. It can express a mood ranging from whimsical and creative to conservative and traditional in the corporate building. It will, as no other medium can, charge a room with energy and light (The Glass Portal, 2012).

The uses of stained glass are not limited to doors and windows. Stained glass can also be used in an interior opening, such as a room or office divider. In this role, it offers a barrier between two or more rooms and yet gives a feeling of openness. In the corporate setting, it can be used to divide workspaces, thus offering privacy while increasing available light. In the home, it can be installed between rooms such as a kitchen and dining area, thus separating the two but not dividing them. In restaurants, interior stained glass walls can separate dining areas, allowing for increased light transmission while offering the diners privacy. The stained glass dome or ceiling is an excellent element for providing decoration and atmosphere in a restaurant; the dome can be artificially lit to enhance mood in the room. The ability of stained glass to uplift the spirit can also be used to great advantage in a hospital. The color and light offered by the medium will serve to lessen stress in waiting rooms. Stained glass windows are an excellent vehicle for enhancing the mood in a children's ward. Even a hospital cafeteria can benefit from the use of stained glass (Stained Glass Association of America, 2012).

2.6.2 Tiffany Glass

Tiffany glass is the generic name used to describe the many and varied types of glass developed and produced by Louis Comfort Tiffany, (1848-1933), one of the most famous stained glass artists of the United States; he is remembered not only for his windows but for decorative glass objects as well, in particular the so-called

Tiffany lamps. Tiffany was an interior designer, and in 1878 his interest turned towards the creation of stained glass, when he opened his own studio and glass foundry because he was unable to find the types of glass that he desired in interior decoration. Most people think of Tiffany glass as decorative bronze lamps with intricate multicolored, stained-glass shades, but it actually includes other glass products, including solid color windows, painted art glass shades and lamps, and flat and pressed glass (Stained Glass Association of America, 2012).

Tiffany glass pieces were incorporated into homes, most notably in lamp and window construction. The glass work was used in the homes of the wealthy, but also in public buildings. Tiffany glass not only incorporated the color into the glass, but also tonal variations and texture, as well as use tonal variations to suggest depth. The pieces of glass were not evenly colored but were pieces of opalescent window glass made by combining and manipulating several colors to create an unprecedented range of hues and three-dimensional effects. Thus the tiffany windows look like paintings, which were therefore in great demand. The Preston Bradley Hall dome (Preston Bradley Hall is now home to the Chicago Cultural Center) put in place in Chicago's first public library in 1897 features more than 1,000 square feet of Tiffany glass (The Glass Portal, 2012).

2.6.3 Opalescent glass



Image 2.35: Opalescent glass (Source: www.bogenriefstudios.com, 2012)

Opalescent glass as shown in image 35 above is commonly used to describe glass where more than one color is present, being fused during the manufacture. Opalescent

glass is made with a combination of white glass and a cathedral color. The opacity of this type of glass is in relation to the amount of white glass used in its creation. Opalescent glass radiates especially deep, vibrant hues to achieve pictorial effects of unsurpassed beauty. This stunning stained glass piece features transparent enamels, silk-screened and kiln-fired on hand-rolled glass. It can be both a most beautiful and challenging glass with which to work. This is because the pigments are mixed into opalescent glass by hand during manufacture, with the result that the color patterns and tones in the glass are never exactly the same in any two sheets. Opalescent glass has one characteristic that transparent glass does not: namely, that it can be seen in both transmitted and reflected light. Opalescent glass has color impregnated into it to the extent that the pigmentation is visible by light rays reflecting off it. It can be seen as well as seen through (Stained Glass Association of America, 2012).

2.6.4 Favrile Glass



Image 2.36: Favrile glass (Source: www.bogenriefstudios.com, 2012)

Favrile glass often has a distinctive characteristic that is common in some glass from Classical antiquity: it possesses a superficial iridescence. This iridescence causes the surface to shimmer, but also causes a degree of opacity as shown in image 36 above. This iridescent effect of the glass was obtained by mixing different colors of glass together while hot. Favrile is different from other iridescent glasses because its color is not just on the surface, but imbedded in the glass. Some of the distinguishing colors in Favrile glass includes "Gold Lustre", Samian Red", " Mazarin Blue", "Tel-al-amana" (or Turquoise Blue), and Aquamarine. Favrile was the first art glass to be

used in stained-glass windows (Stained Glass Association of America, 2012).

2.6.5 Streamer Glass

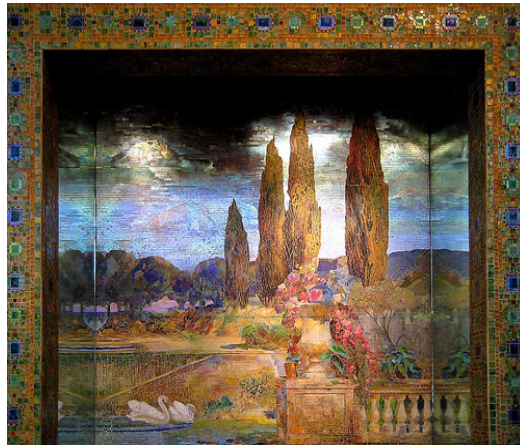


Image 2.37: Streamer glass (Source: www.bogenriefstudios.com, 2012)

Streamer glass such as the one shown in image 37 above refers to a sheet of glass with a pattern of glass strings affixed to its surface. Tiffany made use of such textured glass to represent, for example, twigs, branches and grass. Streamers are prepared from very hot molten glass, gathered at the end of a punty (pontil) that is rapidly swung back and forth and stretched into long, thin strings that rapidly cool and harden. These hand-stretched streamers are pressed on the molten surface of sheet glass during the rolling process, and become permanently fused (The Glass Portal, 2012).

2.6.6 Fracture and Fracture-streamer Glass

Fracture glass as shown in image 38 below refers to a sheet of glass with a pattern of irregularly shaped, thin glass wafers affixed to its surface. Fracture glass is made from paper-thin blown shards or flakes of intensely colored glass fused to the bottom of sheets during the rolling process. Tiffany made use of such textured glass to represent, for example, foliage seen from a distance. The irregular glass wafers, called fractures, are prepared from very hot, colored molten glass, gathered at the end of a blowpipe. A large bubble is forcefully blown until the walls of the bubble rapidly stretch, cool and harden. The resulting glass bubble has paper-thin walls and is immediately shattered into shards. These hand blown shards are pressed on the surface of the molten glass sheet during the rolling process, to which they become permanently fused.



Image 2.38: Fracture glass (Source: www.bogenriefstudios.com, 2012)

Fracture-Streamer glass is fracture glass combined with hand-stretched streamers or strings of glass during the rolling process. Fracture-streamer glass refers to a sheet of glass with a pattern of glass strings, and irregularly shaped, thin glass wafers, affixed to its surface. The “fractures” are created by the addition of thin blown flakes of intensely colored glass, while the “streamers” are pulled or drawn strings of intense colors (Stained Glass Association of America, 2012).



Image 2.39: Fracture streamer glass (Source: www.bogenriefstudios.com, 2012)

Both fractures and streamers are quick-fused to the bottom of sheets during the rolling process. Fracture and streamer glass is used primarily for backgrounds; the fractures suggest multitudinous leaves or flowers in the distance, while the streamers suggest twigs or stems. For this reason, fracture colors are usually selected to correspond to

the colors used in leaf or flower foregrounds as shown in image 39 above (The Glass Portal, 2012).

2.6.7 Ring Mottle Glass



Image 2.40: Ring Mottle glass (Source: www.bogenriefstudios.com, 2012)

Ring mottle glass is an opalescent glass in which rates of crystal growth have been controlled to create ring-shaped areas of opacity. The effect is a visual surface mottling created by localized, heat-treated opacification and crystal-growth dynamics. Tiffany's distinctive style exploited glass containing a variety of motifs such as those found in ring mottle glass, and he relied minimally on painted details. This type of glass has a locally varying opacity; the "rings" are more opaque than the surrounding matrix. Ring mottled glass is used to provide color and image gradation that is non-streaky, or non-linear. The naturally rounded shape of each ring breaks up the more typical streakiness of stained glass. The artist, using ring mottles, can create shading and imagery unavailable from other glass types as shown in image 40 above (Stained Glass Association of America, 2012).

2.6.8 Drapery Glass

Drapery glass refers to a sheet of heavily folded glass that suggests fabric folds. To create drapery glass, the molten glass is shaped by taking a hand held roller and using it like a rolling pin to create "speed bumps" on the surface.



Image 2.41: Drapery glass (Source: www.bogenriefstudios.com, 2012)

It can also be tugged and pulled by hand using steel tongs to create the deep fabric-like folds in the surface. It is easy for the glassmakers to get burnt while making this unusual glass and extreme care must be taken while rolling the glass. Tiffany made abundant use of drapery glass in ecclesiastical stained glass windows to add a 3-dimensional effect to flowing robes and angel wings, and to imitate the natural coarseness of magnolia petals as shown in image 41 above (The Glass Portal, 2012).

2.6.9 Etched Glass



Image 2.42: Etched glass (Source: www.bogenriefstudios.com, 2012)

Etched glass is the result of intentional and often artistic carving of the surface of glass to leave a white, frosted finish as shown in image 42 above. Etched glass was introduced in the latter half of the 19th Century and was developed to provide a highly detailed decorative finish. Etching refers to the technique of creating art on the surface of glass by applying acidic, caustic, or abrasive substances. Etched glass can

be found in a wide variety of decorative contexts, including glass doors and windows, furniture, wine bottles, and serving dishes. The skill of the artisan etching the glass will determine the quality and detail of the resulting piece (British Glass Manufacturers' Confederation, 2011).

2.7 Recycled Waste Glass in Interior Design

Sustainable design is a process that includes goals that go beyond the footprint of the building. Selecting finishes and new materials that mine their raw materials from waste make an environmental commitment. Recycled glass surfaces and products are a unique product that provides durable and elegant solution for interior surfaces (Celeste, 2010). Globally some manufacturers are now transforming materials taken from refuse and scrap into exciting new building materials like recycled glass surfaces. The up-cycling of glass waste from bottles, jars, architectural glass, traffic signals and beverage containers is just one way to celebrate and display sustainable initiatives by design. As Partner and Interior Director of Interior Design for sander architects, LLC of Venice California, Catherine Holliss states that, *“We love to work with recycled glass counter materials because they are not only green, they are gorgeous and practical. It also doesn’t hurt that for our clients, that the pricing is comparable to other options and they will have an interesting story to tell their friends.”*

Glass counters, wall surfaces and fireplace surrounds made from recycled glass shards embedded in a cementitious surface tell a story about materials and sustainability while creating a durable indoor and outdoor surface. Among the added benefits of up-cycling waste glass into a new product is that it allows designers to demonstrate their commitment to the triple bottom line of sustainability (<http://www.glazette.com>, 2012).

Recycled glass can also be used in kitchen tiles, counter tops, and wall insulation (US EPA, 2012). Recycled glass surfaces are considered up-cycled when they utilize unmelted glass resources. Globally, the most sustainable recycled glass sources use verifiable post-consumer and post-industrial glass. Post-consumer glass remains the best source in up-cycling because it closes the loop of waste in the materials economy and also encourages recycling which in turn adds to new green jobs. It contributes to a developing new domestic market for products that are up-cycled from waste

materials. It also conserves energy by using the material as it was originally manufactured while maintaining its performance and performance values. Post consumer glass has a unique identity and adds value by the story embedded in its surface about the source of this material (The Glass Portal, 2012).

2.7.1 Recycled Glass Tiles

Because of the durable nature of glass, it doesn't break down over time in landfills. To reduce landfill waste, recycled glass is used to make "*glass-phalt*" for road surfaces, backfill and storm water drainage systems. It's also used to make fiberglass insulation, reflective paint and decorative tiles. Bathroom and kitchen designs are often the centerpieces of today's residential houses. Colors, fixtures, lighting, style and comfort are all critical elements of these often used spaces. For builders hoping to incorporate a unique design while being environmentally responsible, recycled glass tiles can provide the best of both worlds (British Glass Manufacturers' Confederation, 2011).

These decorative glass tiles are ideal for builders and homeowners looking for a beautiful, colorful touch and a natural beauty. The translucent surface offers a look not found in other, more common types of tile. Recycled glass tiles are produced by melting down waste glass in furnaces heated to a temperature exceeding 2000 degrees Fahrenheit. The molten glass is then stamped into shape, hand trimmed and ground to its finished form. This sort of workmanship gives each tile both a professional finish and a hand-crafted appeal. The benefits to homeowners who choose recycled glass tile for their backsplash, bathroom floor, or other prominent area of the home are two-fold.



Image 2.43: Recycled glass tiles (Source: www.doughlahdesigns.com, 2012)

First, recycled glass tile is a good way to keep glass products from building up in landfills. In addition to helping conserve the environment, homeowners getting a unique product that adds style to their home. Glass tiles come in a variety of colors and finishes, both matte and glossy, and are a durable way of decorating surfaces (Celeste, 2010). Glass tiles can be used anywhere normal ceramic tiles would be installed, and they have the added benefit of being resistant to chemicals and stains, which makes them good for areas that are prone to getting wet. They can be installed on floors, walls, countertops as shown in image 43 above, tabletops, among other locations, and they can be used outdoors as well as indoors (www.bogenriefstudios.com, 2012).

Recycled glass tiles may be used in residential and commercial settings, in vertical and horizontal applications. As vertical accents, they make stylish kitchen backsplashes and shower surrounds. Horizontally, they may be used on ceilings, surfaces (like desk tops) and as flooring. Recycled glass tiles come in a variety of shapes including circles, hexagons, squares, and subways. Hundreds of colors allow for customization of design and finishes include clear, iridescent, glitter), and matte finishes. Recycled glass tiles give new life to materials that would have typically ended up in a landfill. Recycled content includes reclaimed windows, manufacturing waste from window and windshield production, and glass drink bottles (www.bogenriefstudios.com, 2012).

2.7.2 Recycled Glass Counter Tops

In the USA, the life-cycle of a glass bottle that becomes part of a new countertop begins with curbside recycling. Waste is scanned with high-tech equipment and glass is sorted into clear (also called “flint”) green and brown or amber glass. Sorting is not 100 percent accurate and that leads to variations in unique one of a kind surfaces. Larger glass pieces embedded in a slab can create a mosaic of interesting hidden messages depending on the source of the recycled glass. Color variations and glass variations contribute to a distinctive character and beauty of the glass counter or wall surface. To make a recycled glass surface, a manufacturer measures, mixes, pours and bakes the product in a process that uses less energy than if the glass were melted. After mixing, this cementitious product is molded into the desired shape and allowed to cure and harden like concrete. Color may also be added to the mix by adding metal

as a powdered oxide, sulfides or other compound. Most slabs are 3 cm thick and the maximum slab size is 5 ft by 9 ft. It is polished and stored by color types based on the contents of the mix of colors from recycled glass. Recycled glass counters accommodate many edge profile, they can be rounded or square as shown in image 44 below (Plycor Vetrazzo Inc., 2011).



Images 2.44: Recycled glass countertops (Source: www.doughlahdesigns.com, 2012)

2.7.3 Recycled Glass and Cladding

Curtain walls, cladding and glass facades can be used to replace the traditional masonry and concrete walls. These facade systems offer new dimensions and excitement in architectural designs. Curtain wall is a lightweight external wall system that is hung on the building structure. It is one of the favoured systems used in modern architecture and is characterized by grids of infilled material such as glass, metal, granite or a combination of these. Its flexibility allows architects to create striking designs for new buildings and refurbishment of old buildings. The reduction in weight leads to savings in structure and foundation. Coatings on the glass panels can enhance the thermal insulation of curtain walls. The use of double glazing not only further enhances the thermal insulation of curtain walls, but also their acoustic performance. Glass curtain walls can be used with aluminium and granite panels with back-pans and insulation in spandrel areas. Strategic use of insulation in solid and opaque areas of the elevations can allow these lightweight systems to achieve high thermal performance. The panels can be pre-assembled under strict quality control and can incorporate architectural and solar control elements such as shading, lighting, light shelves and blinds. The use of modular and standardized panel sizes would speed fabrication and keep the cost down. For areas of larger span, glass and aluminium can be used with steel sections, trusses and tension systems to provide light and highly

transparent walls as shown in image 45 below (Building and Construction Authority, Singapore, 2007).



