IMPACT OF COLOUR IN CREATING ERGONOMICALLY EFFICIENT RESIDENTIAL INTERIORS

By

CHETNA. P. BHANSALI

(10PIR05)

A THESIS SUBMITTED TO
AVINASHILINGAM DEEMED UNIVERSITY FOR WOMEN
COIMBATORE-641043

In partial fulfillment of the requirements for the Degree of

MASTER OF SCIENCE IN

INTERIOR DESIGN AND RESOURCE MANAGEMENT

APRIL 2012

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Certified as a Bonafide Research Work

Signature of the
Head of the Department

30/4/2012

Signature of the
Guide

Acknowledgement

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“Gratitude is the most exquisite form of courtesy.”

-Jacques Maritan

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"A thankful heart is not only the greatest virtue, but the parent of all other virtues."

- Cicero

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Introduction

I. INTRODUCTION

"Dwelling", in the words of Martin Heidegger, is "the essential property of human existence".

The house grew out of man's need for shelter and also out of his ability to symbolize and his need for identity. The divergent origins of the house distinguish "house" from "home." "House" refers to an object, possession, or measurable space, while "home," describes an "emotionally based and meaningful relationship between dwellers and their dwelling places." The first thing a house needs in order to create a home is a human being. A home is about personal creativity and style, love and the desire to create a sacred space no matter how big, small, fancy or shabby it is. It is a home to that person. There is an old expression; "Home is where the heart is". It is often a reflection of the people who live within that home and the ones that create the space.

"Home is the foundation of our identity as individuals and members of a community," Ralph says, "the dwelling place of being. Home is not just the house you happen to live in but an irreplaceable centre of significance" (Singleton, 1997). Whether it is an elaborate building or a cottage, Varghese et al., (1994) opine that a major portion of our time is spent at home, and a thoughtfully decorated home should provide the needed comfort and pleasant surroundings. The purpose of Interior Decoration is to make a home livable by enhancing the appearance of interior by combining beauty and functionalism.

"Good design combines usefulness with at least one of the following: beauty, comfort, efficiency, economy, or durability."

- Michael Maurer

Neilson and Taylor (2002) state that Interior design concerns itself with more than just the visual or ambient enhancement of an interior space; it seeks to

optimize and harmonize the uses to which the built environment will be put. It is "practical, aesthetic, and conducive to intended purposes or improving life style."

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 life, health, safety, and welfare of the public. It encompasses designers who specialize in residential or commercial interior design; designers who dwell in the commercial or contract realm of interior space design; and others who specialize in furniture design, healthcare design, hospitality design, retail design, and workspace design. (http://www.kwika.org/ resources/the-art-of-interior-design.html). Designs are created in response to and coordinated with the building shell, and acknowledge the physical location and social context of the project. Thus Pile (2005) avows that Interior Design touches the lives of all in a direct way.

“Design is everywhere…It touches and affects everyone. Design is human-centered.”

-Jack Weber

The goal of interior decoration is to provide a certain “feel” for the room; it encompasses applying wallpaper, painting walls and other surfaces, choosing furniture and fittings, such as lighting fixtures, floor plans, providing other decorations for the area such as paintings, sculptures and carpets.

Interior Decoration gives scope to the homemakers and other members to express their personality, aesthetic taste through proper selection of furniture, furnishings and accessories. Interior design is not just about the looks of the building’s interior but it also plays the key role in its functionality. The house’s interior must be aesthetically appealing and practical at the same time. The standard architectural plans rarely meet the client’s needs completely therefore a good interior designer should be hired to design an interior that will consider the

user's needs and lifestyle because the interior of a home should not only look good but should also be functional (http://www.transedit.co.uk/).

"Design is the expression of the envelope that surrounds you at work, at home, at play, everywhere. It's creating an experience, an emotion, or a story of your surroundings; helping life's functions to be pleasing to the senses while organizing you."

- Jessica Mann Amato

Recent developments and research indicate a strong correlation between the quality of workplace design and worker productivity. Fehrman and Fehrman (2009) define that design, like any aspect of life, cannot exist in vacuum. It relies heavily on what has gone before and influences what will follow. Hiring an interior designer is therefore more than just a good idea one has to build a new house or remodel/renovate the existing one (http://www.wbdg.org/design/dd_ interiordsgn.php).

An interior designer is a person who is considered an expert in the field of interior design or one who designs interiors as a part of their job (Gray, 2007). The professional Interior Designer is qualified by education, experience, and examination to enhance function and quality of interior spaces (http://www.iida. org/content.cfm/what-is-interior-design).

"The selective eye must be an experienced eye, an eye that knows the genuine pleasures of harmonious colours and textures, of sensitive line and proportion, of the play in contrasts of light and shade. The selective eye must see beyond immediate limitations, recognize possibilities that a fertile imagination suggests, and translate the difference between the genuine and the false."

-Michael Taylor, The Finest Rooms

One cannot stress the importance of an interior designer enough. Interior Design is not only about matching colours, bits of furniture and accessories. It is about matching all the elements in relation to some criteria which is generally overlooked, like the size of the rooms, height of walls, fenestration and orientation (sun, wind and light) and so on (http://omeima-ismaiel.suite101.com/the-importance-of-interior-design-a86929).

The elements of design are the building blocks used to create a work of art. The elements of design constitute the language of art. The elements of design are Point, Line, Shape, Form, Colour, Texture, Pattern, Light and Space.

"I wonder if any element of interior design is more personal than colour. Nothing can more quickly reveal aspect of personality and character than the choice - or absence - of colour."

- Van Day Truex, Interiors, Character and Color

Colour is an important element in Interior Design. The colour in itself is as important as the Interior Design. Colour is everywhere, and in home designing and interior décor, colour is the most important factor in creating moods of a room. The impression begins as soon as one steps into a home and notices the colour scheme of the entrance, the lounge, the kitchen and all other rooms. This is the reason why interior designers consider colour consulting an important dimension and addition to the services that they offer. Choosing the right paint colour, whether it be interior or exterior, is one of the most important decisions to be made when decorating a home, it makes sense to hire someone who can take the guesswork out of the confusion and create the colour palate that provides the user with years of enjoyment and pride (http://www.interiordesignpro .org/blog/color-consultant).

Colour has been investigated and used for more than 2000 years. Throughout recorded history, humans have had the desire to decorate their living

space. From using natural pigments for ritualistic cave paintings over 30,000 years ago to modern day therapy, colour has had an immense impact on humans.

Colour plays a vitally important role in the world in which we live. Colour can sway thinking, change actions, and cause reactions (http://library.thinkquest. org/08aug/01276/colorsanddesign/colorsininteriordesign.html).

"Colour! What a deep and mysterious language, the language of dreams."

- Paul Gauguin

Colours surrounding us in our homes can be very important. When we are at home, we want to feel comfortable - we want to belong; it's our home. That is why it is important to decide on a good colour scheme that makes us feel good about our surroundings (http://library.thinkquest.org/08aug/01276/colorsand design/ colorsininteriordesign.html).

Many people think that colour is just a matter of how things look and it is often dismissed as being purely cosmetic. However, the truth is that; there is nowhere that colour does not exist and our instinctive, unconscious response to it is a vital element in our survival. Colour can make or break a space. Choosing appropriate colours for spaces is an important aspect of interior design. Colour has a profound influence on a space and the people in it. Use it to your advantage to create an inviting, productive space (http:// www.facilitiesnet.com/flooring/tip/ The-Importance-of-Color-in-Interior-Design--17811).

The quickest, the most dramatic, and the most reasonable way in which one can create instant change in a room is through the use of colour. A fresh dose of colour will instantly revitalize an interior, camouflage cosmetic problem and minimize architectural defects and faults. The colour can completely change the atmosphere of a room, establish harmony within a décor, create illusion, and

accent an interior with personal style **(**http://lindaroseninteriors.com /blog/importance-of-color-interior-design/).

Colour is vital is because our minds, moods and emotions respond to colour in different ways, depending on our personalities and experience. Colour helps fulfill psychological needs in interior designing (http://interiordesigndiy. blogspot.in/2011/09/colors-in-interior-design-and-decor_14.html).

Singleton (1997) avows that People need to give meaningful structure and symbolic significance to the relationship between themselves and their environment (the human "condition"). Through repeated encounters and complex associations, people invest the space they inhabit with meaning.

Interior designers focus on the human, the interaction of humans with their built environment, and the art or aesthetic components brought to the interior environment that must reflect the socio-psychological needs of the humans who use the space, contributing to their welfare (http://www.idbok.org/ PDFs/IDBOK_2005.pdf). We all expect a facility to be functional and maintainable. Achieving coordination of the building interior and furnishings, meeting human ergonomic and psychological needs, and providing optimum aesthetic effect are identifiable and attainable goals for every interior design project (US Army Corps of Engineers, 1997).

Although it may come in all shapes and sizes, all manner of forms, the home is of huge social significance. We spend much of our lives in the home; our primary emotional connections are shaped in the domestic arena of the home.

Cieraad (2006) affirms that The home is a nodal point in a whole series of polarities: journey – arrival; rest - motion; sanctuary – outside; family - community; space – place; inside – outside; private – public; domestic – social; spare time - work time; feminine - masculine; heart - mind; being - becoming.

There is a lopsided understanding of the world; the domestic places of our lives are not given as much attention as the public spaces. We have much more work on the workplace than on the homeplace. The investigator plans to correct some of this imbalance and focuses attention on one of the most important places, "the home".

Today the home has also become a "workplace", where the homemaker is the "worker" in or "user" of that place. The homemaker spends long hours at her the workplace which, may be the kitchen, the dining room, the living room , the bedroom and so on. Therefore providing a good workplace environment to the homemaker is the need of the hour, in which she is comfortable and productive and which is aesthetic and appealing to the eyes.

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Since Ergonomics means the science of work and a person's relationship to that work, it is used to create or establish a good workplace environment for its users. The workplace communicates with its users in such a way that, when there is a good relationship between the two there is an increase in the productivity. As a powerful form of communication, colour is irreplaceable, as the colours of our environment affect our behaviour and mood (http://motivationcentre.blogspot.in/2006/06/ importance-of-colours.html). These aspects associate Colour and Ergonomics in such a way that when both are used together, an ergonomically efficient workplace results, in which colour plays its influential role.

The Design of our world is a product of centuries of cultural and ideological influences. Colours stand for all sorts of things, and since they are used nowadays in pretty much everything, it makes sense to study the influence and

potential of colours in making a workplace comfortable and productive (http://library.thinkquest.org/08aug/01276/colorsanddesign/colorsininteriordesign.html).

As there is paucity of research data available related to colour and its importance in making the residential spaces ergonomically efficient, the investigator has taken up the study entitled **"Impact of Colour in Creating Ergonomically Efficient Residential Interiors"** to investigate the depth of this vast subject with the following objectives:

- To assess the views of the selected homemakers on the impact of colour in terms of comfort and productivity.
- To analyze the preference of colours for residential spaces among the selected homemakers.
- To examine the benefits and problems encountered by the users as a result of their choice of colour schemes for the residential spaces.
- To offer suggestions regarding the selection and use of colour in relation to the principles of ergonomics.
- To develop Colour Scheme Modules based on the principles of ergonomics for 'Residential Interiors'.

It is hoped that this study would throw light on the important aspects of colour. This knowledge would also strengthen the theoretical approach in the study of colour in relation to the principles of ergonomics in order to provide residential spaces that would be comfortable to work in, be productive in nature and aesthetic and appealing to look at.

Review of Literature

II. REVIEW OF LITERATURE

The review of literature pertaining to the study entitled **"Impact of Colour in Creating Ergonomically Efficient Residential Interiors"** is discussed under the following headings.

F. Colour Theory
G. Planning Colour Harmonies
H. Colour in Ergonomics
I. Colour Perception and Colour Psychology
J. Factors Influencing the Selection of Colour Schemes

A. Colour Theory

"Mere colour, unspoiled by meaning, and unallied with definite form, can speak to the soul in a thousand different ways." - Oscar Wilde

1. Definitions of Colour

"COLOUR" is defined as the quality of an object or substance with respect to light reflected by the object. Colour is refracted light. Every ray of light is composed of a group of perfectly balanced colour waves or vibrations, which are conveyed through the eye to the brain as colour sensations (http://dictionary. reference.com/browse/coloring).

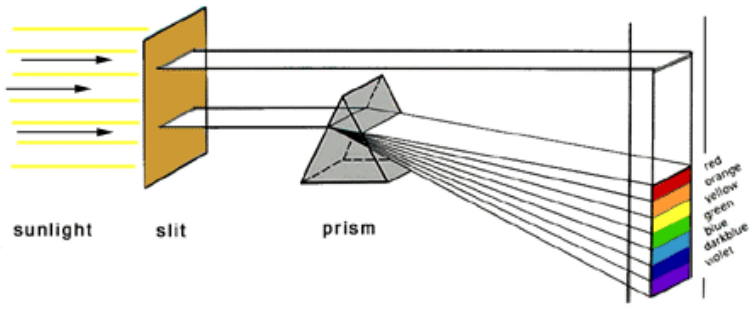
The Concise Oxford Dictionary describes colour as "sensation produced on eye by rays of light when resolved as by prism into different wavelengths; one, or any mixture, of the constituents into which light can be separated as in a spectrum or rainbow."

The McGraw Hill Dictionary of Scientific and Technical Terms describes colour as, "a general term that refers to the wavelength composition of light, with

particular reference to its visual appearance.” From these definitions it is clear that for a human eye as well as its brain and mind to perceive colour, light is essential.

2. Origin of Colour

In 1676, English scientist Sir Isaac Newton, using a triangular prism, analyzed white light into a spectrum of colours. Newton performed his experiment as follows:

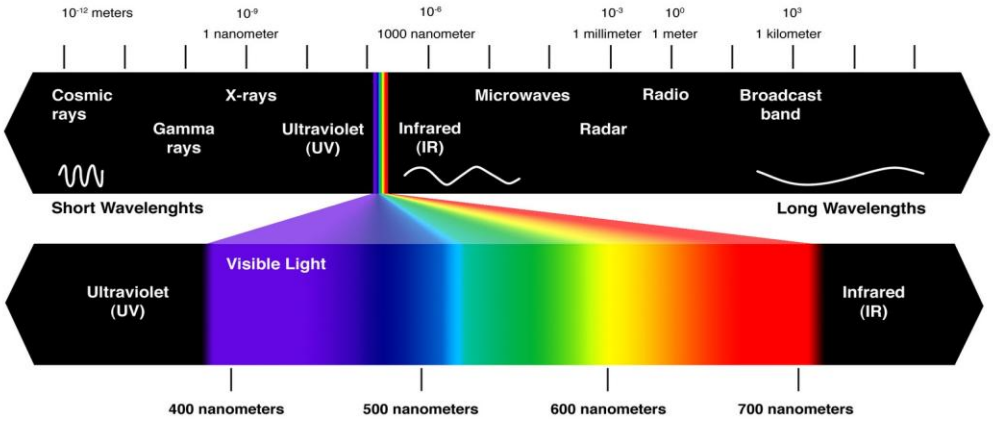


Sunlight entering through a slit falls upon a glass prism. In the prism, the ray of white light is dispersed into a band of prismatic colours, blending almost imperceptibly into each other - forming a rainbow. This is also called the spectrum, the principal colours of which are violet, blue, green, yellow, orange and red. The dispersed ray of light can be projected on a screen to display the spectrum. By using a second prism placed in a position to catch the refracted rays of light from the first prism the spectral colours will revert to white light. In these experiments, he came to the conclusions that colour is contained in the light and that white light is a combination of all colours in the spectrum (Itten, 1970).

3. The Visible Spectrum

According to Goldstein (2009) our eyes are sensitive to light which lies in a very small region of the electromagnetic spectrum labeled "visible light” or “visible spectrum”. This "visible light" corresponds to a wavelength range of 380 - 780 nanometers (nm) and a colour range of violet through red. The human eye is

not capable of "seeing" radiation with wavelengths outside the visible spectrum. The visible colours from shortest to longest wavelength are: violet, blue, green, yellow, orange, and red.



Ultraviolet radiation has a shorter wavelength than the visible violet light. Infrared radiation has a longer wavelength than visible red light. The white light is a mixture of the colours of the visible spectrum. Black is a total absence of light (Bohren, 2006).

Table 1indicates the colours of the visible spectrum and their corresponding wavelengths.

Table 1: Colours of the Visible Spectrum and their Wavelengths

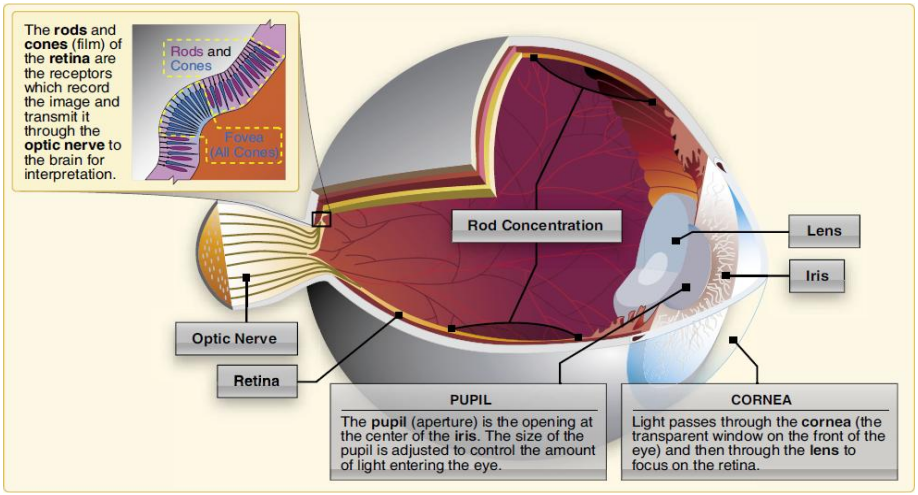
Colour	Wavelength (in nanometers)
Violet	380 – 436
Blue	436 – 495
Green	495 – 566
Yellow	566 – 589
Orange	539 – 627
Red	627 – 780

4. How We See Colour

Hardy and Perrin (1932) state that, “Colour is the visual effect that is caused by the spectral composition of the light emitted, transmitted, or reflected by objects". Colours are components of light. Where there is no light there is no colour. Objects generally absorb some of the light and reflect the rest of it. The colour of the object is dependent upon which parts of light are absorbed and reflected. Thus a red object reflects the red part of the light. An object is black when it absorbs all the colours; it is white when it reflects them all.

From Light to Colour

When an image enters the eye in the form of light and is projected onto the surface of the retina, an entire series of chemical reactions takes place. The light signals travel through the cells on the surface of the retina and flow down into the rods and cones. The cones can distinguish colour from the frequency of the light being reflected off of the viewed object.



Each colour has its own unique wavelength. The rods and cones convert the light wavelengths into electrical signals. The photoreceptors then send the signals down through cells below them that lead to the optic nerve. The optic nerve sends

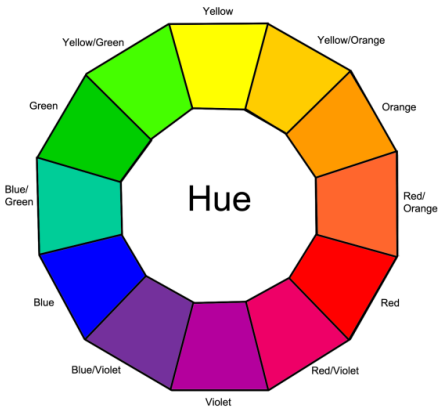
the electrical impulses into the brain, where the signals are translated into what we perceive as sight (Schopenhauer et al., 2010).

5. Dimensions of Colour

There are three dimensions or attributes of colour - hue, value and intensity. This makes colour multidimensional. Any colour appearance can be described in terms of these three dimensions (Nissen et al., 1994).

a. Hue

Of the three dimensions of colour, hue is the simplest to identify. Hue is usually the first thing one notice about an object; the sky is blue, that car is red. Hue is often interchangeable with the word colour. Hue is the term for the pure spectrum colours commonly referred to by the "colour names" - red, orange, yellow, blue, green, violet - which appear in the hue circle or rainbow e.g., Red is the name of a broad colour family. The popular term, pink and maroon are variations of that hue (Bustanoby, 1947).

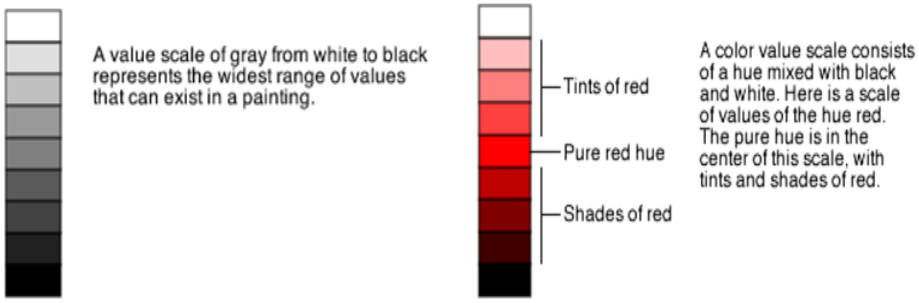


In the colour wheel, the hues fall in two large groups. Hues on the side of the blues and greens are the cool hues, and those on the side of red and orange, are the warm hues (Seetharaman and Pannu, 2009).

b. Value

Value refers to the lightness or darkness of a colour. It is often related to a grey scale where white is the lightest value followed by a series of greys to black, the darkest value. The hues are located somewhere in between the extremes of white and black in value. A colour value

scale has a hue mixed with white to form tints and with black to form shades of that hue (Soundararaj, 1974).