Image 2.45: Recycled glass cladding wall (Source: Polycor Vetrazzo Inc., 2011)

2.7.4 Recycled Glass and Sustainability

The inherent properties of glass make it a strong sustainable solution for the interior design professional. Recycled glass surfaces meet high performance criteria for quality and durability and have the following advantages:

Ease of maintenance: A recycled glass surface can be cleaned with a damp cloth, liquid soap or mild detergent. Used as a countertop it requires periodic sealing like granite and other stone. The glass surfaces will require occasional waxing for enhanced stain resistance, however, glass by its nature is vitreous and non-staining (Polycor Vetrazzo Inc., 2011).

Heat resistance: A resin-based surfaces such as quartz and solid surfaces can withstand only up to 300 degrees Fahrenheit, however, recycled glass surfaces can withstand temperatures of over 600 degrees Fahrenheit making them superior surfaces for kitchen counters. The process of combining the thermal properties of cement with the thermal properties of glass creates a product with superior thermal resistance (Celeste, 2010).

Durability: Recycled glass surfacing is similar in density to granite. It has greater strength than concrete or marble. Some recycled glass surfaces have 10-year warranties (British Glass Manufacturers' Confederation, 2011).

Scratch Resistance: Recycled glass surfaces have been tested and found superior to marble or solid surfaces for scratch resistance and they are comparable to stone surfaces. As mentioned above, glass is highly resistant to scratches falling between a 6 to 7 on the Mohs scale (The Glass Portal, 2012).

Stain Resistance: The porosity of recycled glass surfaces is better than concrete and similar to marble because glass itself is an inert substance impervious to stains. Although most of the surface is comprised of glass, regular sealing will extend performance (<http://www.glazette.com/Glass-Knowledge-Bank>, 2012).

Colorfastness: These counters can be used near windows, skylights and outdoors. Recycled glass surfaces with cement binders are impervious to UV light, unlike polyester resin binders that may be prone to discoloration (Celeste, 2010).

Standard Fabrication: Recycled glass surfaces use the same equipment and techniques as those used for natural stone. Fabricators who work with stone find it easy to fabricate recycled glass surfaces. As with any high-end material, the fabricator should measure thrice to cut once. Because of the unique quality of the glass mosaic pieces, the installer may need to cement inlays to fit. Recycled glass panels do not require a plywood substrate. A variety of edge profiles, are available and skilled fabricators can work with the client to determine which profile is best for their project. Typically same skilled craftsmen who work with granite, etc. can expertly fabricate recycled glass surfaces (www.bogenriefstudios.com, 2012).

Food safety: Some recycled glass surfaces are tested and certified by relevant regulatory bodies for food safety and can be used in numerous commercial applications (Polycor Vetrazzo Inc., 2011).

2.8 Barriers to Sustainable Interior Design

One of the most important elements of sustainable design is the use of recycled waste materials in interior spaces. For this reason the researcher assumed that barriers encountered when using recycled waste materials in interior spaces may be grouped together with those encountered by interior designers as they utilize sustainable interior design practices. Pidcock (2005) argues that the design industry is well placed to take a fresh look at problems and create design solutions that are both creative and

desirable. Embracing sustainable interior design practices could however present a number of challenges to designers. According to Hes (2005) integrating green innovation into the built environment is a “*wicked*” problem, which makes identifying barriers hindering this practice essential (Aye, 2003; Mate, 2006). Stieg (2006) presents similar observations in referring to the practice of sustainable design as both difficult and complex. Designers should therefore understand the social and moral obligation associated with sustainable design whilst acknowledging that the practice of sustainable design presents various difficulties.

Research conducted in the United States of America (US) and Australia suggest that although there is interest in sustainable interior design, its frequency of application is poor (Aye, 2003; Kang & Guerin, 2009; Mate, 2006). These authors identified multiple barriers to incorporate sustainable interior design into practice. These include perceived cost (Aye, 2003; Mate, 2006); time to source materials, education and training, understanding and in house experts (Aye, 2003). Studies also identified client resistance and demands (Aye, 2003; Hes, 2005), client knowledge and call backs from clients (Davis, 2001), knowledge of materials, limited material selection and authenticity of suppliers (Mate, 2006), along with understanding of the impact of materials (Kang & Guerin, 2009), accurate and accessible information and appropriate tools (Aye, 2003; Hes, 2005; Davis, 2001).

2.8.1 Attitude

Abuthnott (2009) explained there is less of a chance of making a sustainable choice when an action, in this case a sustainable interior design practice, is perceived as beyond ones control. Among the possible barriers to using sustainable interior design practices is attitude. Does attitude play an important role in choosing sustainable interior design practices, and is ones attitude toward these practices enough to make a difference and overcome other barriers encountered (that is, project capabilities, transition to sustainability, knowledge and skills)? In their study, Kang and Guerin (2009) sought to determine the characteristics of interior designers who are applying environmentally sustainable interior design in their work.

They used a purposeful sample of members of the American Society of Interior Designers (ASID). Personal characteristics studied were geographic region of

employment. Professional characteristics studied were education, experience, examination, and regulation. Results showed a relationship between interior designer characteristics and the frequent use of environmentally sustainable interior design. Project size was the only predictor of how often environmentally sustainable interior design was used. Larger interior design projects used environmentally sustainable interior design more frequently. An interior designer's specialty was related to the importance designers placed on environmentally sustainable interior design practices. Those who specialized in child care and educational facilities were most concerned with sustainable interior design followed by hospitality/ entertainment, financial institutions, health care, government/ institutional, corporate/ office, and residential (Kang and Guerin, 2009).

Marchand and Walker (2007) studied consumer characteristics. They examined the motivation for pro-environmental behavior and responsible consumption and found four common profiles describing participant's reasons for sustainable lifestyles: eco-efficient simplifiers, better world simplifiers, quality of life simplifiers, and involuntary simplifiers. Eco-efficient simplifiers did not consume less; instead they substituted their regular products with eco-efficient products. Better world simplifiers adopted sustainable lifestyles to better the world, and for personal benefit. Quality of life simplifiers lived a sustainable lifestyle to improve their quality of life. Involuntary simplifiers simplified because of financial constraints. Environmental and social issues did not motivate involuntary simplifiers. All groups intend to consume less, but lacked a true understanding of how their actions influence the world (Marchand & Walker, 2007).

2.8.2 Clients

Barriers and motivators concerning construction waste were identified by Osmani, Glass, and Price (2007) in their research on waste minimization. The major barrier to waste reduction was a lack of interest from clients, followed by the view that waste was inevitable, poorly defined individual responsibilities, and a lack of training; only 14% had attended a waste minimization course. This lack of training created a barrier to minimizing waste in the design process. On the other hand, respondents agreed that financial rewards and legislation were incentives that encouraged waste minimization. Overall, factors hindering waste reduction were impacts on the generation of

construction waste, a lack of client concern, poor understanding of waste origins and improper training (Osmani et al., 2007). Rider (2005) found architecture and interior design respondents were interested in sustainability for the following reasons: marketability, professional reasons, internships, service learning, and recreation interests. Other reasons for an interest were a speaker's influence, travel, formal education, conference attendance, books or articles, co-workers, acquaintances, upbringing, or other miscellaneous factors. Many design professionals were involved with green design because of a fundamental dedication to sustainability (Rider, 2005).

2.8.3 Perceived costs

Project capabilities form another area of possible resistance to the implementation of sustainability. The cost of implementing green measures might negatively affect behavior (Fujii, 2006). Further, there is, on average, an additional 6% in construction costs to building green (Fleming, 2009). Applying sustainable design practices within the time constraints and deadlines of a project can be a challenge. Osmani et al. (2007) looked at the impact architectural design practices have on construction waste in the U.K. They found last minute design changes by clients, other design changes, and detailing errors were the highest cause of design waste. Not designing to minimize waste, not designing for standardization, and not implementing a consultation process were other contributing factors of design waste (Osmani et al., 2007).

Contextual factors and infrastructure also play a role in the implementation of sustainable practices. Pro-environmental lifestyles are stifled by current infrastructure and product choices (Marchand & Walker, 2007). It has been suggested sustainable behaviors be made more convenient (Fujii, 2006), and money be spent to reduce the cost of sustainable behaviors rather than given to industries that degrade the environment. Further, legislation has the ability to encourage pro-environmental behavior, and should be taken into consideration by leaders and lawmakers (Arbuthnott, 2008; Fujii, 2006). In Kagawa and Fumiyo's (2007) exploration of student's understandings and perceptions of sustainable development, they found that students felt responsible for the environment as consumers. They suggest university infrastructures facilitate pro-environmental actions, and provide opportunities for students to influence the greening of campus regulations (Kagawa & Fumiyo, 2007).

Osmani et al. (2007) found legislation and financial rewards were incentives for waste reduction during the design process. Their findings suggested rewards instead of fines as a more effective approach to waste minimization rather than voluntary waste minimization (Osmani et al., 2007). Stern pointed out that the behaviors of many could be changed simultaneously with the use of public policies (Stern, 2000).

2.8.4 Codes, tools and labels

Several codes, tools and labels pertaining to sustainability are emissions guidelines such as, Green-guard, the Carpet and Rug Institutes Green Label (Loftness et al., 2007), and LEED requirements. Participants might use tools because of demands from national, international or public body legislation, to gain a perspective on a present situation, to find alternatives to business operations, and for better management of the decision making process. The desire for a green image might motivate people to use a sustainable measurement tool. There are benefits associated sustainable practices, for example, from a green label might come public finance opportunities, greater chance of building quotas, and backing from local authorities. Reasons for not using tools are a lack of motivation and openness; the tools create more difficulty when there is no perceivable gain or obligation for using a tool. A lack of motivation and openness were reasons planners, designers, consultants did not use urban sustainability tools in the research by Jensen & Elle (2007). Little knowledge of a tool and the extra time it takes to find the correct tool also prevented a tools use (Jensen& Elle, 2007). More knowledge of tools may be necessary to promote sustainable practices. Ruff and Olson (2009) concluded respondents did not have an adequate interpretation of environmental sustainability, but it could be strengthened through a change in interior designer education whereas green professionals in another study did not consider their education a factor in their interest in sustainability (Rider, 2005).

2.8.5 Education

The study by Ruff and Olson (2009) addressed the education of interior designers. It was an investigation of the attitudes of interior design students toward environmental sustainability. Ninety-five students enrolled in all levels of interior design courses in the same program participated. The survey consisted of four parts: demographics, ecology, sustainability, and comments. They found respondents had a pro-

environmental and pro-sustainable attitude, yet they did not have a complete understanding of environmental sustainability. Most respondents thought the Earth's resources would renew themselves, and many students believed man was superior to nature, and relied on technology to correct man's mistakes. Students felt they could use sustainable products in commercial and residential projects; however, they were unsure about directing clients to examples of sustainable homes (Ruff & Olson, 2009).

Arbutnott (2008) suggested technology as a way to allow individuals to live as they always have while lessening environmental impact. From a slightly different point of view, McDonough states the importance of designers to creating a sustainable world in the midst of technology that has potential to negatively affect the world (McDonough, 2002). Resistance to change might be caused by industry culture (Teo & Loosemore, 2001). As noted earlier current infrastructure does not always allow for sustainability, and environmentally sustainable behavior will require more effort as society adjusts (Arbutnott, 2008). Knowledge and skills concerning sustainability include new practices and products. New green sustainable building materials are unfamiliar, keeping professionals from using them (Osmani et al., 2007). Although it is evident that a number of international studies have been conducted regarding this topic, similar studies on barriers to sustainability with special reference to use of recycled waste glass in local interior spaces are not available.

Osmani et al. (2007) ranked a lack of client interest and changes to meet client's requirements and preferences as a leading cause of design waste. Many studies suggested educating clients and the public as an important step in achieving sustainability (Fujii 2006; Arbutnott, 2008; Osmani et al., 2007). Properly educating end users about the importance of sustainable design decisions can encourage sustainable choices. The occupants of a building have a large impact on indoor air quality, the selection of materials, finishes and products, furnishings and appliances, and maintaining healthy indoor environments (Loftness, 2007). When considering consumer education, Arbutnott (2008) found public education was more effective when focused on specific pro-environmental behaviors rather than larger environmental issues (Arbutnott, 2008). Additionally, educational interventions promoting equal opportunity and active engagement that contrast education models characterized by competition or individualistic goals and a passive environment were

related to higher levels of efficacy and personal responsibility toward global warming among children (Devine-Wright et al., 2004).

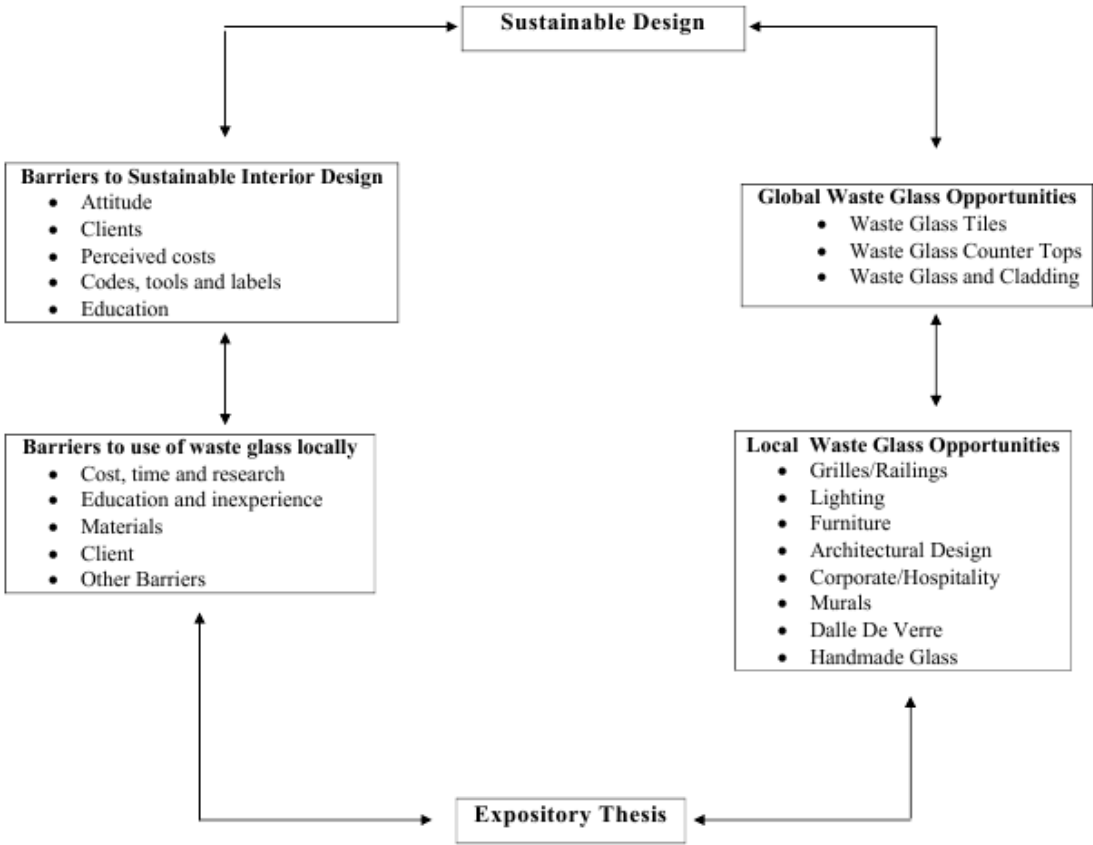
2.9 Summary

From literature review, it emerged that there are vast opportunities for use of recycled waste glass in interior spaces. It is important for interior designers to apply and use green design in their projects through re-use of reclaimed materials from waste which will not only lower but will also assist in minimizing environmental degradation and at the same time solve interior design problems. However, interior designers are likely to encounter various barriers in use of recycled waste glass in interior spaces. The researcher aimed at investigating and establishing those barriers by having a closer look at attitudes and factors that might present barriers to the use of environmentally sustainable design practices part of which recycled waste materials could be an important component. Waste glass was the reference point.

2.10 Conceptual Framework

Zeisel (2006) recommends that concepts which help to order information are formed from available data. In line with this, the conceptual framework of the study was formulated from information gathered from the review of literature. The framework was the basic research process and the review of literature was used to form the conceptual framework of the study. According to the problem of the study, use of waste glass in local interior design is an area that has not been studied extensively so far. It therefore follows that interior designers may encounter barriers when using waste glass in interior spaces and therefore the double benefit of solving interior design problems while saving the environment is hardly realized. It was therefore considered appropriate to undertake the research as a descriptive one aimed at bringing clarity to an area that is little explored (Zeisel, 2006). Further, the pilot study revealed that the data required was largely qualitative in nature. According to Mugenda and Mugenda (1999) and Serekan (2003) data collection in a descriptive study can best be done through observation. Zeisel (2006) seconded this by proposing that empirical testing in design related fields can be done through observation and sampling.

Illustration 2.1: Conceptual Framework



(Source: Author, 2012)

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Overview

In this Chapter, the research methodology is discussed. A qualitative research approach was employed. The aim was to establish whether there are opportunities for use of recycled waste glass in interior design and what barriers are likely to be encountered in the use of recycled waste glass in interior spaces. Through personal interaction with people in the interior design field, the study aimed to present thick and rich descriptions by critically reflecting on data elicited from field study. Ethical clearance was obtained from the University of Nairobi prior to commencing with the field study. Methodology included collection of primary and secondary data. Secondary data was collected through the review of literature concerned with the subject matter from publications such as books, reports, articles, journals, academic papers as well as web sources. Primary data was collected from a selected group of interior design firms, waste glass artisans, clients and customers, interior space owners and users, and other stakeholders. Much of the information was collected through in-depth interviews, non participant observation, and examination of existing records. Analysis of the data collected involved field notes, narratives, records and visual observations that can only be submitted as photographs.

3.2 Research Design

In this study, a descriptive qualitative approach was used to help understand social phenomena in a natural rather than an experimental setting while emphasizing the experiences, attitudes, and views of the participants rather than providing quantified answers to a question and to explore the research question as this is well suited to the study of human experiences and the aim was to gain an understanding of interior designers' experiences of barriers when using recycled waste glass in interior spaces (Nieswiadomy 2008). The research obtained data in the form of words, based on observations and interviews, rather than numbers which is the basis for quantitative research (Fawcett & Garity 2009).

Data collection instruments were pilot tested on interior designers, artisans operating within Nairobi's Ngong Road that is relatively near the study site, and also owners of interior spaces. The subjects were identified through a process of field search that included referrals. Most of the data will be presented in descriptive form while statistical data will be presented in tables. Review of literature revealed that the population of the study made up of individuals, artisans, interior design firms as well as professional interior designers was mostly concentrated within and around Nairobi. The case study method was therefore deemed the most appropriate sampling method because the information required was in-depth and contextual in nature (Mugenda and Mugenda, 1999). The choice of case studies was conditioned by the scarcity of information on the Interior Design sector and the recycled waste glass industry in Kenya. The Government Institutions concerned do not have complete records and the reasons provided were that most Interior Design enterprises were not registered at all while others are registered with different bodies such as the City council as businesses and the Registrar of Companies as companies. These records have not been compiled to provide one comprehensive record on the Interior Design sector. The case studies were therefore selected from Interior Design enterprises known to the researcher. The interior designers and waste glass artisans themselves were well informed concerning use of waste glass in interior spaces in Kenya and were helpful in providing information about other such enterprises.

3.3 Target Population and Sampling

The population is the entire group of people the researcher wishes to obtain knowledge from. A selection of these individuals is taken from this population and is known as the 'sample' (Gerrish & Lacey 2006). The sample provides the information and data for the study. According to Parahoo (2006) non-probability samples can be useful with qualitative research as "the purpose of qualitative research is to contribute to an understanding of phenomena" and the sample can be 'chosen' to best provide the required data for the study. It was difficult to estimate the actual number of interior designers working in Nairobi due to the fact that majority are freelance designers not formally registered and also because there are no professional registering bodies offering guidelines and regulations as to what defines an interior designer. Nowadays, most of those who refer to themselves as interior designers have

not really undergone any specialized training and are really interior decorators. Majority have also been trained in dubious colleges which do not offer in-depth training. Very few professional interior designers have registered their firms through registrar of business and works in collaboration with architects and artisans who are paid per job done.

3.3.1 Characteristics of the sample

As the author intended to specifically target Interior Designers dealing with recycled waste glass in interior design and spaces, purposive sampling was used, as the sample is chosen deliberately, “on the basis that those selected can provide the necessary data” for the study (Parahoo 2006). This allows the researcher to pick a selected group of individuals most appropriate to answer the questions and select the specific information sources required to gain insight into the research study (Burns & Grove 2011). As this research was self-funded with limited time available for the study, this sample technique and size allowed for easy access as it was cost effective.

The researcher approached a gatekeeper; an individual who enables the researcher access to the setting and research participants (Gerrish & Lacey 2006) for example, the head of an interior designer firm. Permission was sought from the artisans fabricating décor items using recycled waste glass, asking permission to conduct the study and further ethical approval was sought from the owners of interior spaces that have used recycled waste glass. A semi structured interview guide was sent to potential respondents from the target population. Contact information of the author was made available for further information or enquiries regarding the topic of study. Once the Board of Postgraduate approved carrying out of the research, a copy of the letter of permission was subsequently sent to the relevant respondents.

Inclusion criteria which involved characteristics the individual must have to participate and exclusion criteria which are attribute which excluded people from the study (Bloom & Trice 2007) was established. The sampling criteria for this study included that participants must be professional interior designers working with recycled waste glass in interior spaces, waste glass artisans, customers and clients whose interior spaces have used recycled waste glass, architects with knowledge of recycled waste glass in interior spaces and staff and students from the School of Arts

and Design at the University of Nairobi. According to Burns & Grove (2011) a small sample size can be adequate for a qualitative study, “when the quality of the data is high, with a rich content” and for this reason the author required a sample of between 15 and 25 interior designers for interviewing. It was proposed that these participants would achieve saturation of information, whereby “additional sampling provides no new information, only redundancy of previously collected data” (Burns & Grove 2011).

The author recognized this was a small sample size, however Bowling (2002) advocates the use of a small sample size when using qualitative interviews, as the focus is on quality of the information rather than quantity and the data aims to “*provide rich insights in order to understand social phenomena rather than statistical information*”. This sample size reduces time constraints of the interviewing process and the transcribing of the interviews (Parahoo 2006). Barroso (2010) supports the use of smaller sample sizes for qualitative research (under 30 participants) due to the large quantities of written text which will need to be analyzed by the researcher. Consequently, the author felt the sample size was appropriate for the study.

The unit of analysis was fifteen (15) interior designers out of the estimated twenty five (25). Elaborate field investigation, snowballing method and elimination were used to identify the fifteen (15) interior designers who can be said to be sample of the target population which fit the criteria for the investigation. Out of the estimated twenty five (25) the researcher interviewed at least twenty (20) of them which represented eighty percent (80%) of the population. Other persons involved in recycled waste glass in interior design were important in understanding barriers to use of recycled waste glass in interior spaces and included customers and architects. The purpose of investigating them was to validate some of the information already collected and also to highlight some of the barriers that hinder use of waste glass in interior spaces that could not be established from the interior designers themselves. The customers were identified through interior designers themselves and were randomly selected and were seen to be sufficient in representing other customers who have used waste glass in their interior spaces. It was expected that academic staff and students from School of the Arts and Design (StAD) in the University of Nairobi had knowledge regarding sustainable interior design practice and materials with emphasis

on the use of recycled waste glass in interior spaces. The table below provides an outline of the interior designers and other subjects who were interviewed.

No.	Description	No. of subjects
1	Interior designers	25
2	Waste glass artisans	5
3	Customers / clients	10
4	Interior space owners / users	15
5	Architects	5
6	StAD Staff	5
7	StAD Students	10
TOTAL		75

Table 3.1: Distribution of sample (Source: Author, 2012)

3.4 Data collection methods and procedures

For this study, the following research instruments were used to collect data;

1. Semi structured / Focused Interviews
2. Informal Interviews,
3. Observation and Non-participant Observation,
4. Archival research

3.4.1 Semi-structured interviews

The author used semi structured interview guide as the main method of data collection which allowed for a fixed set of questions but with no fixed responses (Burns & Grove 2011) and allowed participants to expand on points made in the conversation. Semi-structured interviews allow for flexibility that the researcher had not anticipated when preparing the interviews (Tod 2006). Interviews were more appropriate to use in this instance, as there was no previous research surrounding interior designers' experiences with barriers to use of recycled waste glass in interior spaces and therefore a questionnaire was inappropriate at that moment in time as the researcher did not know if there were issues or problems relating to opportunities of and barriers to use of waste glass in interior spaces. Qualitative research needed to be conducted

before quantitative research to assess if there were barriers with use of waste glass in interior spaces.

The author used face-to-face interviews rather than telephone interviews, as they were more personal and it was easier to explore participants' experiences face-to-face (Macnee & McCabe 2008). The interview lasted for between thirty (30) and Forty (40) minutes and followed an interview schedule (Tod 2006). The interview had an opening introduction, guiding questions and a final, closing statement; which remained the same for each interview to ensure consistency. The questions which were used for the interview had emerged from the literature review conducted prior to the commencement of this research study, and were pilot tested to see if the questions would answer the research questions. Through the use of individual interviews, the author sought to understand personal attitudes and beliefs surrounding the topic (Jackson et al. 2008).

3.4.2 Informal Interviews

The researcher used informal interviews to gather information and to probe or ask follow-up questions. Informal interviews were chosen because most of the target population was more comfortable with this method which allowed for use of informal language (Sheng) especially the artisans. Also there was a lot of work going on in the fabrication workshops when the interviews were being conducted and this allowed the work to go on as the interview was being conducted through informal discussions. The advantages for using informal interviews being that: they provide in-depth data which is not possible to get using a questionnaire; they guard against confusing the questions since the interviewer can clarify the questions thereby helping the respondent give relevant responses; they are very sensitive and personal information can be extracted from the respondent by honest and personal interaction between the respondent and the interviewer; and they yield higher response rates mainly because it is difficult for a subject to completely refuse to answer questions or to ignore the interviewer (StudyMode.com, 2011).

3.4.3 Observation and Non-participant Observation

Observation involved the identification of the phenomenon to be observed, getting the right tools such as camera or note books and information on how waste glass has been

used in interior spaces was captured through photography. A digital camera was used so as to make the transfer to computer easy. Note taking was also used to capture points and activities that required greater detail. Observation allowed the researcher to capture information that would otherwise be difficult to capture using other means. For example, how waste glass has been used in interior spaces which is the focus of this research. The main advantage of this method is that it is not possible without observation to transcribe “unspoken” ways in which waste glass is transformed in interior spaces into information that can be analyzed (StudyMode.com, 2011). Non participant observation required the researcher to observe without interfering with the on-going activities. This method allowed the researcher to record non-verbalized phenomenon and visual elements that could only be recorded using visual observational tools.

3.4.4 Archival Research

Archival research was used to review relevant literature for the study. This was sourced from publications such as books, reports, articles, journals, academic papers, web sources, local authority’s by-laws as well as any other literature that contained relevant material and information to this study.

3.5 Data analysis

According to Burns & Grove (2011) data collection and data analysis occur simultaneously in qualitative research, as the emerging results may require further data collection. The researcher concurrently gathered, managed and interpreted data. Accurate transcribing of audio-taped interviews as soon as possible after the interview was essential before data analysis could occur (Polit & Beck 2010). This can be time-consuming, as Bowling (2002) emphasizes for one hour of recording it may take up to four hours to transcribe verbatim. The author believed this validated the use of the chosen small sample size. The storage of data was done in an organized, secure manner and was disposed of confidentially and appropriately when necessary. Hand written information was typed into a word document for electronic secure storage with correct dates, locations and identities in the form of pseudonyms.

Colaizzi’s framework (1978) for descriptive analysis as cited by Polit & Beck (2010) was used for data analysis. The aim of this was to establish common patterns and

trends relating to interior designers experiences in use of recycled waste glass in interior spaces. There were certain stages involved in this process, as highlighted by Holloway & Wheeler (2002) and Polit & Beck (2010) as explained below;

- The researcher listened to each of the interviews, transcribed them verbatim and gained a broad understanding of same.
- Significant statements were extracted and meanings formulated from these. These meanings were organized into clusters of themes and grouped together, while ensuring these statements were original and not changed to fit into a theme.
- The results were integrated into an exhaustive description; which ensured the participants views were described accurately and appropriately. According to Holloway & Wheeler (2002) exhaustive description is “writing that aims to capture and describe the intensity and depth of the participants’ experiences”.
- The themes of the research study emerged from linking the patterns found within the exhaustive description and were discussed further.
- The researcher provided the participants with a copy of the findings in order to validate the results and ensure rigour.

3.6 Data presentation methods

Most of the data was presented in narrative, describing the opportunities and barriers to use of recycled waste glass in interior spaces.

3.6.1 Photography: Photographs were presented and complemented by descriptions to explain the circumstances and their relevance to the research. There were several aspects of use of waste glass in interior spaces that could not be explained appropriately without photographs that made the explanation more explicit.

3.6.2 Tables: Data that was collected from structured interviews was presented in tables and charts form. The tabulated data was complemented with narrations to explain their relevance to the research.

3.6.3 Narrative: Notes that were used during focus group discussions were analyzed and presented in narrative. Field notes were transcribed and clustered accordingly under various headings according to the research objectives.

3.7 Ethical Considerations

Written ethical approval was obtained from the School of the Arts and Design prior to the commencement of the study for the protection of the participants and their rights. Informed verbal consent was obtained from each participant before the study and this was after they had received adequate information, briefing and understanding of what participation in the study entailed as informed by Bowling (2002). Participants were informed of their right to voluntary participation and the right to withdraw from the study at any time without incurring a penalty, which protected their right to self-determination of participation as advocated by Burns & Grove (2011). All information obtained within the study was treated as confidential and stored securely as proposed by Parahoo (2006).

Within qualitative research total anonymity is not possible, as the interviewer will be aware of the participant (Burns & Grove 2011). The individuals were given an opportunity to adopt a pseudonym in order to maintain anonymity for the duration of the rest of the process in order to protect subjects and records (Zanotti & Cowman 2008). Confidentiality was maintained at all times by not disclosing the information shared to any other parties, without consent and by avoiding attributing information in the findings which would identify the participants (Parahoo 2006). Justice and fairness were upheld through equal opportunity for all eligible participants regardless of nationality, language and education levels.

3.8 Summary

The methodology adopted for the research was mainly qualitative. Data was collected using social and design methods such as photography. Data collection tools included non participant observation, interview guides, and photography and note books. Field notes was analyzed and presented as narrative, tables and photographs, complemented by descriptions. The population was drawn from interior design firms, waste glass artisans, clients or customers to waste glass artisans, interior space owners or users, and other experienced interior designers and architects who were not necessarily operating in formal interior design firms among others.