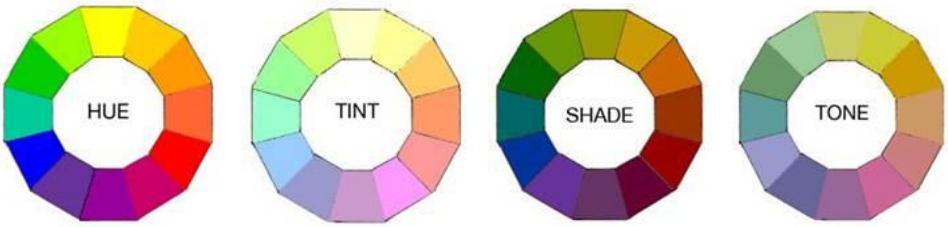
Every individual colour on the colour wheel can be altered in value in three ways by tinting, shading or toning.

Hues - Hues are the purest and brightest colours. They form the full spectrum of colours. These colour schemes are bold, cheerful and exciting.

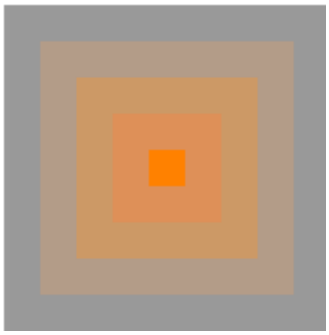
Tints - A Tint is sometimes called a pastel. It is simply any colour with white added. A colour scheme using tints is soft, youthful and soothing.

Shades - A Shade is simply any colour with black added. Shades are deep, powerful and mysterious.

Tones - A Tone is created by adding both white and black. Any colour that is "greyed down" is considered a tone. Tones are somehow more pleasing to the eye. (http://www.asianpaints.com/world_of_colours/colour_basic.aspx).



c. Intensity or Saturation



According to Morton (1953) Intensity refers to the purity or impurity of a hue. The more pure hue a given colour contains, the more intense it is. Opposing terms used to describe this contrast are intense vs. grey, saturated vs. desaturated or bright vs. dull. A red rose and a red brick may be of the same hue and value, but the rose exhibits greater purity of saturation. A colour in its purest form has the greatest brilliance or intensity. Therefore, intensity is that quality of colour that makes it possible for a certain hue, such as red, to shout, or speak in a gentlemanly tone.

When a colour is too bright and its intensity needs to be reduced, we will often say," Grey that colour." The most typical ways to grey a colour are to add grey or by adding some of the complementary colour. The complement of a hue is the hue opposite it on the colour circle. Red and green, orange and blue, and yellow and violet are examples of complementary colours. Changes in the intensity of a colour may be brought about through mixing the complementary colour which lies opposite on the colour chart. When complementary colours are mixed, they neutralize each other and when mixed in certain proportions destroy each other and produce grey or neutrality.

6. Types of Colour

Cheskin (1962) affirms that Colours are divided into two general psychological classifications - stimulants and sedatives. All red hues are stimulating to some degree. The warmer the red (the more yellow it contains) the more aggressive and advancing it is. A colour is said to be "advancing" when it appears nearer to the eye than other colours lying in the same plane.

Blue, though the coldest of colours, enjoys wide popularity. It is generally found that this colour is a psychological sedative for people who are inclined to be easily over stimulated. It can be depressing for the morose type of individual, and persons inclined to melancholy should avoid an over-abundance of it.

Colours are divided into two distinct psychological groups- cool and warm.

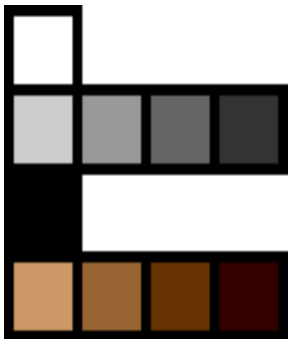
a. Warm Colours

The reds, yellows and oranges of the colour wheel are referred to as the warm colours; these colours give the effect of creating more adrenaline, raising the blood pressure, increasing the rate of breath and therefore increasing the temperature, making a person feel warm. These hues are also said to advance, meaning they appear to come forward, making the walls feel closer. Thus, they can actually make a room feel cosy when used in decorating (http://www.color. interiordezine.com/color-theory/warm-and-cool-colors/).

b. Cool Colours

The cool colours are blue or predominantly blue in cast. The greens and blues of the colour wheel are referred to as the cool colours; these slow the heartbeat, relax the muscles and lower the temperature, making us feel cool. Violet can appear warm or cool depending on the proportions of the parent colours. Because these colours have a tendency to feel like they are receding cool tones are often used to paint the walls of a small room to make the room appear larger (Dunne et. al, 1998).

c. Neutral Colours or Achromatic Colours



Any colour that lacks strong chromatic content is said to be unsaturated, achromatic, or neutral (http://en.wikipedia.org/wiki/Color_theory). Khanna (N/A) states that black, white, grey, and brown are considered to be "neutral" colours because they are (theoretically) neither warm nor cool colours. These colours are very versatile. They are restful and safe, because they mix well with others. These colours do not feature on the basic colour wheel. Some neutral colours may be achieved by mixing a complementary colour pair-which "neutralizes" them (http://www.ket.org/artstoolkit/visual/glossary.htm).

B. Planning Colour Harmonies

1. The Colour Wheel

According to Martin (1994) a colour wheel (also referred to as a colour circle) is a visual representation of colours arranged according to their chromatic relationship. Dodsworth (2009) asserts that a helpful tool for considering the relationship between colours is the colour wheel. A colour wheel is formed by positioning primary hues equidistant from one another, and then creating a bridge between primaries using secondary and tertiary colours (Figure 1).

a. Primary Colours

The colour wheel starts with the **3 primary colours**: yellow, red, and blue placed in an equilateral triangle (Figure 2). They are called primary colours because they cannot be created by mixing other colours. Primary colours form the basis for colour theory or colour mixing, as using these three colours it's possible to mix most other colours.

The next aspect to the colour wheel is creating the **secondary colours**. These colours are placed in triangles above the corresponding primary colour combination.

b. Secondary Colours

When any one primary colour is mixed with another in equal amounts a secondary colour effect is produced (Figure 3). Three secondary colours are produced from the mixing of one primary colour with another. The secondary colours are:

- orange (1 part red + 1 part yellow)
- violet (1 part red + 1 part blue)
- green (1 part yellow + 1 part blue)

c. Tertiary Colours

These colours are created when mixing one secondary and one primary colour (Figure 4) and in the colour wheel each tertiary colour created will be an equal combination of the two colours, left and right (one primary and one secondary, which is the combination of two primaries) (http://www.color-wheel-artist.com/primary-colors.html). The tertiary colours are:

- Yellow-orange (2 parts yellow + 1 part red)
- Red-orange (2 parts red + 1 part yellow)
- Red-violet (2 parts red + 1 part blue)
- Blue-violet (2 parts blue + 1 part red)
- Blue-green (2 parts blue + 1 part yellow)
- Yellow-green (2 parts yellow + 1 part blue)

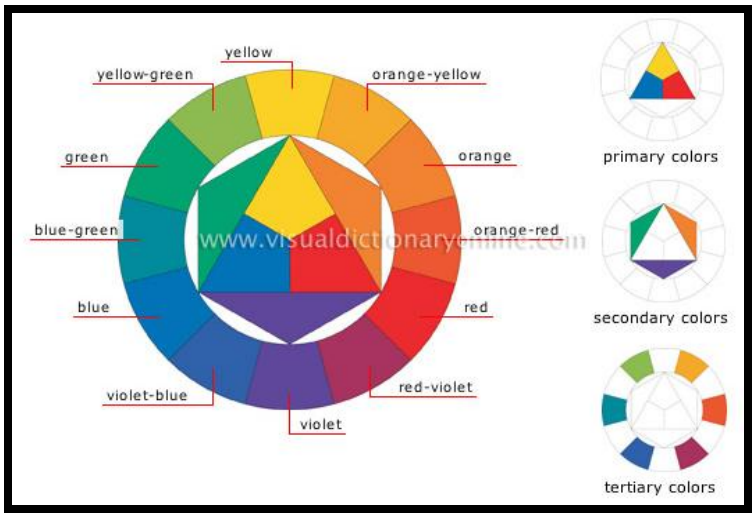


Figure 1 - The Colour Wheel

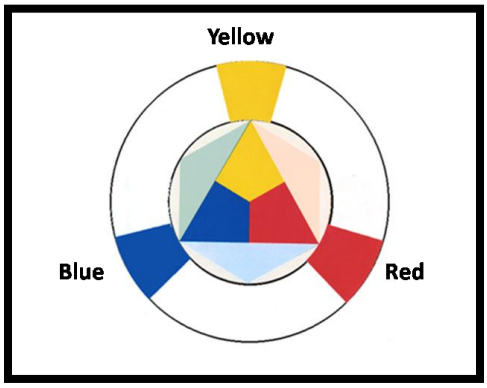


Figure 2 – Primary Colours

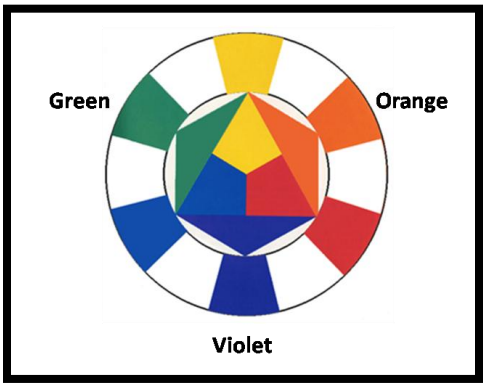


Figure 3 – Secondary Colours

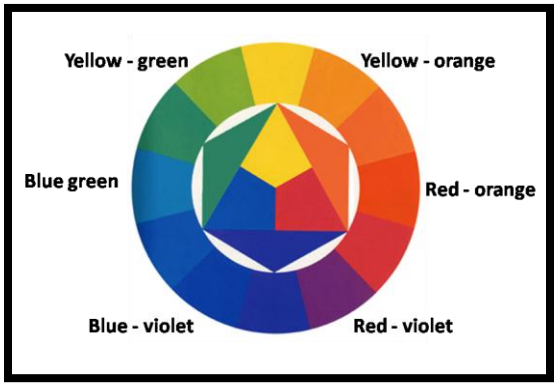


Figure 4 – Tertiary Colours

The sequence of colours on the colour wheel resembles that of the rainbow. The colour wheel is used as the basis to understanding colour and colour combination techniques. The colour wheel is also an excellent tool to help create harmonious colour schemes for painting, interior decorating, and commercial design. It creates an orderly progression of colour that helps us understand colour balance and harmony (http://www.artsparx.com/colorwheel.asp). Shaw and Drake (2003) avow that like all maps, the colour wheel can only show one dimension of an immensely complicated world.