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION

4.1 Overview

This chapter focuses on interpreting data that was obtained from the primary research. Findings are based on interviews, photographs and observation. The data was analyzed using Microsoft Excel while the findings are presented in pie charts. While the tables attached in the appendix presents the frequencies of answers from the respondents, the pie charts present percentages of the same. The narrative analysis is presented above the pie charts. The researcher concentrated on assembling together data collected and started putting it in a form that would enable him to carry out analysis and interpretation. The author contributed to this study by highlighting barriers that interior designers are likely to encounter when using recycled waste glass to solve an interior design. In addition to this, the researcher highlighted possible mitigation effects to counter those barriers.

4.2 Analysis of Response

The researcher in this section sought to establish the response rate to interview guides issued to the respondents. As shown in Chart 4.1 below, the researcher scheduled a total of seventy five (75) semi structured interviews with the target population. Of these interviews, a total of sixty were successfully carried which was a response rate of eighty percent (80%). This survey can therefore be said to have been successful.

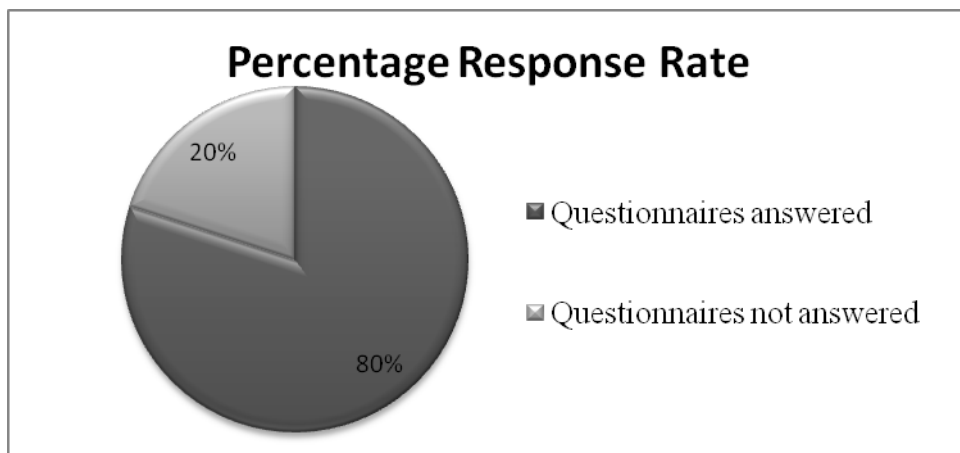


Chart 4.1: Response rate (Source: Author, 2013)

4.2.1 Profession Category of Respondents

Here, the researcher wanted to establish the various professional categories of the respondents as indicated in Chart 4.2 below. The results show that the respondents professions were distributed as follows: interior designers who comprised 32% of total respondents, waste glass artisans who comprised 9% of total respondents, customers/clients who comprised 9% of total respondents, interior space owners / users who comprised 16% of total respondents, architects who comprised 9% of total respondents, members of staff from School of the Arts and Design, University of Nairobi who comprised 9% of total respondents, and students from School of the Arts and Design, University of Nairobi who comprised 16% of total respondents.

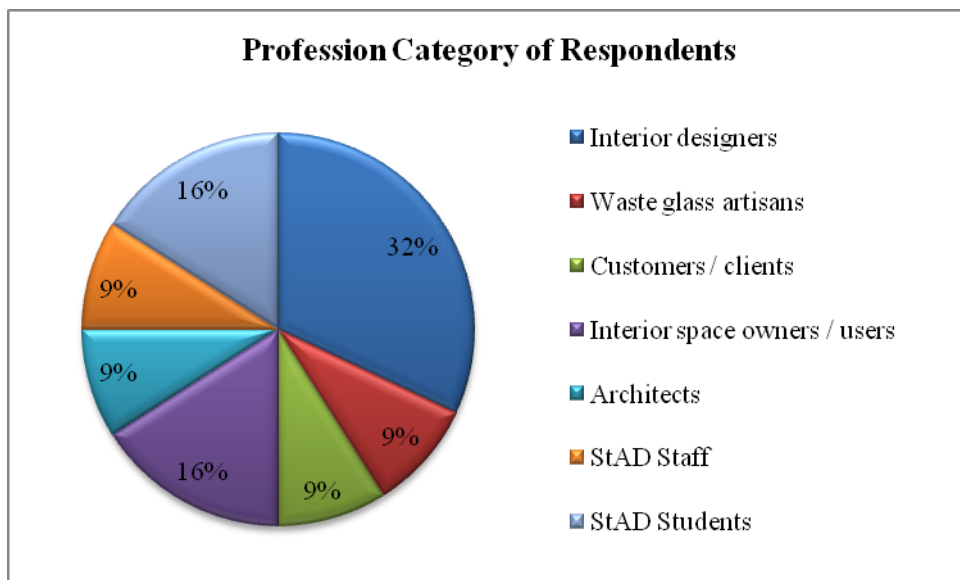


Chart 4.2: Professional category of respondents (Source: Author, 2013)

4.2.2 Opportunities for use of recycled waste glass in interior spaces

The researcher further sought information from respondents on what opportunities they had utilized in using the waste glass in interior spaces. The results in Chart 4.3 below indicate opportunities identified by the respondents: interior finish material (7%); décor purposes (22%); part of grills and railings (7%); fabrication of furniture (9%); part of architectural design (3%); part of light fittings (25%); making murals (11%) and lastly converted to décor items (16%).

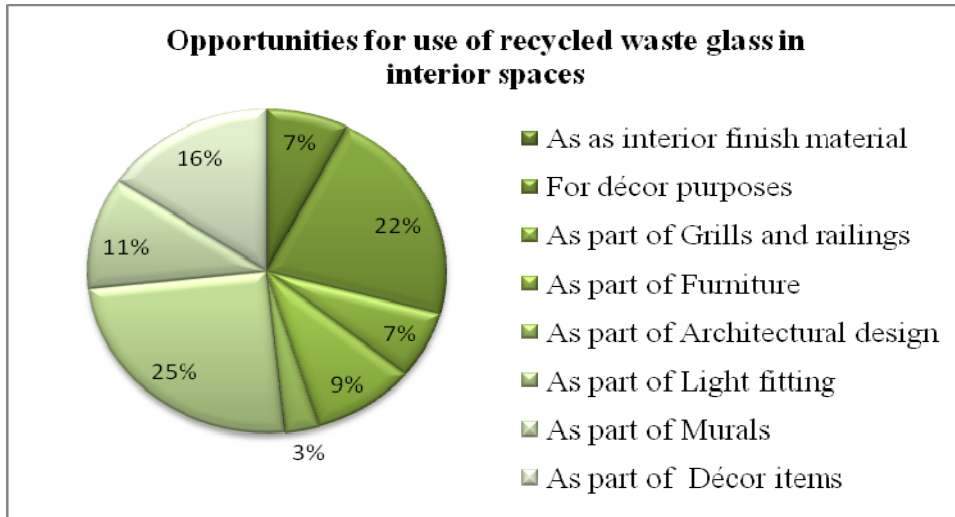


Chart 4.3: Opportunities for use of recycled waste glass in interior spaces
(Source: Author, 2013)

4.2.3 Barriers to use of waste glass in interior spaces

The researcher with this question sought information on what barriers the respondents had experienced in using waste glass in interior spaces. The results in Chart 4.4 below show that 24% of the respondents indicated lack of enough time to source for, fabricate and use waste glass in interior spaces as being one of the biggest barrier. Lack of enough information on sustainable interior design and the benefits of using recycled waste materials in interior spaces were also cited as a barrier by 24% of the respondents.

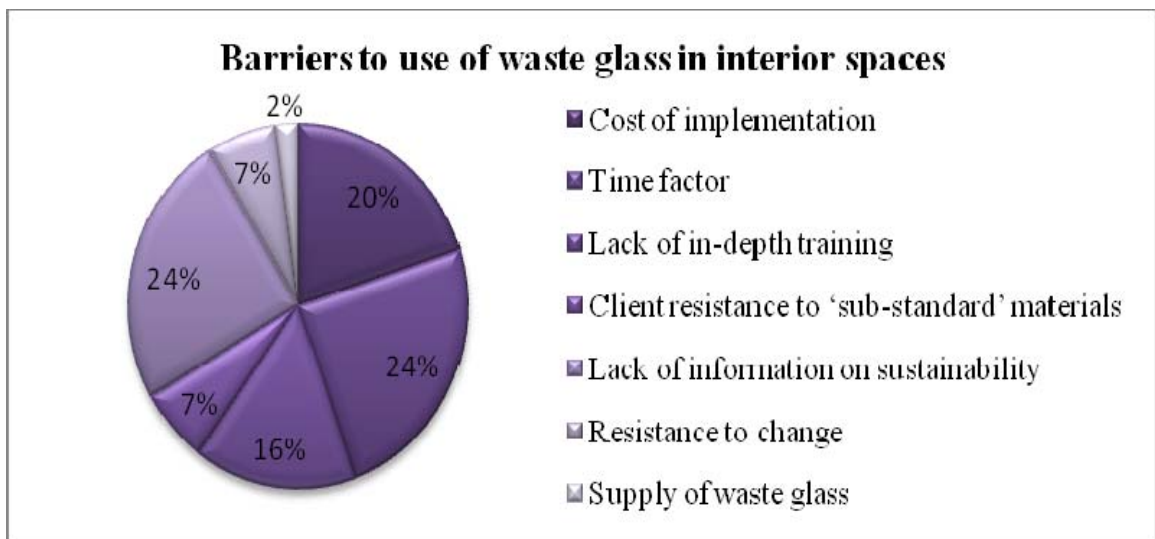


Chart 4.4: Barriers to use of recycled waste glass in interior spaces (Source: Author, 2013)

Other barriers were: cost of implementation (20%); lack of in-depth training to the artisans and interior designers on how to effectively fabricate and use waste glass in interior spaces (15.5%); client and space owners’ resistance to “sub standard” materials (6.6%); resistance to change by stakeholders in the interior design industry and refusal by the same stakeholders to explore, use and recommend recycled waste materials in interior spaces (7%) and inconsistent supply of waste glass to the artisans (2%).

4.2.4 Overcoming barriers to use of waste glass in interior spaces

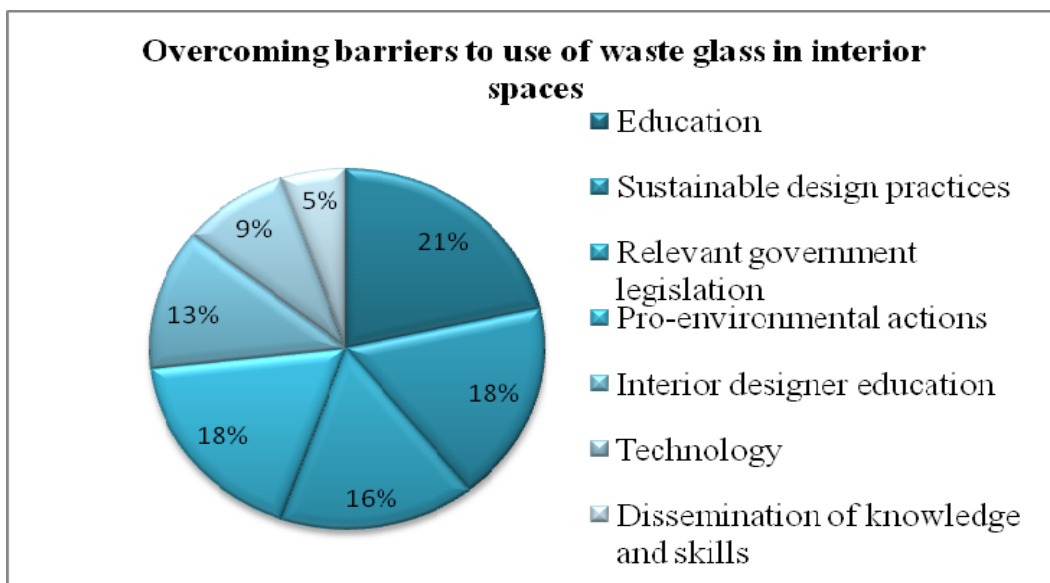


Chart 4.5: Overcoming barriers to use of recycled waste glass in interior spaces
(Source: Author, 2013)

The researcher further sought information from respondents on how the barriers they had identified in the previous interview guide question could be overcome. From the responses as indicated in Chart 4.5 above, the respondents felt that the following should be done to encourage use of recycled waste materials in interior design and spaces: Educating stakeholders in the construction and interior design industry on the benefits of using recycled waste in interior spaces (21%); encouraging application and use of sustainable design practices (18%); relevant government legislations and implementation of policies encouraging waste recycling and re-use (16%); institutes of learning and higher education to be on the forefront of encouraging and supporting pro-environmental actions to raise awareness among learners the benefits of sustainability (18%); interior design education especially at the specialization levels at

the School of Arts and Design and other institutions offering the same course should factor and emphasis on sustainability with bias towards use of recycled waste materials in interior spaces (13%); use of technology to minimize waste production and modification of generated waste to suit application and use in interior spaces (9%) and finally dissemination of knowledge, information and skills to the public regarding advantages of using waste in interior spaces (5%).

4.3 Opportunities for use of waste glass in interior spaces

In this section, the different aspects of the data gathered from the survey and the interview are analyzed through narrative and photographs. This section will focus on meeting the objectives of this research on opportunities for use of recycled waste glass in interior design and barriers to these opportunities.

4.3.0 Kitengela Hot Glass

Anselm Croze was born in Cumbria in Northern England to an American zoologist father, Harvey Croze, and a stained-glass artist mother, Nani Croze. He came to Kenya with his parents and underwent home-schooling in a tent in Tanzania; later, Anselm went to study in France and Holland with master glass blowers. On the heels of these apprenticeships, he returned to East Africa in the early '90s. Anselm then decided to further explore his calling in glass blowing. The whole design process of recycled waste glass by Kitengela Hot Glass is sustainable and therefore the benefits outweigh hazards associated with raw glass production. Anselm informed the researcher that; *“Because we had no electricity, we had to be self powered, so a Finnish glassblower named Mikko Merikallio helped us to put in this steam-injected system that utilized recycled engine oil to power the furnaces and melt our material. Energy-saving processes such as these were important to us. Even back then we wanted to have a good working relationship with the environment”* (A. Croze, personal communication, November, 2012).

Anselm and his workers were learning as they went, blowing objects and casting glass that they then turned into furniture. Then Anselm's sister Katrineka began making glass beads and things started taking off. The team finished the front part of the studio, but in order to create the now-famous dome, Kitengela Hot Glass needed bricks. Anselm informed the researcher that; *“We sold goblets to build it and based*

the design on an old 15th century glass working furnace. Plus I thought the shape was cool. It took three or four years, but by the time it was done, we'd evolved from one studio into a number of them. As it turned out, the guys who'd been working with us needed jobs and I asked, 'Who wants to learn how to blow glass?' That's basically how Kitengela Hot Glass got started. We all just dove in" (A. Croze, personal communication, November, 2012).

The researcher found out that hundreds of different objects are made from waste glass at Kitengela Hot Glass, from individual glass artworks to entire collections custom designed for clients throughout Africa. Croze informed the researcher that their approach is very hands on. He observed that to make everything work both as a craft and a business, they've had to be very flexible in the things that they do, building it all up from scratch. He explained that they are inspired by the pragmatism of the Kenyan Jua Kali artisans who make shoes from tires, stoves and lamps from old cans, using discarded items to make needed objects. Croze further informed the researcher that pragmatism has been ingrained in their ethos.

4.3.1 Grilles/Railings



Images 4.46, 4.47, 4.48 and 4.49: Grilles (Source: Kitengela Hot Glass Ltd, 2012)

The researcher observed that Kitengela Hot Glass has an entire metal works section for making molds and the armature or skeleton for chandeliers, as well as garden gates, funky fences and pergolas for interior or exterior use. On metal moulds, Croze explained that they incorporate blown elements like plates, flowers or leaves, casted details and recycled bits of metal and glass which give a nice sort of filigree or spots of colour to objects that require a grille-like effect. The observation by the researcher revealed several designs as captured in the images in the previous page.

4.3.2 Lighting

Observation also revealed that Kitengela Hot Glass provides bespoke interior lighting solutions from a single embedded LED (light-emitting diode) in a paperweight to heavy chandeliers.



Images 4.50, 4.51, 4.52 and 4.53: Lights (Source: Kitengela Hot Glass Ltd, 2012)

Croze informed the researcher that the lighting that they do, which includes skylights, standing lamps and floor lighting, often comes from collaboration with Interior designers and architects who go to Croze needing specific elements, something that hadn't been done before, like a unique design for hanging lights fabricated from waste glass. The researcher photographed some of these lights as shown in the images below.

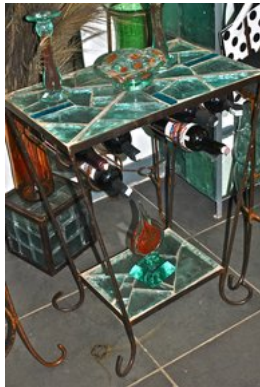


Images 4.54, 4.55, 4.56 and 4.57: Wall mounted and external lights (Source: Kitengela Hot Glass Ltd, 2012)

4.3.3 Furniture

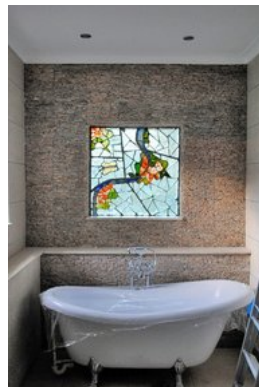
Croze informed the researcher that designing furniture using waste glass came from a need to create things that occurred to him. He explained that it was really born of

necessity and he might work out a piece for himself where he perceived a niche – like a kitchen counter or a spiral staircase. The researcher observed that Kitengela Hot Glass’s range of furniture fabricated from waste glass includes dining/cafe/coffee tables, chairs, bar stools, shelves, hanging seats, planters, fire pits and wine racks. These functional designs often incorporate sculptural accents, bits of metal or granite, or three-dimensional elements like paperweights as captured in the images below.



Images 4.58, 4.59, 4.60 and 4.61: Wine rack table, bar table & stools, and café table & chairs (Source: Kitengela Hot Glass Ltd, 2012)

4.3.4 Architectural Design



Images 4.62, 4.63, 4.64 and 4.65: Shower windows and a skylight (Source: Kitengela Hot Glass Ltd, 2012)



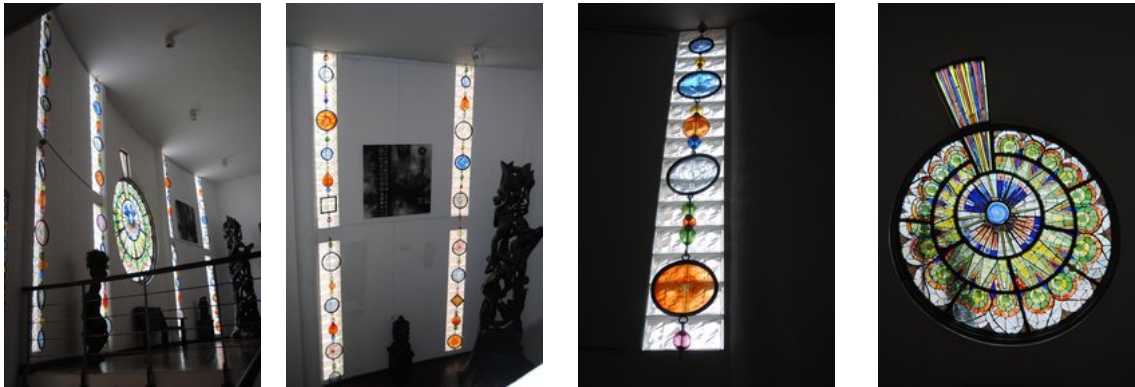
Images 4.66, 4.67, 4.68 and 4.69: Architectural blocks and a door surround (Source: Kitengela Hot Glass Ltd, 2012)

The researcher found out that blocks of waste glass from Kitengela Hot Glass get incorporated into an aspect of interior architecture such as a stairwell containing a floor light, or a sink with a mosaic of tile and glass. Of such one incorporation, Croze informed the researcher that they had previously transformed a verandah with clear panels (floor lights) that had little red sections with an LED (light-emitting diode) embedded in each block. He recalled that it had quite a surprising effect which was great in and of itself, because each block would glimmer, giving the impression that the verandah was lit from underneath. The researcher was further informed by Croze that in one Kilindi design, a lighting system is embedded in 400 blocks surrounding a “T”-shaped pool so that its edges give off light. Croze further recalled that in one hotel in Zanzibar, a series of dome-shaped accommodations with 48 glass blocks, half of which contain LEDs; create a stunning effect at night as rings of light seem to float in the air. Images above reveal some of these architectural designs as highlighted by Croze.

4.3.5 Corporate/Hospitality

The researcher found out that Kitengela Hot Glass’s bespoke recycled waste glass design collections for top restaurants and hotels have included the Fairmont Group (Norfolk Hotel, Fairmont Mara & Mt Kenya), Tamarind & Carnivore Restaurants and Sankara Hotel, as well as many others in Kenya, Tanzania & Uganda. From beer steins to mural work; from serving bowls to candle shields; from chopstick holders to condiment trays, these custom designs create solutions that synchronize with the ambience and experience of a particular place. Croze informed the researcher that the clients come to Kitengela Hot Glass with an object they haven’t been able to find, or

for something that has a high impact like handmade juice or wine glasses instead of sterile machine-made ones and request for a similar design.

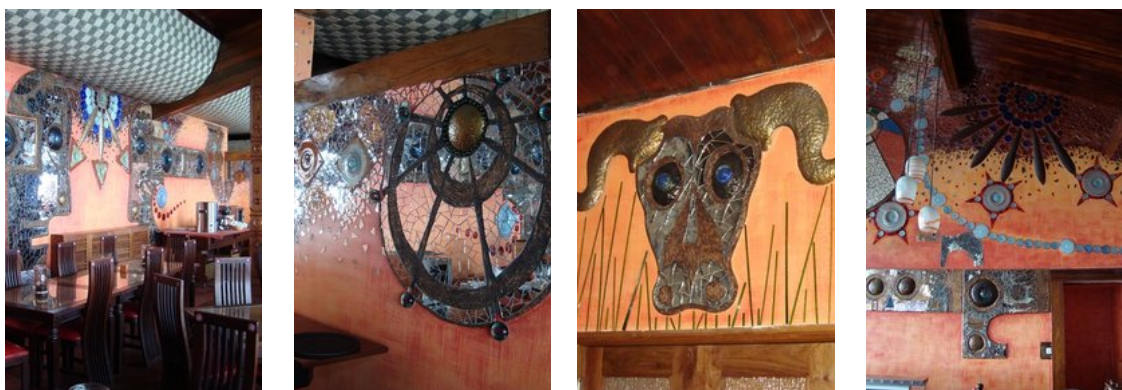


Images 4.70, 4.71, 4.72 and 4.73: Cultural Heritage Art Gallery 'Maasai Necklace'

(Source: Kitengela Hot Glass Ltd, 2012)

The researcher further found out that one of Kitengela Hot Glass's most compelling commissions has been a mural for the Cultural Heritage Art Gallery in Arusha, Tanzania. Croze's team created an abstract representation of a Maasai necklace. Croze informed the researcher that because of its size, the glass design had to be separated into 13 different panels like a huge puzzle. Using uncut murrine (coloured square one-inch canes of glass) to give the effect of a piece of jewelry, the striking mural also involved tinga-tinga (a traditional Tanzanian painting style) influences, Dalle de Verre sections of glass with flattened paperweights that light up inside, and strands of coloured discs (giant jewellery) spaced between large blown beads which frame the design.

4.3.6 Murals



Images 4.74, 4.75, 4.76 and 4.77: Ngorongoro Wildlife Lodge mural dining

(Source: Kitengela Hot Glass Ltd, 2012)

Murals made out of waste glass were found out to be one of the signatures of Kitengela Hot Glass by the researcher. Observation revealed that attached pieces of pre-blown or casted waste glass, different painting techniques, inlays, wood and metal make for explosions of colour and texture. At Ngorongoro Wildlife Lodge, the researcher was informed that Anselm and his team have created an elaborate and definitive mural, utilizing nearly every technique at their disposal. Croze informed the researcher that commission all added up to coherence for the piece and it was fun, like being in a big paint box. He further observed that the mural was originally supposed to be one wall but it lifted everything else up, so Croze's team extended it right up to the entrance of the hotel to result in a very comprehensive treatment.

4.3.7 Dalle De Verre



Image 4.78: Pioneer House **Image 4.79:** Door surrounds **Image 4.80:** Tinga tinga giraffe (Source: Kitengela Hot Glass Ltd, 2012)

On Dalle de Verre technique, Croze explained that it has been interpreted by Kitengela Hot Glass into everything from furniture and floors to sculptures and shelves. He explained that they started Dalle de Verre as a result of doing stained glass. He further explained that he was melting waste glass and discovered that there were many new and exciting things he could do with this medium. Croze informed the researcher that Dalle de Verre, was taught to them by a German master, Alphons Bippus. He observed that they take chunky blocks of waste glass and carve them up with a tungsten-tipped hammer according to whatever design they feel like. They then use a steel mold to cast certain specific, difficult shapes like stars or sharply-curved sections. Croze further explained that the glass pieces are then cast into a cement and wrought iron matrix to create colourful panels. Freestyle and freehand, one of

Kitengela Hot Glass's most elaborate Dalle de Verre designs by Anselm is a glass-and-mirror abstract sculpture that forms a three-story wall of Pioneer House, Nairobi (replacing a damaged ventilation wall, a result of the bombing of the neighboring U.S. Embassy in 1998).

4.3.8 Handmade Glass



Image 4.81: Handkerchief bowl (Source: Kitengela Hot Glass Ltd, 2012)

The researcher was informed by Croze that repurposing factory-made glass is quite tricky because it's not designed for hand work; rather it's originally made for a machine and that is why he prefers working with waste glass. He further observed that the colouring factor is a big issue if you're working with various sources of waste glasses and as a result, one needs strong colouring agents which can be achieved by running different colours through furnaces to produce unique results. Croze further informed the researcher that melting tinted office window glass yields a chic grey; wine bottles give shades of olive to emerald; and plain scrap window glass results in a classic recycled aqua as shown in the decorative handkerchief bowl in the previous page.

4.4 Tonney Mugo of Kuona Trust

The researcher found out that Kuona Trust is a not-for-profit organisation founded in 1995 at the National Museum of Kenya to serve visual artists. It has since worked with over one thousand five hundred artists giving them skills and opportunities to advance themselves while increasing the profile and role of the visual arts in Kenya. Its artists' studios, library, programme of exhibitions, artists' talks, training &

mentoring, education and international exchange aims to provide opportunities for artists to develop new and experimental contemporary artwork within a context of international current practice. Sources within the trust informed the researcher that Kuona provides a platform for innovation through art and creativity. Kuona's Mission is to advance the skills and opportunities of contemporary visual artists to create innovative, world class art in Kenya while its vision is *"Art is a valued and integral part of our society."*



Image 4.82: Tonney in his studio during interview (**Source:** Author, 2013)

Among the many artists operating from Kuona, the researcher found out that one of them is Tonney Mugo shown above in image 4.82, working with waste glass as a design medium. Having worked with waste glass since 1991 Tonney seeks to make a meaningful contribution to society while adding value, drawing from his experience, education, training background and the working environment at large. He designs on glass and seeks to reflect and enhance the architectural setting while expressing a meaning for aesthetic that goes beyond mere decoration. His designs provoke thought inspire interest and challenges tradition. His work is done under private practice but within Kuona Trust.

The researcher observed that Tonney Mugo incorporating techniques which in addition to traditional lead work include; sandblast carving and etching, wheel and flexible drive engraving, glass painting and fusing as shown in image 4.83 below, laminating and mosaic.



Image 4.83: Mixed media art (Source: Author, 2013)

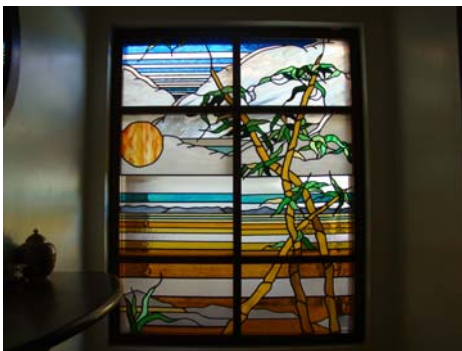


Image 4.84: Stained glass partition

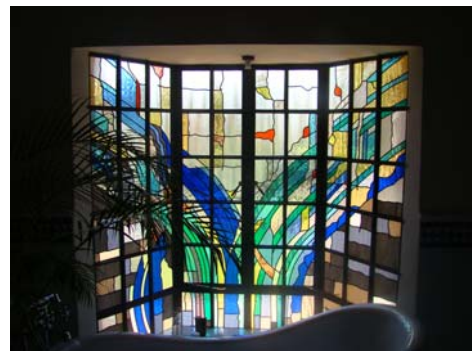


Image 4.85: Stained glass window

(Source: Tonney Mugo, 2013)

The researcher further observed that Mugo fabricates design solutions for interior and exterior spaces using waste glass designs to architectural specifications such as the stained glass partition and window shown above in images 4.84 and 4.85 shown above.

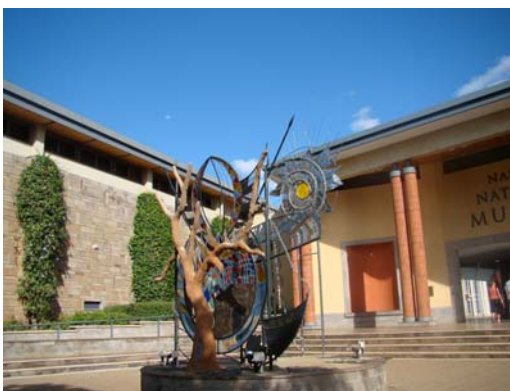


Image 4.86: 3D National Museum of Kenya outdoor art



Image 4.87: 3D indoor art

(Source: Tonney Mugo, 2013)

Tonney further informed the researcher that other design which he does include mixed media art outdoor designs such as the one he did for National Museums of Kenya as shown in image 4.86 and 3D indoor décor art works as shown in image 4.87 in the previous page, and lighting all fabricated using recycled waste glass as shown in images 4.88 and 4.89 below:



Image 4.88 and 4.89: Ceiling lighting (Source: Tonney Mugo, 2013)

4.5 Maxicrafts Wrought Iron

In seeking to further establish other opportunities for use of waste glass in interior spaces, the researcher found out that Maxicrafts is another established company based at Gikuyu Close, Racecourse Nairobi Kenya which undertakes any aspect of stained glass fabrications for customers throughout East Africa. The researcher established that at Maxicrafts, the workforce measures and provides on-site expert custom designs, fabrication and fitting of ornamental works for both residential and commercial interior design premises for stained waste glass finishes.