2. Colour Harmonies

Goethe (1982) affirms that when the eye sees a colour it is immediately excited and it is its nature, spontaneously and of necessity, at once to produce another, which with the original colour comprehends the whole chromatic scale. A single colour excites, by a specific sensation, the tendency to universality. In this resides the fundamental law of all harmony of colours.

Martin (1994) states that colour harmonies or colour chords result through the combining of tints, tones, shades, and hues from the colour wheel. Colour harmonies are combinations of colour that are pleasing to the eye. They represent a satisfying balance or unity of colours. Albers (1976) avows that certain constellations within a (colour) system provide colour harmony. The basic types of colour harmonies are named in relation to how the colours sit on the colour wheel (Dodsworth, 2009).

Nissen, Faulkner and Faulkner (1994) affirm that Colour harmonies may be related or contrasting, depending on their location on the colour wheel (Figure 5). Related colour harmonies are monochromatic and analogous. These harmonies are safe and usually pleasing to most people.

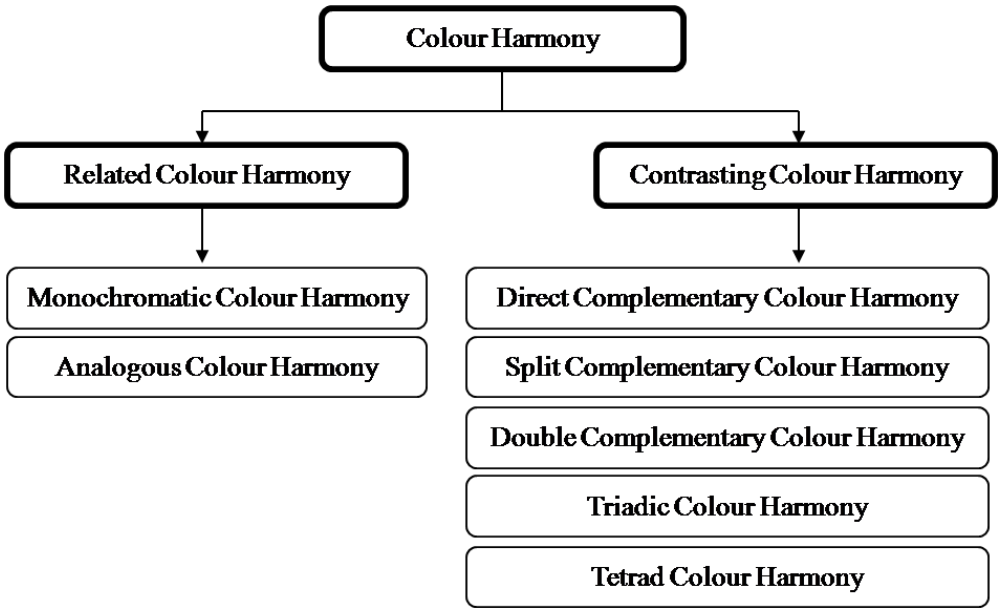
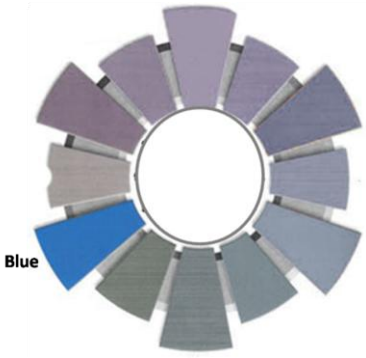


Figure 5 – Classification of Colour Harmony



A **monochromatic colour harmony** includes tints, tones, and shades of the same hue (Figure 6). Although it is a basic colour harmony, it is sometimes challenging to maintain interest. Hence, textures and values are necessary to provide interest.

An **analogous colour harmony** consists of related colours that are adjacent on the colour wheel (Figure 7). They usually match well and create serene and comfortable designs. Adjacent hues in an analogous colour harmony consist of tints, tones, and shades. They usually include only one primary colour. An analogous colour harmony allows one colour to dominate and others to support and enhance it (Jonathan, 1994).

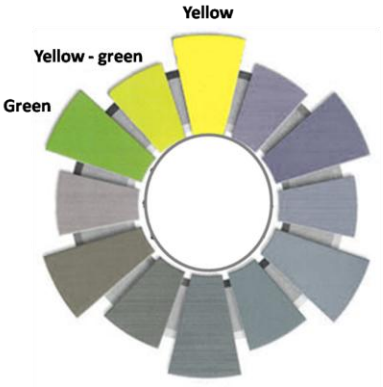


Figure 6 – Monochromatic Colour Harmony

Figure 7 – Analogous Colour Harmony

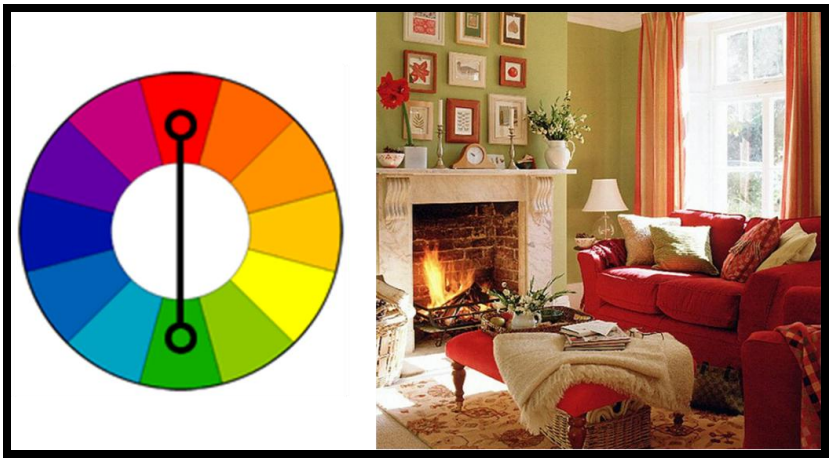
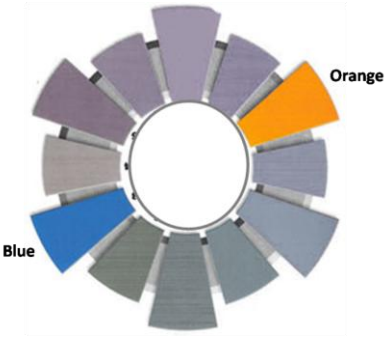


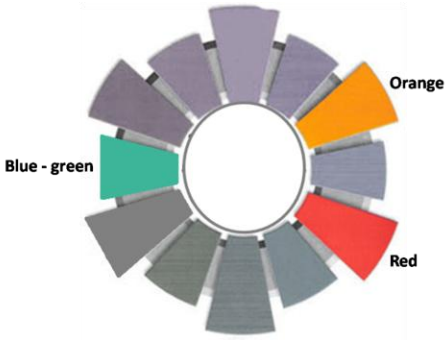
Figure 8 – Direct Complementary Colour Harmony

Contrasting colour harmonies include direct complementary, split complementary, double complementary, triadic, and tetrad colour schemes. Developing these colour schemes is more challenging because of the variety of colours from diverse parts of the colour wheel. Contrasting colour harmonies are dramatic, exciting, and make visual statements (Seetharaman and Pannu, 2009).



Direct complementary colour harmony features colours directly opposite on the colour wheel (Figure 8). Using a warm and a cool colour, these direct opposites create visual depth and make bold colour combinations. This type of colour harmony emphasizes colour differences rather than similarities. The combination of orange and blue is a good example for direct complementary colour harmony. This colour scheme must be managed well so it is not jarring. Complementary colour schemes are tricky to use in large doses, but work well when you want something to stand out (McMillan and McMillan, 2011).

Combining one colour with two colours on either side of its direct complement results in a **split complementary colour harmony** (Figure 9). Split-complementary colour scheme is a variation of the complementary colour scheme. A good example of split complementary colour harmony is Blue-green combined with orange and red. This colour combination provides a softer contrast than a direct colour complement. The split-complimentary colour scheme is often a good choice for beginners, because it is difficult to mess up.



A colour scheme that uses four hues; two adjacent hues and their respective complements is a **double complementary colour harmony** (Figure 10). E.g. Orange, blue, red-orange and blue-green (http://my worldofcolour.wordpress.com/category/color-harmony/).

A **triadic colour harmony** involves three colours equally spaced on the colour wheel. Although challenging, this colour harmony allows a skilled designer to create a pleasing combination by allowing one colour to dominate. Tints, tones, and shades are also effective in harmonizing this colour scheme (Figure 11). A combination of yellow-orange, red-violet and blue-green is a good example. (http://www.tigercolor.com/color-lab/color-theory/color-harmonies.htm).

A **tetrad colour harmony** comprises of any four colours which are equidistant on the colour wheel, forming a square or rectangle on the colour wheel (http://www.sensationalcolor.com/understanding-color-theory/color-theory/color-harmony.html). When placing a square (Figure 12) or rectangle (Figure 13) in the center of the colour wheel, the four colours touched by the four corners at once are known as tetrad colours. These four colour combinations create a harmonious colour theme (http://www.artsparx .com/color_tetrad.asp). A combination of yellow-orange, red, blue-violet and green is a good example for tetrad colour harmony.

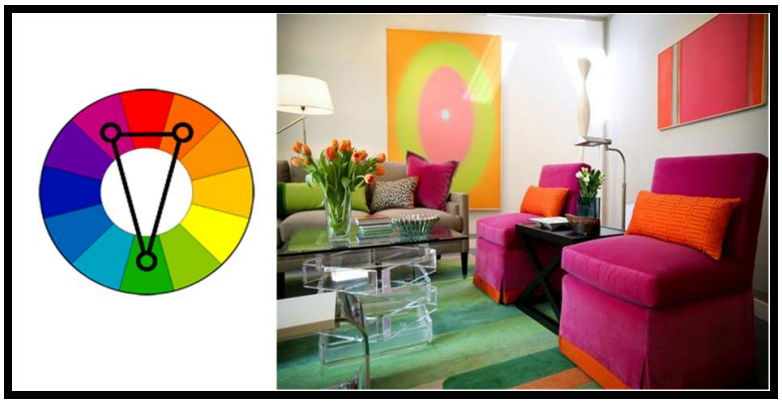
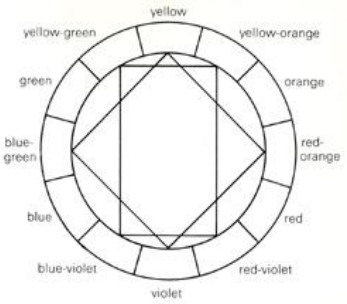
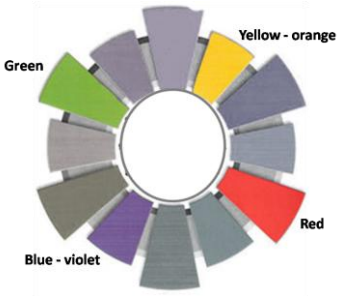


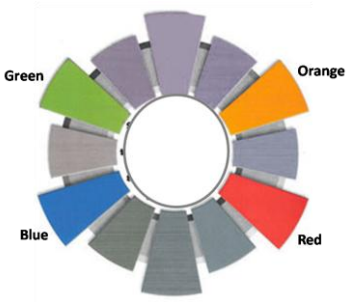
Figure 9 – Split Complementary Colour Harmony

Figure 10 – Double Complementary Colour Harmony

Figure 11 – Triadic Colour Harmony







A **neutral colour harmony** or **achromatic colour scheme** is a colour scheme that includes only colours not found on the colour wheel, called neutrals, such as beige, brown, grey, black and white (Figure 14) (http://en.wikipedia. org/wiki/ Color_scheme).