With reference to stained glass and use of recycled waste glass in interior spaces, Max Waithiani, the owner and proprietor informed the researcher that Maxicrafts have had a lot of experience providing professional service to various client base one of which was Mercury Group who set up an up-market Irish style Bar and Restaurant at Nakumatt Junction Center along Ngong Road. In images 4.90 and 4.91 in the next page, Maxicrafts designed and fabricated floor lights using blowing method and

consulted an electrician who wired and fixed the lights. And as shown in images 4.92 and 4.93 below, Maxicrafts used recycled glass waste to come up with table screens and window panes.



Image 4.90: Table Screen



Image 4.91: Free standing lighting

(Source: Max Waithiani, 2013)



Image 4.92: Close-up of table Screen



Image 4.93: Stained Window (Source:

Max Waithiani, 2013)

4.6 Barriers to use of recycled waste glass in local interior spaces

Four main barriers among others were identified through the study, namely: cost, time and research, education and experience, materials and the client.

4.6.1 Cost, time and research

A major barrier to use of waste glass in interior design as identified by majority of the interviewees was cost. Tonney Mugo of Kuona Trust informed the researcher that the costs involved in opting for use and implementing design solutions with waste glass were usually an overriding barrier.

Nani Croze of Kitengela Hot Glass informed the researcher that startup capital was a big issue:

“Kitengela started as a pioneer homestead and grew into an oasis. As the area is semi-arid, few trees would grow, so we began to build our own shade in the form of sculptures. Money was always scarce so we used available materials; grass, mud and stone. Setting up was not easy and even with the back drop of Kitengela Hot stain Glass, we struggled to raise startup capital. We needed to buy furnaces, gas and oil tanks as well as operating capital. Luckily Mikko Merikallio, a Finnish friend, agreed to design and build the glass blowing furnaces for us. The furnaces are powered by steam injected oil a system that takes into account the fact that there are no amenities like electricity, water or gas in the bush” (A. Croze, personal communication, November, 2012).

When discussing the amount of capital required purchasing necessary tools and equipment for turning the waste glass into interior space design solutions, Tonney observed:

“The costs are beyond reach for those aspiring to work with waste glass especially in terms of tools. They’re expensive things and often when people are forced to face up to that, they get scared” (Mugo, personal communication, November, 2012).

Discussing the implications of cost, Max of Maxicrafts explained that:

“It is more expensive to fabricate waste glass designs especially if the client insists on using coloured glass which is more expensive, so you need clients to be on board to pay a little bit extra. You need someone to really want to do it” (Max, personal communication, November, 2012).

In essence the waste glass artisans agreed that it was always about the bottom line. According to them, at present waste glass fabrication and tools carry cost implications. This is due to a number of factors, a few being lack of capital for start

ups, the fact that not many can afford to undergo training and, being fashionable, carry a novelty price tag.

In terms of immediate savings the artisans explained that as far as possible, clients want immediate savings. Max stated:

“People want immediate saving as opposed to long term saving” and “the issue that a lot of people don’t want to hear is that there are some upfront costs, so you would be investing more money” (Max, personal communication, November, 2012).

Time was identified by most of interior designers as another cost-related barrier. They expressed difficulty in finding time to do research into what a client would like incorporated in their interior spaces using waste glass due to lack of awareness on how waste glass can be used in those spaces. Also most of the time, the project being undertaken is restricted within a specific time frame and has to be completed and handed over to the owner/client/space user.

The overall lack of time to conduct research has a definite negative impact on the use of waste glass in interior spaces. The concerns around time and relation to cost can be expressed as follows as observed by Tonney of Kuona Trust:

“If it requires research it will be more expensive, and the client will go for the cheapest option nine times out of ten” (Mugo, personal communication, November, 2012).

Max Wathiani of Maxicrafts informed the researcher that:

“To fully implement use of waste glass in interior spaces is difficult. It takes a lot of time. I should be charging more fees, which I don’t, now but the plan is to eventually charge more so that I can compensate for the amount of effort it takes” (Max, personal communication, November, 2012).

4.6.2 Education and inexperience in using glass as a medium

The researcher found out that Kitengela Glassworks supports the Bosco Boys Home where Anselm recruits many of his glassmaking trainees who have no knowledge of working with glass. Anselm pointed out that;

“Intense training is necessary because glass blowing is essentially an art. Besides, once glass is melted it becomes difficult and dangerous to handle. It's alkaline, heavy, and extremely hot and eats away the inside of the furnace so you need very special material and skills to handle it. Learning the skill however takes time. Glass blowers have to be trained regularly to keep up with new styles, techniques and customer demands. The firm often sends them to Holland for training which is expensive” (A. Croze, personal communication, November, 2012).

Anselm also said that;

“The process of making blown glass items is complex. Glass has to be heated to 1,100 degrees centigrade before it melts. Using a long blowing pipe, artisans gather a gob of molten glass from the furnace and shape it into desired designs. Once an item is completed, it is gradually cooled” (A. Croze, personal communication, November, 2012).

Tonney of Kuona Trust informed the researcher that he had to go abroad in order to study how to use glass as a design medium. Max of Maxicrafts observed that:

“I never learnt use of waste glass design at college, but I like to think I would go to a course if one arose, what I do I have learnt through trial and error” (Mugo, personal communication, November, 2012).

In Kenya professional architects are required to engage with continued professional development in order to acquire and maintain membership with the Architectural Association of Kenya (AAK). Architects interviewed appeared to have a better knowledge of the sustainable design practices of which waste materials are one important aspects. Majority of the interviewed architects had an idea or two on how waste glass can be used in interior spaces compared to interior designers who do not

undergo any professional development once they attain their qualifications. Local interior designers should be introduced to opportunities available for use of recycled glass in interior spaces so that they can fully exploit waste glass in solving interior space problems. The process and production of design products from waste glass should be the prerogative of individual designers as part of furthering and increasing their knowledge on sustainability. The actual production process should be left too artisans and craftsmen in order to encourage and promote collaboration. Currently architects are trained issues to deal with sustainable environmental design as seen in their curricula (see literature review section) in their undergraduate course at Department of Architecture in the University of Nairobi.

The interior designers on the other hand, explained that the only conferences, courses and seminars that they are aware of take place outside the country such as in the USA where the interior design profession is more regulated than locally. The other source of professional development for the designers is through exhibitions such as the ones held in KICC and Sarit Center on building, housing and construction materials but which do not really focus on use of waste materials. Ms Mumbi of Cinnabar Interiors stated that:

“All the conferences are outside Kenya, and because of the affordability thing, I haven’t been able to attend anything like that”

(Mumbi, personal communication, November, 2012).

Despite this observation, 80% of interior designers expressed an interest in conferences, courses and seminars that could help them improve their knowledge of environmentally sustainable design such as use of waste glass in interior spaces. The remaining 20% of interior designers did not have the time or an interest in attending. During the interviews only one interior design firm confessed on applying waste glass in interior spaces. In the study the percentages of work on sustainable design projects were identified as follows: 10% have worked with waste glass; 70% occasionally works with waste glass; whilst 20% have yet to work on a design project using waste glass. A major theme that was made evident by interviewees was that there are not enough clients or projects that allow interior designers to gain much needed experience in use of waste glass in interior spaces. For this reason, most participants discussed feeling somewhat “new” and inexperienced in the practice thereof.

4.6.3 Materials

Anselm of Kitengela Hot Glass informed the researcher that;

“The firm has a zero waste policy, which is important given where we are located. We often sources for waste glass from used bottles, construction and renovation sites which is unreliable. We also use recycled materials like old glass, scrap metal and recycled newspapers and wastepaper for packaging. However acquiring some colours such as aqua, green, blue, champagne pink and amber is a big challenge as they are not easily available” (A. Croze, personal communication, November, 2012).

The respondents informed the researcher that selection of waste glass designs for interior spaces and products being produced by the artisans are often limited and don't accommodate a client's needs. A residential owner informed the researcher that:

“Well there's not a whole bank of waste glass designs to choose from, so it is a barrier, because you are limited in what you can actually select from” (Jane, personal communication, November, 2012).

The client also felt that:

“It's hard for me to choose from a limited range of those waste glass designs for my house, when there are so many other options out there” (Jane, personal communication, November, 2012).

A major obstacle experienced by interior designers locally is the inability to convince their clients to use locally produced environmentally responsible products in their interior spaces. Considering that majority of Kenyans are obsessed with imported products and materials, one interior design contractor stated,

“Everybody wants imported stuff and when you try to use waste glass as part of design solution; it is dismissed as an inferior product” (Tarsem, personal communication, November, 2012).

4.6.4 The client

Anselm of Kitengela Hot Glass informed the researcher that trying to make clients understand the process and time it takes to come up with a design product is an issue;

“Making a single item is involving and physically demanding, meaning production is painstakingly slow. When we are working on simple items like goblets, we can make about two hundred in a day, while large items like decorative glass are more sophisticated and we make about three in a day. Unfortunately, many walk in clients do not understand this” (A. Croze, personal communication, November, 2012).

Most interior designers explained that a number of their clients expressed interest in using waste glass designs in their spaces. When it came to implementation however, various factors inevitably deterred their commitment to this approach. The greatest obstacle is feasibility or cost, which often results in the client disregarding waste glass design. Tonney of Kuona Trust explained that fabricating and fixing of waste glass designs such as windows require greater upfront costs, which clients are often not prepared to pay. He also explained that few designers are not conversant with the whole process of waste glass fabrication and fixing and therefore time is required for research by those designers before they can implement waste glass designs. This inevitably costs the client which can be problematic because as he explained:

“It always comes down to bottom line” (Mugo, personal communication, November, 2012).

He however argued that with time and experience in using waste glass as a medium of solving interior space problems, costs should decrease. Until such time, this will remain an expense to the client. Max of Maxicrafts explained that majority of his clients are committed to applying waste glass design in their spaces but they are faced with the limited designs on offer. This indicated that many clients are not prepared to compromise on their aesthetic material choices or on the convenience of the non-environmentally friendly systems on offer. One client remarked:

“It’s convenience and reliability, and a lot of these eco things come with compromises” (Susan, personal communication, November, 2012).

Until such time that there is a wider selection of waste glass designs, designers need to specify and clients need to choose from a limited range.

Although most of his clients have expressed interest in sustainable design solutions, and are to some extent aware of the advantages of using waste glass products and designs in their interior spaces, Max of Maxicrafts said he rarely insist on it. For this reason, it seems that the public still has a way to go in becoming informed and educated on the importance of sustainable development through use of waste products in design, before sustainable design will become a priority and common practice in the profession.

A member of staff from School of the Arts and Design, University of Nairobi reiterated the need for education on sustainable development with emphasis on waste, by stating that:

“Sustainable design is a kind of niche market and certainly not everybody’s main concern, most people have other concerns. At the end of the day it’s not the only factor that goes into the built environment, there are all sorts of other factors” (Makunda, personal communication, November, 2012).

Until such time that environmental responsibility is a priority, and is enforced by government, it is not likely that clients will insist on and embrace sustainable design.

4.6.5 Other Barriers

Other barriers identified by the respondents include but are not limited to;

Labour intensive in terms of manpower costs – according to Tonney of Kuona Trust, working with glass as a design medium requires patience and is extremely labour intensive. It may take a longer period of time to produce a design solution such as a stained glass window or partition using glass as compared to using other mediums.

Most of design products and art works produced using waste glass are delicate and not heavy and can easily be broken or stolen when displayed in a public space leading to injury of space users. Lack of technical knowhow by the artisans working with glass is also a major barrier as most of them have learnt through trial and error and are not therefore professionals.

For artisans producing art and design works using waste glass, lack of space for fabricating is a problem due to the high rent costs therefore the artisans are not able to

work with more freedom and explore different ideas at the same time. They are forced to carry out a commission one at a time.

Lack of proper technical tools such as glass firing kilns, glass cutters and glass finishing equipments is a major hindrance to working with the glass medium. Up to date equipment and machinery are expensive and the artisans cannot therefore be able to afford purchasing them, rather they use outdated ways and means to produce their design products. Other tools lacking are affordable glass moulds which can assist in shaping large pieces of glass blocks to smaller pieces.

Challenges in research and salvage work by designers and artisans in obtaining waste glass of different colours such as blue glass is a major challenge. Waste glass despite being available for recycling in abundant quantities suffers from lack of centralized collection points and therefore accessibility to large quantities at a go becomes a barrier to mass production.

Using the current configurations by the Kenya Power and Lighting Company one phase power system and its adjustment to suit the requirements of glass fire kilns is another area that was identified as being a big barrier especially by the artisans. Also the frequent power surges, outages and black outs leads to frustrations and not meeting project's deadlines.

Tonney of Kuona Trust informed the researcher that he feels there is lack of exposure for glass art medium art works and design solutions as most of those designs are mostly done for discerning and exclusive clientele base.

4.7 Summary

From analysis, it emerged that there are vast opportunities for use of recycled waste glass in interiors spaces locally such as an interior finish material, for décor purposes, as part of grills and railings, in fabrication of furniture, as part of architectural design, as part of light fittings, among other opportunities. However, interior designers are likely to encounter various barriers such as cost and lack of enough information. The researcher aims to synthesis those results in the next chapter.

CHAPTER FIVE

5.0 SYNTHESIS AND INTERPRETATION OF RESULTS

5.1 Overview

This chapter will focus on synthesis and interpretation of data that was analyzed and presented in the previous chapter. The analysis is discussed based on the research questions.

5.2 Objectives and Research Questions

This study sought to;

- i. To establish opportunities for use of recycled waste glass in interior spaces,
- ii. To investigate barriers to use of recycled waste glass in interior spaces, and
- iii. To propose appropriate methods to integrate recycled waste glass into interior space designs.

The research questions that defined the scope of this study were:

- i. What opportunities are available for use of recycled glass in interior spaces locally?
- ii. What barriers may local interior designers encounter when using recycled waste glass in interior spaces?
- iii. How could waste glass be integrated into design of interior spaces?

While meeting the above stated objectives, the researcher used a semi structured interview guide as the main method of data collection and the guide was sub divided into various sections each seeking to fulfill the objectives outlined at the beginning of the study. The results revealed that indeed there exists numerous opportunities for use of recycled waste glass in local interior spaces but at the same time there are various barriers to those opportunities. It was therefore conclusive and final on the issue of study objectives that although there are barriers in using recycled waste glass in local interior spaces, there are several ways in which waste glass can be integrated into design of interior spaces to promote sustainable design.

From literature review regarding the historical perspective of glass as used in design, it is evident that present designers keep borrowing heavily from the past for their design products. Decorative bowls and accessories as fabricated by current glass artisans are eerily familiar to those of the past and we can conclude that there is a symbiotic relationship on the past and the present. The process of how decorative glass products was made in the past such as through glass blowing is almost similar as it is being done today further rendering credibility to the importance of learning history of glass.

5.3 Opportunities for use of recycled waste glass in interior spaces

In a bid to answer the first research question, seeking *to determine what opportunities are available for use of recycled glass in interior spaces locally*, the results revealed that indeed there are various opportunities that can be exploited to solve an interior space design problems using waste glass. Data was collected, analyzed and results reported as shown in the tables attached in the appendix. The data used for analysis of this research objective was collected from a practical survey with three local case studies: Kitengela Hot Glass, Tonney Mugo of Kuona Trust, and Maxicrafts Designs. The examination illustrated which opportunities are available.

The study sought to establish whether the respondents had an experience in dealing with recycled waste glass in design. As shown in Table 5 in the appendix, a majority of 75% of population interviewed informed the researcher that they had an experience of dealing and working with recycled waste glass in interior spaces whilst 25% informed the researcher that they had never dealt with recycled waste glass in interior spaces. On whether respondents were familiar with the use of recycled waste materials being an important part of sustainable design, majority (83%) agreed while 17% disagreed as shown in Table 4 in the appendix.