3. Application of Art Principles in the Use of Colours for a Room

According to Goldstein and Goldstein (2004) there are certain guiding art principles in the use of colour. All the principles of design apply to colour use and also contribute to beautiful colour effects.

a. Balance: It is the first essential principle for good colour arrangements:

- Large areas of colours should be quiet in effect, while small amounts may show strong contrasts.
- Value is also important in colour balance. If there is a difference in value, there must be corresponding change in amounts used in order to give the effect of repose. Thus, a large amount of light value will balance a small amount of dark value, or small amounts of dark balance large areas of light.
- Complementary colours form a natural balance because they complete or complement each other.

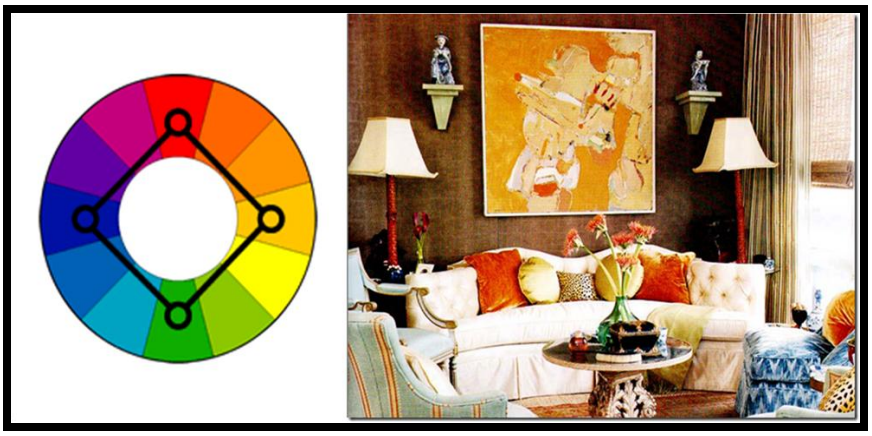


Figure 12 – Tetrad Colour Harmony (square)

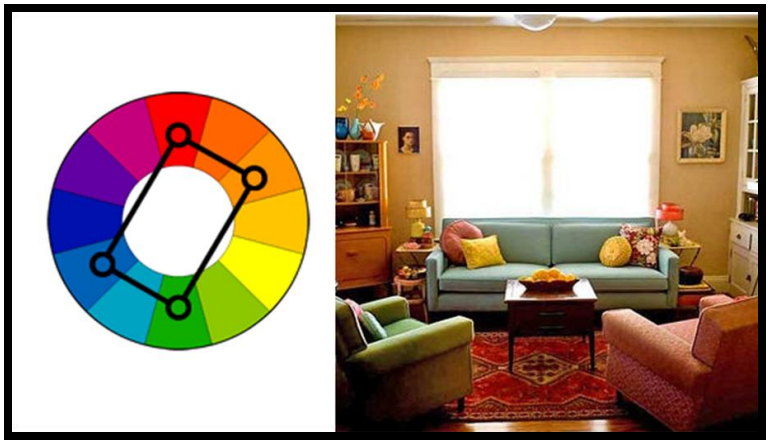


Figure 13 – Tetrad Colour Harmony (rectangle)

Figure 14 – Neutral Colour Harmony

- Colour or values can be balanced by repeating some of the same colours or values in various parts of an arrangement and this repetition, sometimes called crossing, has a tendency to give a feeling of rest.

b. Proportion: The proportion of one colour to another must be taken into account. Colour combinations are more beautiful when the amounts are varied than when they are equal. In any arrangement if the colours used are equal in their power of attraction, then the Greek proportion of 2:3 or 5:7 will be good.

c. Harmony: Unity or harmony in the colour combinations gives great pleasure. They give the impression that all the colours really belong together, and yet at the same time there must be sufficient variety to avoid monotonous arrangements.

d. Rhythm: Rhythm refers to the arrangement of colours along which the eye can move easily from one colour to another. When colours are skillfully repeated in several places in a room, the eye travels rhythmically as it follows these colours. Rhythm also results from the use of gradations in hue, value and intensity.

e. Emphasis: Emphasis can be gained by contrasts of hue, value and brightness. In any colour arrangement there should be one outstanding colour effect whether the scheme is simple or complicated. Colours of background in rooms should be quiet, because only then the objects planned against them will be more effective.

Colour is a powerful element in design. A designer uses the power of the language of colour and blends it with knowledge of the principles and elements of design to create arrangements that are beautiful and unique (Itten, 1976).

4. Architectural Use of Colour / Colour Treatments

The qualities of colour can be exploited to the advantage of the user while planning a new house or remodeling an old one. Room size, shape and character seem to change with the “architectural” use of colour. Some colour treatments stated by Faulkner and Faulkner (1994) are:

- An advancing colour on the ceiling makes a very high ceiling seem lower or nearer in order to make a room seem cosier.
- When the ceiling of a room is too low, a receding colour can be used to paint the ceiling to add height to a room. This makes the ceiling seem to be further away. White is the obvious choice but not the only one. Light colours with reflective finish or gloss finish should be used on the floor and ceiling.
- Using light receding colours on walls make a small room seem larger. Also called cool colours, receding colours are said to make walls appear to recede. Too much contrast in colour should be avoided and harmonious neutrals or monochromatic colour schemes should be used instead.
- Colours can be used to make a large room seem cosier by using warm, advancing colours on the walls. Warm advancing colours and contrasting textures bring instant warmth to a room. The use of complementary colours on curtains that contrast with walls, or furniture that contrasts with the floor also help to draw the room in.
- Colour can be used to camouflage or disguise unwanted features like storage by using the same treatment as on the walls to help them melt away.
- Attractive features in rooms can be enhanced by painting the feature to contrast with a background; smaller rooms can use neutral colours against a white background and larger rooms can use an advancing colour against a receding one.
- Rooms that are too narrow can be made to look wider by painting narrow end walls in an advancing colour and the other walls in a receding colour.
- Rooms that are too square and boxlike seem less awkward if one or two walls are treated differently from the others or if one wall and the ceiling or the floor is similar in colour.
- In a very large open plan room colour can be used to create zones for different activities. Each zone is defined by its colour scheme, furniture and lighting (http://cflynn.hubpages.com/hub/Ten-Top-Visual-tricks-With-Colour).

C. Colour in Ergonomics

1. Meaning, Definition and Aspects of Ergonomics

Dul and Weerdmeester (2008) state that the word ergonomics is derived from the Greek words “ergon”(work) and “nomos” (law). Ergonomics is the application of human sciences to the optimization of people's working environment`. It is a multi-disciplinary study of the relationships between the person and the environment in which both must operate. It is intended maximize productivity by minimizing effort and discomfort (http://www.agius.com/hew/ resource/ergo.htm).

The formal definition of ergonomics, approved by The Executive Council of the International Ergonomics Association (IEA) reads as follows “Ergonomics (or Human Factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance”(International Ergonomics Association’s Executive Council, 2000).Ergonomics is sometimes defined as the science of fitting the work to the user instead of forcing the user to fit the work (http://ergonomics.about.com/od/glossary/g/ defergonomics.htm).

According to Lacey (2009), the five aspects of ergonomics are Safety, Comfort, Ease of use, Productivity/performance and Aesthetics

2. Colour Ergonomics

Colour is all around us. Theorists like Birren believed that colour's influence extended beyond simply being a source of mere pleasing perception to having a fundamental influence on artwork, human psychology and the workplace experience (http://www.ehow.com/about_5366927_birren-color-theory.html).

'Colour Ergonomics' is the science of using the most appropriate colour in a certain situation that will best benefit the individuals working in that environment. Today 'Colour Ergonomics,' or colour theory, is critical to creating productive atmospheres in increasingly demanding work environments. It is based on matching colour responses to expected behaviors and attitudes in any given environment. The selection of appropriate colour is based on everything from lighting conditions, temperature fluctuations and working atmosphere, to concentration on the product or service being provided. For example, when we perform a task, our eyes are constantly adjusting to compensate for lighting levels, so severe differences of light and dark can cause problems. They constrict the pupil and deprive the eye of sufficient light to see clearly, causing strain. It's the goal of the colour consultant or designer to select colours that will minimize eye strain and enhance the work atmosphere (http://www.devoe.com/Jahia/home/ professionals/ designers/desergonomics).

3. Role of Colour in Ergonomics

Mahnke and Mahnke (1987) note a debt to Birren, and state their premise: Colour and light are major factors in man-made environments; their impact influences man's psychological reactions and physiological well-being. It is no longer valid to assume that the only role of light and colour is to provide adequate illumination and a pleasant visual environment.

- Effectively decorating the workplace with colours encourages creativity, productivity and positive morale.
- The appropriate use of colour can not only maximize productivity levels and minimize fatigue, but it can also stimulate collaboration, creativity and cooperation (http://www.colorcombos.com/is-coloring-the-workplace-really-worth -it-article .html).
- If a space is too dark, people tend to be less active, or they may feel anxious.

- If a space is too bright, people may feel overly exposed, or they will complain of glare or thermal discomfort.
- If there are too many different colours, too large an expanse of very saturated colour, or too many "busy" patterns of colour within a space, people will become irritated after more than a brief exposure to the space.
- If there is too little colour, no visual pattern, texture, or other decorative break in the visual environment, people will find the space monotonous, and irritating to the point of subconsciously wanting to escape.
- Colour can be used to minimize eye strain, enhance concentration and make the work environment safer.
- The temperature of the environment is also an important consideration when selecting colours. Warm and cool colours can be used to help create surroundings that are more comfortable.
- The level of activity in each workplace will vary. Colour can be used to help sort, organize, prioritize, transport and identify. Important elements may be easily distinguished from those that are more insignificant simply by colour application.
- Using appropriate safety colours to designate cautions and hazards, as well as safe areas, is a significant step in achieving excellence in the industrial atmosphere (http://www.afcee.af.mil/shared/media/document/AFD-070919-099.pdf).

D. Colour Perception and Colour Psychology

1. Colour Perception

When we deal with our environment, we are in constant interaction with our perception of colour. Perception is "the awareness of objects or other data through the medium of the senses" (Webster, 1968).

The eyes, with some help from the brain, can determine colour. Our perception of colour is influenced by several factors, which means that our

experience of colour is not absolute; it changes all the time. Dodsworth (2009) asserts that some of the reasons why colours seem to shift and change are:

- Light sources rarely emit light that is truly white with an even mix of wavelengths. Incandescent lamps give out relatively warm (red-yellow) light, for example, while other types of artificial light source all have their own colour characteristics. Daylight, which is often quoted as a reference standard, will actually change in quality throughout the day, and is also dependent on geographical location and orientation, which refers to the outlook of a space in relation to compass point.
- Material surfaces can reflect light in a diffuse or spectacular (mirror-like) way.
- Colours can be changed to a subtly different hue by the presence of other colours nearby.

Because of these and other reasons, it is impossible for us to accurately remember a colour. Actual references should always be taken or noted when trying to colour match.

2. Colour Psychology: The Psychological and Physiological Effects of Colour

a. The Psychological Effects

"Colours are forces, radiant energies, that affect us positively or negatively, whether we are aware of it or not. The effects of colours should be experienced and understood, not only visually, but also psychologically and symbolically."

- Faber Birren

Colour is very powerful. We encounter colour in every aspect of our lives. We respond to the colours in everything we do, whether we realize it or not. Psychologists believe it can influence our moods and how we feel about spending time in a particular room. These emotional responses vary, depending on each

person's exposure to specific colours. Yasuda (2007) stated that "Colours do appear to elicit certain emotional responses".

Psychologists credit certain colours as having specific associations. In a study examining colour-emotion associations, Boyatzis and Varghese (1994) found that light colours (e.g., yellow, blue) are associated with positive emotions (e.g., happy, strong) and dark colours (e.g., black, grey) with negative emotions (e.g., sad, angry). Hemphill (1996) also found that bright colours elicited mainly positive emotional associations, while dark colours elicited negative emotional associations, confirming the results obtained by Boyatzis and Varghese (1994).

As a result of many studies done by various psychologists through the years, general lists have been composed of emotions, ideas and objects associated with various colours. The following list is a compilation of lists made by Pile (1997) and Mahnke (1996):

- **Red:** arousing, passion, love, blood, life, warmth, intensity; danger, enemy
- **Orange:** bright – exciting, light – cheery, lively, energetic; fire, sunsets; caution
- **Yellow:** cheerful, happiest, optimistic; mental and spiritual enlightenment; life-giving sun, sunshine, spring; expresses activity; intense hue – egocentric, overbearing
- **Green:** light – retiring, pure hue – relaxing, tranquil, natural, life, growth, fertility, hope; envy, tiresome, guilty, poison, illness; toward blue – colder; toward yellow – lighter, stimulating, fresh, youthful
- **Blue:** relaxing, calmness, comfort, security, yearning; spirituality, wisdom, nobility, dignity, honesty; cold, melancholy, depressing; wet, clean
- **Violet:** regal, defined; wealth, pompous; mysticism, magic, dramatic, imaginative; lonely, mournful; under certain shades – morbid and unsettling; toward red – seductive, sensual, secretive, sweet and intimate

- **White:** spiritual, hope, chastity, purity, innocence, good; surrender/submission; clean, clinical, unemotional, empty, blank
- **Black:** darkness, ominous, fear, evil; negative; hatred, defiance; gloomy emptiness, heavy, death; status, elegance, richness, dignity; erotic, mysterious
- **Grey:** conservative, quiet, calm; dreary, tedious, passive, lifeless, no clarity, neutral, lacks energy
- **Brown:** Serious, warm, earthy, reliable; lack of humor, heaviness, lack of sophistication, sad, dirty

b. The Physiological Effects

Amazingly, colour affects all aspects of your body in some way whether directly or through a chain of events. The eyes are directly affected which in turn sends signals to the brain and then causes the chain reaction through the rest of your body. These reactions to colour are very important to scientists and psychologists because they give us the information we need to make the best of environments.

Various studies have been done on the inner physiological effects of colour and surroundings. Mahnke (1996) states that one of the earliest studies reported by Louis Cheskin, former associate director of Color Research Institute of America, compared four rooms decorated entirely in one colour (furnishings included): red, blue, yellow or green. An increase in pulse and blood pressure and difficulty working due to overstimulation was noted in the red room. In the blue room the exact opposite was observed – blood pressure and pulse declined and participants worked slower. There were no effects on blood pressure or pulse in the yellow room, but eyestrain made it nearly impossible to work. The green room had no effects except that participants claimed it was “monotonous” (Mahnke, 1996).

F. Birren (1978) also performed studies on the effects of coloured light. Participants were asked to stand in front of a large screen that was illuminated with a certain colours. His results showed that red light did increase blood pressure, pulse and respiration. Skin responses were higher and more brain activity was noted. Participants were often distracted by the outside environment. Green and blue lights tended to have the same effects. The rates of body functions were lower than seen in the red light and participants were able to direct their attention toward the light rather than being distracted by their surroundings.

In general, all studies have found overstimulation with bright colours and patterns to be distracting and fatiguing thus slowing down the work process. It causes inconstant blood pressure and tension, which can lead to serious illnesses. On the other hand, under stimulation can cause similar problems. The senses are not stimulated and the worker gets bored and easily distracted. Therefore, careful thought must be given to colour usage and placement.

c. Colour Psychology as a Therapy

Several ancient cultures, including the Egyptians and Chinese, practiced chromotherapy, or using colours to heal. Chromotherapy is sometimes referred to as light therapy or colourology and is still used today as a holistic or alternative treatment (http://psychology.about.com/od/sensationandperception/a/colorpsych .htm). In this treatment:

- **Red** was used to stimulate the body and mind and to increase circulation.
- **Yellow** was thought to stimulate the nerves and purify the body.
- **Orange** was used to heal the lungs and to increase energy levels.
- **Blue** was believed to soothe illnesses and treat pain.
- **Indigo** shades were thought to alleviate skin problems.

E. Factors Influencing the Selection of Colour Schemes

Kasu (2005) affirms that we have to consider the following factors before deciding a colour scheme:

1. Individual Choice

Since an interior of a workplace is designed for a certain person who has to work there for a considerable time, the worker's likes and dislikes should be considered for choosing a colour scheme. But for spaces used by more than one person the colours favored by the majority of occupants should be used.

2. Utility

Before we decide what type of colour scheme is required in a room, three factors decide it:

- ♣ Span of time - An entrance hall, living room, bathroom, dressing room, etc are used for shorter span and hence warmer or exciting colours can be utilized. But for the rooms which are used for longer period like bedroom, kitchen, etc, cooler and sober colours are used.
- ♣ Function - The level of activity in each workplace will vary. Some facilities may operate at a moderate pace, while others may be extremely hectic. Colour can be used to help sort, organize, prioritize and identify. E.g. A kitchen is a space which is highly hectic in nature therefore colours that have a soothing or pleasant effect on the user may be used.
- ♣ Size - In smaller rooms, high key colour scheme should be employed to visually enlarge the room. Bigger rooms should be in low-key so that their size would not overwhelm the person in it.

3. Orientation of the Room and the Doors and Windows

The orientation or the location of doors and windows in an area determines the colour to be used for that area. The doors and windows are the sources of natural lighting in a room. The amount of natural lighting entering a room as the result of its orientation will determine both, the amount of artificial lighting that will be required and the type of colour to be used in the area. In places where there is enough natural light, cool and relaxing colours or colours which have low reflectivity can be used to make the room or place comfortably usable. In places where there are less number of windows and doors to allow natural light in the interior, colours with high reflectivity should be used so that the minimum light that is available is reflected to make the availability of light in the interior nominal. Vivid and vibrant colours can also brighten up a room sufficiently.

4. Type and Colour of Artificial Light Used in the Room

Day light is supplemented by artificial light in homes therefore we need to understand their properties. Colours look just right in sun light but change dramatically under artificial or fluorescent lighting. Most fluorescent lights give off a green tinge and dull warm colours and enhance cool colours. Incandescent light or halogen lighting cast a yellowing warm light dulling down cool colours and enhancing warmer colours. If tinted lights are used, it will either increase the colours intensity or dull it if it is a complementary colour. Not enough lighting will further darken a colour and too much lighting will wash out a colour. Lights determine to a very big extent, the effect of colour on the wall and the overall look of the room (http://www.naturalhandyman.com/iip/inf decorating/colorandlight-cn.html).

5. Temperature of the Room and Colour

The temperature of the environment is also an important consideration when selecting colours. Studies indicate that colours have been identified in

conjunction with temperature (Sharpe, 1981). J. Itten performed experiments to show that "colour has the power to suggest warmth or coolness". Itten painted two workrooms, one blue-green and the other red-orange, and maintained the temperature at 59 degrees Fahrenheit. "Occupants of the blue-green room felt that 59 degrees Fahrenheit was cold, whereas the temperature had to fall to 52 degree in the red-orange room before the subjects felt cold". Warm and cool colours can therefore be used in cool and warm spaces respectively to help create surroundings that are more comfortable. In very cold spaces, it makes sense to utilize colours that are 'warm'. Alternately, in very warm spaces, like kitchens and warmer climates where heat is oppressive, 'cool' colours will promote a sense of coolness and freshness (Mahnke, 1996).

6. Texture Of the Surface

The colours that we see in objects are the result of light waves that reach the eye after the object has selectively absorbed some of the wavelengths and either reflected or transmitted the others. In other words, the colour, or pigmentation, of an object absorbs all colours of light except its own colour, which is either reflected or transmitted to the eye. The material or texture of an object will also influence how much light is absorbed, reflected, or transmitted. When light falls on an unpolished (diffuse) surface light waves are reflected in all directions because of the even surface. Smooth, shiny surfaces reflect more light, and dull or matte surfaces absorb most of the light waves, thus modifying the visual appearance (http://www.kitchen-emporium.com/colour.html).

7. The Optical Illusions Created by the Juxtaposition of Colours

Colours reflect nearby colours. No colour stands alone. When two colours are placed side by side, each undergoes apparent change. For example, red placed near or against yellow can take on an orange cast. The various optical illusions

will highly determine the selection of colour and its placement in the interior (http://www.ca.uky.edu/hes/fcs/FACTSHTS/HF-LRA.148.PDF).