From the results as captured in Table 6 in the appendix, majority of the respondents agreed that there exists opportunities for use of waste glass in interior spaces such as an interior finish material (7%); for décor purposes (22%); as part of grills and railings (7%); in fabrication of furniture (9%); as part of architectural design (3%); as part of light fittings (25%); in making murals (11%) and also that waste glass converted to décor items (16%). From the interview discussions with Mr. Tonney

Mugo of Kuona Trust, and Mr. Wathiani Maxicrafts Designs, other opportunities identified were that waste glass can be used for stained glass windows and partitions, in mixed media art, in indoor and outdoor 3D art works, as part of table screens, free standing lighting and door surrounds. The experience in dealing with recycled waste glass in interior spaces question concerning opportunities and how waste glass can be used in an interior space was the second highest scoring question in terms of percentages among the respondents further demonstrating an understanding of the benefits of sustainable interior design practices.

Literature review established and corroborated these results in the sense that the respondents understood the importance of a commitment to sustainable design with special emphasis on recycling and re-use which is important in sustainable interior design. The generally high percentages in support of use of waste glass in interior spaces as revealed by the results indicate that respondents are willing to use or try sustainable methods such as recycling and re-using waste products such as glass which is an important component of sustainable design. Openness to sustainability is an important factor to implementing sustainable practices and encouraging sustainable change in the interior design field. The respondents were confident in communicating their desires to practice sustainable interior design as highlighted in the study by Ruff and Olson (2009) in which interior design stakeholders had pro-environmental attitude, and were sure of how to direct clients to examples of sustainable interior design. The results align with the high affinity towards sustainable interior design among the respondents.

"There are professions more harmful than design", wrote the godfather of sustainable design, Victor Papanek in 1972, *"but only a few"*. Papanek accused designers of creating useless, unnecessary and unsafe products; of wastefully propagating product obsolescence; of creating *"stuff-lust"* that promoted materialistic lifestyles. Though design may be guilty of past malpractice, there's a growing sense that in the next wave of sustainability – focused on creativity, entrepreneurship, innovation and practical solutions – design skills will feature heavily. Californian design professor and Papanek contemporary, Nathan Shedroff, captured this well when he said: "Design is the problem as well as the solution". If environmentalism's success was in spotlighting

sustainability problems to the world, the success of design will be in helping deliver solutions (Sherwin, 2012).

It was therefore conclusive and final on the issue of opportunities for use recycled waste glass in interior spaces that opportunities re-usability and recyclability of waste glass to solve local interior design space problems are high. These numerous opportunities so identified by the respondents is in line with the literature reviewed on sustainable interior design in which interior designers and other stakeholders in the interior design industry have a favorable attitude toward sustainable interior design practices, similar to findings by Rider (2005) in which the majority of interior designers and architects who considered themselves green professionals had a pro-environmental view.

5.4 Barriers to use of recycled waste glass in interior spaces

This second research question sought to establish *what barriers local interior designers may encounter when using recycled waste glass in interior spaces*. While answering this research question, the researcher analyzed responses by the respondents. The researcher with this question sought information on what barriers the respondents had experienced in using waste glass in interior spaces. The results in Table 8 in the appendix reveal that 24% of the respondents indicated lack of enough time to source for, fabricate and use waste glass in interior spaces as being one of the biggest barriers. Lack of enough information on sustainable interior design and the benefits of using recycled waste materials in interior spaces were also cited as a barrier by 24% of the respondents. Other barriers were: cost of implementation (20%); lack of in-depth training to the artisans and interior designers on how to effectively fabricate and use waste glass in interior spaces (15.5%); client and space owners' resistance to "*sub-standard materials and finishes*." (6.6%); resistance to change by stakeholders in the interior design industry and refusal by the same stakeholders to explore, use and recommend recycled waste materials in interior spaces (7%) and inconsistent supply of waste glass to the artisans (2%).

Interior design respondents argued that they did not have the option of selecting products made from waste glass for solving interior design problems due to resistance from client. However, individual client's resistance was greater than overall resistance

suggesting as an interior design project is being undertaken; obstacles and barriers arise within individual clients. Cost of implementing and solving an interior space design problem using waste glass was among other highly rated barrier. Cost may be partially higher due to the transition from common methods of interior design to more sustainable practices of using waste products which requires more resources to fabricate compared to readymade materials. With reference to this study a common method of solving an interior design problem that competes with recycled glass may include the use of window glazing for an internal partition. In such a scenario, solving the problem involves procurement of one piece of glass pane and fitting it. This is because such glass panes are easily accessible from suppliers compared to recycled waste glass panes which take time to fabricate. Also recycled waste glass may come in separate pieces compared to new glass which can come in varied sizes. Cost might also relate to pressure from clients and space owners to stay within a certain budget when carrying out an interior design project.

It was therefore conclusive and final on the issue of barriers that they pose as hindrances to the integration of waste glass in solving interior space design problems as highlighted by the results captured in the previous chapter.

5.5 Integrating recycled waste glass into interior spaces

The final research objective sought to *propose appropriate methods to integrate recycled waste glass into interior space designs*, the results and review of suggestions from the respondents revealed that indeed there are various ways in which waste glass can be incorporated in solving interior space design problems.

From the responses as indicated in Chart 8 in the previous chapter, 21% of the respondents felt that educating stakeholders in the construction and interior design industry on the benefits of using recycled waste in interior spaces should be done to encourage use of recycled waste materials in interior design and spaces while 18% indicated that encouraging application and use of sustainable design practices would go a long way in integrating waste in interior spaces. Furthermore 16% of the respondents informed the researcher that relevant government legislations and implementation of policies encouraging waste recycling and re-use should be put in place while 18% felt that institutes of learning and higher education should be on the

forefront of encouraging and supporting pro-environmental actions to raise awareness among learners the benefits of sustainability. In addition to this, 13% of respondents highlighted that interior design education especially at the specialization levels at the School of Arts and Design and other institutions offering the same course should factor and emphasis on sustainability with bias towards use of recycled waste materials in interior spaces while 9% of those interviewed outlined the use of technology to minimize waste production and modification of generated waste to suit application and use in interior spaces. Finally 5% of those interviewed said that dissemination of knowledge, information and skills to the public regarding advantages of using waste in interior spaces would go a long way in integrating waste.

Sustainable interior design consideration for materials and finishes focuses on the health and productivity consequences of material selections for building occupants, plus the long term social, economic, and environmental impacts of materials used in the design and construction of a building. Although sustainable interior design with reference to use of recyclable waste materials has been discussed by many researchers globally (Hussein, 2011), it has not been give the same consideration locally. Recycled waste materials are one the easiest way for interior designers to begin incorporating sustainable design principles in interior spaces. Local interior designers have neither fully exploited opportunities arising from using waste glass in interior spaces nor taken into the consideration vast benefits likely to be experienced in using recycled waste compared to new materials and finishes in local interior space designs to provide a healthy environment to the interior spaces. Apart from the perceived environmental benefit of using recycled waste glass design products in interior spaces, other benefits accrued include pleasant aesthetics finishes which are pleasant to the eyes, lower costs compared to new imported glass products, creating employment opportunities for the artisans, among others.

The key challenge is to choose materials that can reduce burdens to the environment. The construction industry must recognize that developers, designers, builders and suppliers have a responsibility to develop systems, products and methods that are environmentally friendly. While positive attitudes are hopeful, there are many barriers preventing interior designers to practicing sustainable interior design. It is worth

repeating what Stern's (2000) suggestion: "interventions will be unsuccessful unless important barriers to change are removed."

Consequently the survey findings and results revealed that there are proposals on how to integrate and improve the rates of reusable and recyclable materials such as waste glass in local interior spaces to improve sustainability. Although recycling and sustainable use of resources are increasingly promoted in interior design activities, and efforts have particularly been made in recycling materials such as glass, there is limited studies showing existing opportunities of and barriers to use of waste especially in local interior spaces. Therefore, this research aimed to search for the possibilities of proposing and integrating and using sustainable materials such as waste glass in the local interior spaces.

Feedback from majority of interior designers and waste glass artisans revealed that perception by local interior space owners and users that using recycled waste products in interior spaces is encouraging use of sub-standard materials is incorrect. One of the respondents informed the researcher that *"using recycled waste materials such as waste glass to solve an interior design problem asks interior designers to work a little bit smarter and this is a morale booster to waste glass artisans as they give extra effort to make recycling work, and enhances the overall tone on the interior space"* (Shirley, personal communication, November, 2012).

Logistics and service delivery on time using waste glass in an interior space were other reasons which interior space owners and users felt and suggested might slow down the job. Again, according to interior designers and waste glass artisans, this is not true. According to Tonney Mugo of Kuona Trust, *"The key is to integrate using waste glass with other job site activities so that the overall project objectives are fulfilled on time, for instance, the interior designer and waste glass artisan should be consulted and involved from the beginning of a construction project so that designs that will incorporate materials and finishes such as waste glass are discussed and agreed upon as opposed to whereby the involvement of an interior designer is an afterthought"* (Mugo, personal communication, November, 2012).

The resistance from clients regarding the issue of sub standard materials and finishes arising from use of waste might be lessened with proper education and explanation to

clients about sustainable interior design practices. Properly presenting ideas and communicating the importance of sustainable features is a way of overcoming client objections. Arbuthnott (2008) makes several suggestions for educating about sustainable design issues, such as providing specific behavioral examples and promoting equal opportunity and active engagement. Recognizing barriers interior designers encounter in using waste glass to solve interior design problems is important for moving past a state of transitioning to sustainable practices and to place where sustainable design is common and expected. A good example of an interior design problem with regards to this study is that of solving an interior design problem using new imported piece of glass vis-à-vis recycled waste glass. For instance if a piece of coffee table requires a glass top, the designer may recommend use of one whole piece of clear imported glass or on the other hand a piece comprising different coloured glass top made from recycled waste glass which may appear to be of low quality but serves the same function in solving the design problem. It is not that all sustainable ideas are 100 percent new; rather, ideas need to be re-explored and revamped for current living and designing.

Educating clients and the public about the importance of sustainable practices such as use of recycled and re-used waste becomes important to overcoming the cost barrier which was one of the highest rated barrier to use of waste glass in interior spaces; therefore, an improvement in education will lead to an improvement in client and space owners attitudes and better understanding of costs associated with sustainable interior design features. Interior design education especially at the specialization levels at the School of Arts and Design and other institutions offering the same course should factor and emphasis on sustainability with bias towards use of recycled waste materials in interior spaces. Understanding the client and the different motivations for sustainability, as several studies aim to do (Marchand & Walker, 2007; Spetic et al., 2008), is one possible solution to overcoming the cost barrier such as through encouraging application and use of sustainable design practices.

Many government policies and legislations with regards to integrating waste as part of interior design solutions are not yet required, therefore respondents did not view them as restrictive. It could be that laws and policies may guide respondents toward more sustainable choices. Additionally, the benefits of those regulations, education, and

technology and knowledge dissemination might outweigh the restrictions against the use of sustainable design practices. For example, certification might reflect a company's dedication toward building or designing sustainably, and a commitment to something more than a profit. Finally institutes of learning and higher education to be on the forefront of encouraging and supporting pro-environmental actions to raise awareness among learners the benefits of sustainability as indicated by 18% of the respondents.

It was therefore conclusive and final that there are various steps which can be undertaken to encourage and integrate recycled waste glass into interior space designs and in this way, achieve the twin objectives of solving an interior design problem and promoting sustainable interior design.

5.6 Summary

Based on the literature review and analyzed data, sustainability with reference to recycling and re-use of waste is receiving great attention worldwide. On the other hand, use of recycled waste in interior spaces in Kenya has not been extensively studied in its local context and is therefore looked upon as being inferior to use recycled waste to solve interior design problems compared to brand new products. In addition, opportunities for use of waste glass in interior space design have not been studied at all. In view of this the researcher proposed to explore opportunities and barriers associated with using waste glass in an interior space.

The analysis of data showed that there are vast opportunities for use of recycled waste glass in an interior space to solve various design problems but at the same time, various barriers arise which prevents the stakeholders in the construction and interior design industry to use such waste to solve arising problems. The stakeholders were very receptive to the possibility of practicing sustainable interior design with emphasis on recycling and re-using waste in interior design as demonstrated by their enthusiasm to participate in the research. Their feedback formed part of the recommendations of the study with an aim of establishing an interactive environment for all stakeholders in the interior industry to promote use of sustainable design practices.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

This chapter presents conclusions, recommendations and suggestions for further research based on the results of the study. The study focused on establishing opportunities for use of recycled waste glass in interior spaces, investigating barriers to use of recycled waste glass in interior spaces, and proposing appropriate methods of integrating recycled waste glass into interior space designs. Literature review informed us that sustainability with reference to recycling and re-use of waste is receiving great attention worldwide in all aspects of life including interior design. The findings were thematically based on the objectives of the study and the researcher sought to propose ways in which waste can be integrated in interior spaces. The study conclusions and recommendations are as discussed below.

6.2 Conclusions

Based on the respondents feedback, data analysis and synthesis, several factors have been identified which forms conclusion of this study and which if taken into consideration will go a long way in integrating recycled waste into interior spaces therefore promoting sustainable interior design practices locally. Based on the findings of this study, the following conclusions were made:

The main conclusion as per the findings of this study was that there are various opportunities for use of waste glass in interior spaces. Some of the opportunities highlighted by the respondents were; as an interior finish material; for décor purposes; as part of grills and railings; in fabrication of furniture; as part of architectural design; as part of light fittings; in making murals and also that waste glass converted to décor items. From the interview discussions, other opportunities so identified were that waste glass can be used for stained glass windows and partitions, in mixed media art, in indoor and outdoor 3D art works, as part of table screens, free standing lighting and door surrounds.

Further conclusions revealed that there are barriers which are a big hindrance to use of waste glass in interior spaces such as; lack of enough time to source for, fabricate and use waste glass in interior spaces and lack of enough information on sustainable interior design and the benefits of using recycled waste materials in interior spaces. Other barriers were: cost of implementation, lack of in-depth training to the artisans and interior designers on how to effectively fabricate and use waste glass in interior spaces, client and space owners' resistance to "sub-standard materials and finishes.", resistance to change by stakeholders in the interior design industry and refusal by the same stakeholders to explore, use and recommend recycled waste materials in interior spaces and inconsistent supply of waste glass to the artisans.

Finally, the study concluded that despite those barriers, designers can propose use of and integrate waste glass in interior spaces through the following methods; Educating stakeholders in the construction and interior design industry on the benefits of using recycled waste in interior spaces, encouraging application and use of sustainable design practices, relevant government legislations and implementation of policies encouraging waste recycling and re-use, institutes of learning and higher education to be on the forefront of encouraging and supporting pro-environmental actions to raise awareness among learners the benefits of sustainability, interior design education should factor and emphasis on sustainability with bias towards use of recycled waste materials in interior spaces, use of technology to minimize waste production and modification of generated waste to suit application and use in interior spaces and finally dissemination of knowledge, information and skills to the public regarding advantages of using waste in interior spaces.

6.3 Recommendations

This study identified the following aspects as areas that could receive attention in Kenya to improve and encourage the use of waste glass in interior spaces. This discussion also speculates on the potential transformation of interior spaces design problems through use of waste glass. Should an increasing number of interior designers transform and commit to encourage use of waste glass in interior spaces, their skills and expertise would affect the barriers identified by the study.

6.3.1 Improve sustainable design knowledge with emphasis on waste glass use

From the results, analysis and synthesis of the data in previous two chapters, it emerged that educating stakeholders in the construction and interior design industry on the benefits of using recycled waste in interior spaces was one of the highly rated ways in which stakeholders can overcome barriers to use of waste glass in interior spaces as shown in Table 8 in the appendix.

There is no doubt that sustainable design is an imperative part of design education today. The current environmental movement is currently influencing and altering the world of interior design. As people become more environmentally sensitive, they are choosing new materials for their interiors and designers are now paying more attention to green and sustainable interior design which involves the use of certain materials and building practices to reduce environmental damage such as use of low-pollution, recycled, or sustainable materials.