8. Colour and Reflectivity of the other Elements in the Room

Critic John Ruskin echoed that, “Every hue throughout your work is altered by every touch that you add in other places" (Rossotti, 1983). Colours are affected by the amount of light, the angle of light, the colour of reflected light and the nearby colours. In an interior, the floor will reflect more light than any other surface. The ceiling will reflect the least. A light coloured floor will do more to make a room look spacious than a light ceiling. The recommended reflectance values are given by Dul and Weerdmeester (2001). The reflectance is a value between zero and one, with a zero value meaning that no light is reflected (dark surface) and a value of one meaning that all the light is reflected (light surface). Table 2 reveals the recommended values for the reflectance of various surfaces.

Table 2: Recommended Values for the Reflectance of Various Surfaces

Surface	**Reflectance**
Ceiling	0.80–0.90 (‘light’)
Walls	0.40–0.60
Floor	0.20–0.40 (‘dark’)

9. The Psychological Effect of Colour

Boyatzis and Varghese (1994) state that colours stimulate various emotional responses. These emotional responses vary, depending on each person’s exposure to specific colours and should be considered while selecting the colour for rooms.

Methodology

III. METHODOLOGY

The interior design discipline involves the arrangement of living space to attain greater functionality and the creation of the perfect atmosphere for the space's intended purpose.

"Good design combines usefulness with at least one of the following: beauty, comfort, efficiency, economy, or durability."

-Michael Maurer

The elements of design are the building blocks used to create a work of art. Colour is an important element in Interior Design. The colour in itself is as important as the Interior Design. Colour is everywhere, and in home designing and interior décor, colour is the most important factor in creating moods of a room.

"Colour is the single most powerful component of any interior."

- David Hicks, "Style and Design"

The methodology adopted for the study on **"Impact of Colour in Creating Ergonomically Efficient Residential Interiors"** comprised the following phases:

Phase 1: Household Survey

Phase 2: Case Study

Phase 3: Developing Ergonomic Colour Scheme Modules for Residential Interiors

Phase 1: Household Survey

Groves (2009) avows that a 'Survey' is a systematic method of gathering information from (a sample of) entities for the purpose of constructing quantitative descriptors of the attributes of a large population of which the entities are members. A household survey was conducted to gather information about the effect of colour on its user. The survey included the following aspects:

A. Selection of the Area

B. Selection of the Sample

C. Selection of the Method

D. Conduct of the Study and

E. Consolidation and Analysis of the Data

A. Selection of the Area

Coimbatore, also known as Kovai is the second largest city in the Indian state of Tamil Nadu and one of the fastest growing cities in India. Located at the foothills of Nilgiris, in the western part of Tamil Nadu and at an altitude of 432 meters above the Mean Sea Level (MSL) it is also called as Poor man's Ooty. The city is situated on the banks of river Noyyal, a tributary of river Cauvery. It is blessed with a wonderful climate and water. Coimbatore city is strategically located at the junction of the three modern southern states Tamil Nadu, Kerala and Karnataka with proximity to many important cities of Southern India.

Coimbatore district has a population of about 42.72 Lakhs (Census in 2011). It is known for its peaceful atmosphere, cosmopolitan outlook and private enterprise. The rich black soil of the region has contributed to Coimbatore's flourishing agriculture industry and, it is in fact, the successful growth of cotton has served as a foundation for the establishment of its famous textile industry. The city is home to more than 25,000 small, medium, large and tiny industries and textile mills, hosiery units and engineering industries.No wonder it is rightly called the **"Manchester of South India".**

Coimbatore is a major commercial centre and is famous for Schools, Universities, Engineering Colleges, Medical, Management Schools, Textiles - Yarn, Knitted Garments, Handlooms, Textile Machinery, Motors, Pumps, Industrial goods, Cotton, Tea, and Software.

The Coimbatore real estate has been growing ever since mammoth industries shifted operations to the city. The lack of availability of land and sky rocketing property prices made the companies shift their focus to South India. The primary reason for Coimbatore being chosen as the commercial destination is the fact that it is now emerging as a city following international standard lifestyle. As observed in real estate trends followed across the country, as soon as an industrial wave flourishes a city- be it a tier-II or III- its real estate sector begins to develop exponentially. In such a scenario, the need for urban housing also increases.

The growing number of industries in Coimbatore resulted in an increase in population as the number of migrants entering the city shot up. According to the provisional data of census 2011, Coimbatore Population in the district has increased by 19.06 per cent during the last 10 years as against the State average of 15.6 per cent (http://www.thehindu.com/thehindu/pp/2011/05/21/stories/2011052150110100.htm).

When more people move into the city in search of employment or for educational purposes, they need quality and affordable living space. Increase in population demanded the need for accommodation of professionals working in the various fields. After the humungous development of commercial property, housing sector in Coimbatore began to multiply manifold. From flats to apartments to villas to independent houses, residential property has developed considerably.

High standards of education facilities, blossoming of numerous industries and large number of career opportunities are some of the reasons for migration in Coimbatore. The boom in Coimbatore property is here to stay and will surely yield high returns in future (http://www.articlesbase.com/real-estate-articles/real-estate-in-coimbatore-2366948.html).

With the development of residential property Interior Designers and Colour Consultants have also started expanding cognizant growth in the city. Areas

namely Sivananda colony, Saibaba colony, Gandhipuram, Ramnagar, R.S. Puram and Race Course were selected for the study in the city because all these areas had posh houses that belonged to the families in the High Income Group. Due to convenience, easy accessibility for gathering information and co-operation extended by respondents, the samples were selected in the above mentioned areas.

B. Selection of the Sample

A sample is selected from a sampling frame. This sample is the group from which measurements will be sought. In many cases, the sample will be only a very small fraction of the sampling frame and therefore, of the target population (Groves, 2009).

According to Kothari (2007), Sampling is the process of obtaining information about an entire population by examining only a part of it. Hundred households that belonged to the High Income Group were selected based on purposive sampling method. In this method the choice of sample items depends exclusively on the purpose of the investigator. In other words, the investigator exercises her judgment in the choice and includes those items in the sample which she thinks are most typical of the universe with regard to the characteristics under investigation (Gupta, 2006).

The investigator specially chose for the survey, only those residences that were

- Individual houses and bungalows,
- Constructed between 2006 and 2011 and
- Owned by High Income Group families

The investigator felt that only this group of people would have used the recent fashion in using colours and they would have better awareness and

knowledge on the latest trends in the use of colour. Besides, they will have better acceptance of the ideas and suggestions regarding the use of colour.

C. Selection of the Method

'Survey' refers to the method of securing information, concerning a phenomenon under study from all or selected number of respondents of concerned universe (Kothari, 2007). Singh (2009) affirms that Survey is the process of collection of data and this is the first step for any statistical enquiry. Blaxter et al., (2001) point out survey research as the method of collecting data by asking a set of pre-formulated questions in a predetermined sequence.

Personal interview cum observation method was adopted by the investigator for conducting the survey. Interview method of collecting data, involves a face to face contact with people from whom the information is to be obtained. The interviewer asks them questions pertaining to the problems and collects the desired information (Gupta, 2006).

According to Sharma and Jain (2004) an interview schedule is a pro forma containing a set of questions and is very useful in gathering information. An interview schedule was formulated to obtain relevant and required information regarding the general information of the dwellers of the residence, their socio – economic background, their colour preference for the rooms, the pattern of colour application, effect of other contributing factors like light and texture and the ergonomic aspects of colour usage.

Observation means viewing or seeing (Krishnaswami and Ranganatham 2005). Malhotra and Dash (2008) notify observation as the potential to provide valuable information when properly used. From a practical standpoint, it is best to view observation as a complement to survey methods. The investigator observed the colour of the decorative finishes used in the Living Room, Kitchen, Dining Room and Master Bedroom of the selected residences and made note of it.

Prior to finalizing the questionnaire it is desirable to carry out a preliminary experiment on a sample basis. When questionnaires are to be distributed on a large scale, it is absolutely essential to pre – test them (Donald and Burney, 2002). Pretesting refers to the testing of the schedule on a small sample of respondents to identify and eliminate potential problems. Even the best schedule can be improved by pretesting. As a general rule, a questionnaire should not be used in the field survey without adequate pretesting, assert Malhotra and Dash, (2008). The prepared schedule was pretested in ten residences for its ambiguity and based on the pilot study, the schedule was modified with necessary correction. The modified schedule for the study is presented in Appendix.

D. Conduct of the Study

According to Panneerselvam (2005) Data are the basic input in any decision making process. Direct Personal Interview and Observation method was considered advantageous for collecting data. In the Direct Personal Interview method there is a face to face contact with the people from whom the information is to be obtained. The interviewer asks them questions pertaining to the survey and collects the desired information. The information obtained from this method is likely to be more accurate because the interviewer can clear up doubts of the informants about certain questions and thus obtain correct information. In case the interviewer apprehends that the informant is not giving accurate information, he may cross – examine him and thereby try to obtain the information (Sharma, 2005).

The investigator approached the selected homemakers at their residence. The purpose of the study was explained to them, permission was sought and the survey was conducted. The investigator created a friendly ambience while interacting with the homemakers or house owner’s which is very conducive for obtaining desired data.

The observation method was also used as a complement to the interview method for data collection as the respondents may not be able to spare a lot of time, which is required to answer every division of the schedule. The investigator therefore made a note of all the important things by observation so that valuable time is not wasted on asking of and answering of obviously visible things.

Thus the investigator personally visited all the selected hundred households and collected the necessary information.

E. Consolidation and Analysis of the Data

Interpretation of collected data is not only necessary but unavoidable in research (Reddy, 2004). The data collected are generally in an unintelligible form and need to be classified and tabulated before they are analyzed (Puri, 2000).The data thus collected were consolidated, tabulated and then analyzed. Jain (2000) considers that the purpose of a table is to simplify the presentation and to facilitate comparison. The tabulated data were analyzed, discussed and presented under Chapter IV Results and Discussion.

Phase 2: Case Study

Once all the required data was collected through direct personal interview cum observation method and after all the data was interpreted and analyzed, the investigator felt the need to analyze the overall effect of all the elements in relation to colour, in detail, in at least two of the selected households among the sample where the choice of their colour schemes had a great impact on them.

Hence two residences owned by businessmen, and both constructed in the year 2008 were analyzed for the detailed understanding of their choice and experience with colour in their residences. The two residences were visited recurrently in order to obtain the required information. The details of the Case Study are recorded and presented in Chapter IV.

Phase 3: Developing Ergonomic Colour Scheme Modules for Residential Interiors

Due to the interest in Colour and Interior Designing the investigator attempted to develop a colour scheme using 3-D designing software for each of the important residential workspaces namely Living Room, Kitchen, Dining Room and Bedroom.

The colour scheme was developed taking into consideration all the factors, namely individual choice, utility, orientation and reflectivity of colours, type and colour of artificial lights used in the room, temperature of the room and colour, texture of the surface, the optical illusions created by the juxtaposition of colours, colour and reflectivity of the other elements in the room and the psychological effect of colour.