Higher Education in Kenya needs to make sustainable design a priority in the curriculum. This could encompass among others, recycled and waste materials in interior design, sustainable development, sustainable design processes, principles, policies and building regulations. At post graduate level, research on the topic of sustainable design could expand Kenya's knowledge on the subject, and provide important insight into current issues. The lack of exposure to sustainable design in Higher Education requires that this education needs to be obtained. To bridge the education gap, architects and interior design practitioners could utilize the services of a facilitator, consultant or local resource centres. Primary data showed that interior designers, unlike architects, are not very familiar with use of waste products in interior spaces. It is suggested that a professional body for interior designers needs to be registered by relevant authorities and to attend to the inclusion of continued professional development courses, conferences and workshops within sustainable practices. Learning institutions to facilitate pro environmental actions by changing the architectural and interior design education to factor in sustainability and providing adequate funds to allow research in appropriate and affordable technology on how to use waste glass medium as part of interior space problems design solutions.

Learning institutions should include the collaboration of glass artisans' and Design as formal part of their learning syllabus: Awareness of the need for collaboration between the glass artisans and Design can be promoted through learning institution, for example, it would be essential for interior design students to learn their responsibility in the waste glass industry. Introduction of research platforms to foster the collaboration: In order to enhance the collaboration between design and waste glass artisans, research on the role of each party in the collaboration and on ways to improve the collaboration is essential.

A major barrier mentioned by all participants was the availability of time to conduct research on how waste glass can be used in interior spaces. Once all stakeholders decide to invest their time and resources in to such research, their increased knowledge would offer a worthwhile investment to their respective firms and affiliations. Through the process of “*diving in head first*” and learning through trial and error as advocated by Max of Maxicrafts, it is anticipated that the knowledge gap would be bridged.

6.3.2 Support government policy and implement regulations

From Table 8 in the appendix, it emerged that 16% of the respondents were in favour of supporting relevant government policies regarding sustainable design. The newly unveiled Jubilee Government policy is in favour of sustainable development through promotion and use of locally produced products. The researcher believes use of waste glass can be included in this category whereby artisans can be encouraged to fabricate and produce design products using waste glass. Regulations should be developed in Kenya to assist the built environment in becoming more sustainable. Those mandatory regulations should give built environment professionals a “*good push*” in the direction of becoming more sustainable. The mandatory implementation of these regulations will have an immediate impact on the findings of the study. Practitioners that are currently not encouraging use of recycled waste products in interior spaces would be forced by law, to improve their knowledge and practices in order to comply with national regulation.

Involving Design in government initiatives such as Youth Development Funds is another way to promote waste glass in interior design. There are many government

initiatives that are geared towards promoting the activities of Youth. Many glass artisan groups include youth. It is imperative for government to involve design as a stakeholder in enhancing the glass craft activities of youth. Government supporting Jua Kali craft industry through easing registration process and access of workshops should also be explored. One of the characteristics of most glass artisans' is their informal nature as many are not registered and some lack shelters for fabricating their designs; rather they operate from roadsides such as along Ngong Racecourse road. More government support in easing registration and building of shelters for their activities would improve these activities hence improves their exposure.

The new County government should also facilitate the ease of collection of waste glass through the establishment of convenient waste glass collection points from which artisan and other designers can easily access the materials for creative use through relevant government legislation to encourage pro environmental behavior of recycling and re-using waste products by disseminating relevant knowledge and skills concerning sustainability to the public to include new practices and recycled waste products. Need of working shelters to encourage innovation and creativity should be explored and implemented by relevant authorities such as the new county governments. Availability of working sheds will provide a defined place for glass designers and artisans to meet and work.

6.3.3 Collaboration of glass designers and artisans and stakeholders

It is essential that waste glass designers and fabricators continue developing new range of product and designs, and broadening their product ranges, as with greater selection, designers and clients are more likely to choose this alternative. In addition to this, and despite its difficulty, designers need to continually ask the waste glass artisans about their new designs, processes and the products available. With persistence, this should yield positive results. With an increased number of architectural and interior design practitioners specifying environmentally responsible solutions to interior space design problems such as use of recycled waste glass products, artisans could be motivated to invest in research and development costs that are necessary to provide sustainable solutions. With increased popularity, the artisans

and fabricators would increase their quantities which should stabilise costs and combat the novelty mark-up currently added onto waste glass design products.

Artisans and designers should attend exhibitions where products made of recycled waste materials can be displayed so that people can understand better what it's all about and the beauty one can achieve using readily available waste materials. These exhibitions can work as marketing points for their design products. At the same time, those working with glass as a design medium can get more people to work with the medium through organizing art workshops and training camps at an affordable fee and donating some of their works to public spaces which can work as alternative corridors of exposure.

Improving quality of the tools and equipment used in the industry by the artisans should be encouraged. Use of the right tools and equipment will directly improve the quality of the glass artisans' crafts and design products.

6.3.4 Use rating tools

Kenya is slowly joining the league of countries employing green or environmentally sustainable architecture in real estate development. The move is largely informed by the dwindling natural resources such as fossil fuels and water, resources that were once thought as inexhaustible. The designs are also expected to reduce global warming since current unsustainable buildings in many parts of the globe contribute to at least 50 per cent of the world's carbon emissions. However, the full realisation of green technology is being hampered by lack of properly trained personnel in the field.

According to Architect Musau Kimeu, a leading Environmental Design Expert, architect and lecturer at the School of Built Environment, University of Nairobi, Kenya has less than 20 such architects, the highest in Africa. According to Kimeu: *“Lack of proper expertise in environmental design is largely to blame for the slow progress in green architecture. Most ‘experts’ in the field usually incorporate an element or two of green design and then label the project green resulting in misinformation to the general public”.*

Nairobi, he says, has few buildings that are well designed to make use of locally available materials while minimizing energy consumption and maximizing the use of non-toxic materials.

The researcher is therefore proposing the use of rating tools to encourage sustainability in interior spaces. Although there is no disputing that rating tools aid corporate and developers improve a projects sustainability status and enjoy sustainability credentials, it requires capital expenditure to invest in this costly tool and cannot be achieved by an interior designer in isolation. Instead it requires all stakeholders on a project (i.e. developers, contractors and built environment professionals) to collaborate with the common aim of environmental sustainability. It is however to be noted that in Kenya there is already a “*Green Africa Buildings Standards*” which is an application and certification tool that prescribes the categories, characteristics and rating system used to award a “*Green-Mark*” certificate to all types and sizes of buildings which incorporate building materials, technologies and practices that are environmentally sustainable. The overall purpose of this standard is to provide guidelines for infrastructure, renovation and new facilities to respect green best practices. Characteristics or Categories covered by the Green Africa Building Standards are among others Material and Resources such as use of recycled waste in interior spaces.

The development of Green Africa Building Standards and Certification process is overseen by a pool of experts in building, construction, environmental, occupational health and legal practice drawn from the public, private, academia and civic sectors. The following are some of the organizations which were represented in the Green Africa Building Standards Certification Board and Technical Committee before the new government took over the reins of power: Kenya Bureau of Standards, Architectural Association of Kenya, Institution of Engineers of Kenya, Ministry of Environment and Mineral Resources, Ministry of Public Works, Ministry of Housing, Nairobi City Council, Kenya Industrial Research and Development Institute, Energy Regulatory Commission, and Ministry of Roads. It is the hope of the researcher that this board will in future place emphasis on the use of recycled waste glass as one of its rating standards.

6.3.5 Educate the client

As captured in the results on Table 8 in the appendix, an increase in awareness on the benefits of using waste glass interior design solutions could result in clients becoming better informed. Architects and interior designers should be able to educate clients the benefits of selecting sustainable design alternatives such as waste glass solutions to their interior design problems. Should costs reduce and design options selection increase, it is anticipated that clients would be more likely to consider a sustainable solution when well informed solutions is presented.

Communicate with client on various design solutions for an interior space using waste glass as a medium of solving the problem compared to alternative solutions. Involve interior designer at the beginning of the project – clients do not consult interior designers and waste glass artisans at the beginning of the project - the building has to be designed around the glass art work and not the other way round according to Tonney Mugo of Kuona Trust. A participatory approach towards establishing a healthy relationship and Collaboration between various stakeholders in the built industry is proposed as the most effective solution and should therefore be encouraged. This approach would entail active involvement of design academics and professionals in conjunction with construction stakeholders to develop a body of practical theories and methods applicable to roles of an interior designer in a project.

Interior designer must make an effort to learn and understand the process of using waste glass as a medium of interior space design problem solution and continue keeping up with international and up to date skills and knowledge on the trends worldwide. This way, the designer will be in a position to authoritatively and wisely advise a space user on how waste glass can be used to solve an interior space design problem.

6.4 Areas for Further Research

This research was in no way exhaustive. Being an exploratory study of an area that has not been ventured into by many researchers, it has opened up various opportunities for further research. From this thesis it has been established that there are vast opportunities for use of waste glass in interior design as well as barriers to

those opportunities but at the same time, there are various ways in which waste glass can be incorporated in interior spaces. The data used in this study is viable based on the number of respondents interviewed. Further to this study, more work needs to be done in terms of increasing the number of respondents, selecting respondents from a different region and increasing the number of respondents.

The researcher recommends the following key areas as follow-ups to the current study:

- A study on managing waste through re-use and recycling in interior design application. This is because the study identified gaps in terms of how waste in general is being managed by relevant stakeholders tasked with managing it. Mostly, waste is managed through dumping instead of creatively recycling and re-using it.
- A research on waste as a solution to interior design problems is necessary to ensure that local designers stop over relying too much on imported products in solving interior design problems.
- An analysis of government policies and regulations on managing waste through re-use and recycling design projects is being recommended with the aim of coming up with well regulated policies which will not only assist in managing waste but will also at the same time improve socio-economic livelihood of those involved in salvaging, recycling and re-using waste.
- A study on collaboration of waste glass artisans and interior designers in solving interior space problems. This study will go a long way in being a reference point on future collaborations among artisans and designers dealing with other types of wastes.

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APPENDIX I

TIME SCHEDULE

M.A. Design Thesis Timeline - Munene Michael - B51 / 65513 / 2010
Academic Year 2011 - 2012

NO	ACTIVITIES	YEAR	2012				2013								
		MONTH	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Introduction and background study to formulate problem														
2	Meeting with and proposal presentation to the School Board														
3	Corrections from presentation and Literature Review to formulate theoretical framework														
4	Final proposal presentation to the School Board and Supervisor assignation														
5	Corrections from presentation and formulation of analysis instruments														
6	Pilot testing, fieldwork, data analysis and presentation to the School Board														
7	Compiling and handing in of final draft thesis to the School Board														
8	Correction and handing in of final thesis														
9	Graduation														

APPENDIX II

ESTIMATED RESEARCH BUDGET

a. Personnel

Payments for one Research Assistant – 3 months – Kshs 30,000

b. Equipment

Hire of camera – Kshs 10,000

Purchase of Research Tools & Materials – Kshs 40,000

Purchase of Literature Material - Kshs 20,000

Purchase of Stationery and other writing material – Kshs 10,000

c. Travel

Transport & Lunch to various sites for interviews - Kshs 50,000

d. Other Costs

Scanning - Kshs 5,000

Printing and binding costs - Kshs 40,000

Library Membership at various Libraries - Kshs 5,000

Communication and internet services access - Kshs 30,000

Miscellaneous Costs – Kshs 10,000

Total Direct Costs - Kshs 250,000

APPENDIX III

DATA ANALYSIS TABLES

Category	Frequency	Percentage
Questionnaires answered	60	80
Questionnaires not answered	15	20
Total questionnaires issued	75	100

Table 4.1: Response rate (Source: Author, 2013)

Category	Frequency	Percentage
Interior designers	20	32
Waste glass artisans	5	9
Customers / clients	5	9
Interior space owners / users	10	16
Architects	5	9
StAD Staff	5	9
StAD Students	10	16
Total	60	100

Table 4.2: Professional category of respondents (Source: Author, 2013)

Category	Frequency	Percentage
As as interior finish material	12	7.5
For décor purposes	35	21.8
As part of Grills and railings	11	6.8
As part of Furniture	15	9.3
As part of Architectural design	5	3.1
As part of Light fitting	40	25
As part of Murals	18	11.2
As part of Décor items	25	15.6
Total	160	100

Table 4.3: Opportunities for use of recycled waste glass in interior spaces (Source: Author, 2013)

Category	Frequency	Percentage
Time factor	55	24.4
Lack of information on sustainability	25	24
Cost of implementation	45	20
Lack of in-depth training	35	15.5
Client resistance to 'sub-standard' materials	15	6.6
Resistance to change	15	6.6
Supply of waste glass	5	2.2
Total	225	100

Table 4.4: Barriers to use of recycled waste glass in interior spaces (Source: Author, 2013)

Category	Frequency	Percentage
Education	60	21.4
Sustainable design practices	50	17.8
Relevant government legislation	45	16
Pro-environmental actions	50	17.8
Interior designer education	35	12.5
Use of technology	25	8.9
Dissemination of knowledge and skills	15	5.3
Total	280	100

Table 4.5: Overcoming barriers to use of recycled waste glass in interior spaces (Source: Author, 2013)

APPENDIX IV

SEMI STRUCTURED INTERVIEW GUIDE

The researcher is a final year M.A. Design student at The School of Arts and Design, University of Nairobi, seeking to study “*Barriers to use of waste glass in interior design*” Kindly assist by filling in the Interview Guide. The report will strictly be for scholarly purposes only.

Profession

- Waste Glass Artisan ()
- Interior Designer ()
- Architect ()
- Academic Staff ()
- Student ()
- Customer / client ()
- space owner / user ()

Are you familiar with the concept of recycled waste materials as being part of sustainable design?

- Yes () No ()

Have you ever been involved in dealing with recycled waste glass in Interior Design?

- Yes () No ()

If yes in the above; in what type of manner? You can tick more than one.

- Salvaging and collecting waste glass ()
- Recycling waste glass ()
- Using waste glass in interior design ()

Do you think there are opportunities for use of recycled waste glass to create eco friendly interior spaces?

- Yes () No ()

If yes in the above, in what ways and manner? You can tick more than one.

- As as interior finish material []
- For décor purposes []

Have you ever used recycled waste glass used in interior spaces?

- Yes [] No []

If yes in above question, in what type of ways? You can tick more than one.

- As part of Grills and railings []
- As part of Furniture []
- As part of Architectural design []
- As part of Light fitting []
- As part of Murals []
- As part of Décor items []

In using recycled waste glass in interior spaces, did you encounter any barriers?

- Yes [] No []

If yes in above question, did you encounter any of these types of barriers? You can tick more than one.

- High and prohibitive cost of implementation []
- Lack of time to source, fabricate and fix the waste glass []
- Lack of in-depth training on how to use recycled waste glass []
- Client resistance to ‘sub-standard’ materials []
- Lack of consistent supply of raw salvaged waste glass []
- Lack of information on benefits of using recycled waste glass []
- Resistance to change
- Lack of adequate interpretation of environmental sustainability

Apart from the above; what other barriers did you encounter?

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Of the following what do you think should be done to encourage use of recycled waste materials in interior design? You can tick more than one.

- Educating the public on recycled waste materials
- Applying sustainable design practices
- Relevant government legislation to encourage pro-environmental behavior
- Learning institutions to facilitate pro-environmental actions
- Change in interior designer education to factor in sustainability
- Use of technology in lessening environmental impact
- Encourage use of sustainable recycled waste materials
- Dissemination of knowledge and skills concerning sustainability include new practices and products

Any other suggestions on how to overcome these barriers?

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Thank you for taking time to respond!