The scientific discipline, **"Ergonomics"** was also considered as the colour schemes were developed for the workspaces in Residential Interiors. Every workspace must serve its ultimate function – **Productivity**, to fulfill which, ergonomics should be applied to the workspace design in order to create a workable relationship between the worker and the workspace.

Based on the interaction with the homemakers and the other members of the two selected families, the investigator found the necessity for developing Colour Scheme Modules for Residential Interiors. The goal of the **Ergonomic Colour Scheme Modules** thus developed by the investigator was to use the colours to the optimum thereby benefitting the user and serving its function at the workspace.

Results and Discussion

IV. RESULTS AND DISCUSSION

The findings of the study on **"Impact of Colour in Creating Ergonomically Efficient Residential Interiors"** are discussed under the following headings:

Phase 1: Findings of the Household Survey
Phase 2: Presentation of Case Study
Phase 3: Developing Ergonomic Colour Scheme Modules for Residential Interiors

Phase 1: Findings of the Household Survey

This phase of the findings present the data received from the selected 100 households. They are presented under the following topics:

I. General Family Background
J. Details of the House
K. Preference of Colour for Rooms
L. Effect of Texture on Colour
M. Effect of Light on Colour
N. Relationship between Colour and Temperature
O. Psychological Effect of Colour in Rooms
P. Ergonomic Aspects in the Use of Colour

A. General Family Background

The use of colour and its preference is something that differs from person to person. Its concept, for every person is influenced by the age, sex, education, occupation, income, religion etc. The details on the general family background of the selected families consisted of the age, educational qualification, occupation, monthly income, type of family system and religion.

1. Age, Educational Qualification and Occupational Status of the Families

The age, educational qualification and the occupational status of the homemakers and the heads of the selected families are discussed in Table 3.

Table 3: Age, Educational Qualification and Occupational Status of the Families

Details	**Percentage (N = 100)**	
Age (in years)	**Homemakers**	**Heads**
21-30	24	19
31-40	50	43
41-50	26	30
51-60	0	8
Educational Qualification	**Homemakers**	**Heads**
High School	39	23
Higher Secondary	29	14
Under graduate	10	33
Post graduate	10	10
Professional	12	20
Occupational Status	**Homemakers**	**Heads**
Businessmen/ Businesswomen	2	63
Teachers and Professors	12	24
Doctors	7	9
Engineers and Architects	9	4
Homemakers	70	0

a. Age of the Homemakers and Heads of the Families

Among the surveyed families a majority of 50 per cent of the homemakers and 43 per cent of the heads of the families belonged to the age group of 31-40 years.

b. Educational Qualification of the Homemakers and Heads of the Families

A majority of 39 per cent of the homemakers were high school pass outs and 33 per cent of the heads of the families were under graduates by qualification.

c. Occupation of the Homemakers and Heads of the Families

The occupation of the homemaker and head of the family is an important criterion as it will determine both the income of the family and their standard and style of living. While a majority of 70 per cent of the homemakers were full time homemakers, 63 per cent of the heads of the families were successful and accomplished businessmen by occupation.

2. Monthly Income, Type of Family System and Religion Followed

This heading includes the monthly income, type of family system and religion of the selected families.

a. Monthly Income

Tamil Nadu Housing Board (2005) classifies Higher Income Group as the citizens earning Rs. 7501 and above per month (http://tnhb.gov.in/citizen.aspx). Table 4 shows the monthly income of the selected families.

Table 4: Monthly Income of the Families

Monthly income (in Rs.)	Percentage (N = 100)
30,001 - 40,000	8
40,001 - 50,000	18
50,001 - 60,000	6
60,001 - 70,000	8
70,001 - 80,000	16
80,001 - 90,000	14
90,001 - 1,00,000	16
1,00,001 - 2,00,000	6
2,00,001 - 3,00,000	8

Though all the selected families belonged to the High Income Group, it was seen that there was a lot of disparity in their income (Figure 15). A majority of 18 per cent of the selected families earned an income between Rs. 40,001 and 50,000 monthly. Amongst the surveyed households six per cent each belonged to the income range between Rs. 51,000 and 60,000 and Rs. 1,00,001 and 2,00,000. The lowest income ranged between Rs. 30,001 and 40,000 and the highest income between Rs. 2,00,001 and 3,00,000. Both the extremes had eight per cent of samples each in their favour.

b. Other Sources of Income

While 34 per cent of the selected sample had no other source of income other than the income from their main occupation, 26 per cent earned from interests from savings and deposits, 12 per cent from dividends, shares and debentures, 18 per cent from rent from properties and the remaining 10 per cent from mutual funds.

c. Type of Family System

Among the selected families, 56 per cent were living as a nuclear family and 44 per cent as a joint family, with their in – laws.

d. Religion Followed

A majority of 90 per cent of the surveyed families were Hindus by religion. Of the 10 per cent that remained, six per cent were Muslims and 4 per cent were Christians.

B. Details of the House

The details of the house include the plinth area of the house, year of construction, style of construction, number of stories in the house, number of rooms in the house, details of the rooms, duration of painting the house and the expenditure incurred in painting the house.

1. Plinth Area of the Selected Houses

Table 5 presents the plinth area of the selected houses.

Table 5: Plinth Area of the Houses

Plinth area (in sq.ft.)	Percentage (N=100)
1,001 - 2,000	30
2,001 - 3,000	36
3,001 - 4,000	14
4,001 - 5,000	12
5,001 - 6,000	4
6,001 - 7,000	2
7,001 - 8,000	2

Among the selected houses, a majority of 36 per cent had a plinth area between 2,001 and 3,000 sq.ft. Only a meagre two per cent each belonged to the plinth area range of 6,001 - 7,000 sq.ft. and 7,001 - 8,000 sq.ft. Though, only a small percentage, it was astounding to learn that there were houses that had a plinth area even between 6,001 and 8,000 in the posh and busy areas of the city.

2. Year of Construction

Table 6 presents the year of construction of the selected houses.

Table 6: Year of Construction

Year of construction	Percentage (N = 100)
2006 – 2007	32
2007 – 2008	24
2008 – 2009	22
2009 – 2010	16
2010 – 2011	6

All the surveyed houses were constructed between the time period of 2006 and 2011. Among them, a majority of 32 per cent were constructed between 2006 and 2007, 24 per cent of the houses were constructed between 2007 and 2008, 22 per cent were constructed between 2008 and 2009, 16 per cent of the houses were constructed between 2009 and 2010 and six per cent of the houses were constructed between 2010 and 2011. A gradual decrease can be witnessed in the number of houses constructed with the advancement of the years of construction.

Among the surveyed houses 74 per cent of the houses were constructed by their present residents or owners while 26 per cent of the houses were purchased either from their past owners or from the land developers and promoters.

3. Style of House, Number of Stories and Number of Rooms in the House

Table 7 demonstrates the style of house, number of stories and number of rooms in the selected houses.

Table 7: Style of House, Number of Stories and Total Number of Rooms in the Houses

Details	Percentage (N=100)
Style of House	
Traditional	35
Modern	47
Contemporary	18
Number of Stories	
One storey	9
Two stories	63
Three stories	28
Number of Rooms	
4 to 6	22
6 to 8	36
8 to 10	22
10 to 12	10
12 to 14	10

a. Style of the Houses

The style of construction of the houses varied from their corresponding construction period, i.e., though all the houses were constructed within five years (2006-2011), diversity in the style of construction can be witnessed. While a majority of 47 per cent of the houses exhibited modernity in their style of construction, 35 per cent of them opted for the traditional style and 18 per cent showcased a contemporary style of construction (Figure 16).

b. Number of Stories

The surveyed houses showed diversity in the number of stories also. A majority of 63 per cent of the houses were two storied. While 28 per cent of the houses had three stories, only nine per cent of the houses were single storied, which reveal that people prefer to have houses that are neither too big nor too small.

c. Number of Rooms

The houses differed from each other even in their number of rooms. A majority of 36 per cent of houses had 6 to 8 rooms. Next in line, with a favour of 22 per cent each, were the houses that had 4 to 6 rooms and 8 to 10 rooms respectively. Of the surveyed houses 10 per cent each had 10 to 12 rooms and 12 to 14 rooms.

4. Details of the Rooms

The various details include the number of rooms in each category, the purpose of the rooms and their regularity of use.

a. Number of Rooms

The details regarding the number of rooms are depicted in Table 8 and Figure 17.

Table 8: Number of Rooms in Each Category

Room	Percentage (N = 100)			
	No Room	**1 Room**	**2 Rooms**	**3 Rooms**
Living room	0	86	12	2
Kitchen	0	93	7	0
Dining room	0	87	13	0
Master bedroom	0	56	28	16
Kid's room	16	71	13	0
Guest bedroom	8	71	21	0
Pooja room	10	90	0	0
Recreation room	34	53	13	0

Every house has many different rooms named as Living room, Kitchen, Dining room, Pooja room, Master Bedroom, Kid's room, Guest Bedroom, Recreation room etc., depending on their purpose of use. Ironically every house does not have all the rooms stated above. Amongst the surveyed houses, the most commonly found rooms, and those that were mandatory to every house were the Living room, the Kitchen, the Dining room and the Master Bedroom.

Though present in every house, the number of rooms in each of the above stated category varied.

Living Room: A majority of 86 per cent of the houses had one living room and, while 12 per cent of the houses had two, a minority of two per cent of the surveyed houses had three living rooms. In houses that had two or three living rooms, one was used to entertain guests; the other one/two were family rooms where they either watched television or ate together or had a discussion or even played cards or board games during their leisure time.

Kitchen: While a majority of 93 per cent had only one kitchen, a minority of seven per cent had two kitchens. Of the two kitchens, one was used by the homemaker, only occasionally and the other was used by cooks or domestic helpers regularly for the purpose of cooking.

Dining Room: A majority of 87 per cent of the surveyed houses had one dining room and the rest had two dining rooms. In case of two dining rooms, one was used regularly and was meant for the family while the other was a formal dining table exclusively for guests.

Bedroom: While a majority of 56 per cent of the surveyed houses had one master bedroom, 28 per cent and 16 per cent of the houses had two and three master bedrooms respectively, one of which was used by the head and homemaker of the family and the other(s) used by the other members of the family.

b. Purpose of the Rooms and their Regularity of Use

Table 9 exemplifies the purpose of the rooms and their regularity of use.

Table 9: Purpose of the Rooms and their Regularity of Use

Room	Percentage (N = 100)							
	Purpose						Regularity	
	Work	Relax	Rest	work and relax	work and rest	rest and relax	Every day	Some -times
Living room	6	84	0	10	0	0	96	4
Kitchen	100	0	0	0	0	0	100	0
Dining room	0	75	0	25	0	0	83	17
Bedroom	0	0	64	0	36	0	100	0

i. Purpose of the Rooms

Living Room: While a majority of 84 per cent used the living room for relaxing (watching television, movies, playing games), 10 per cent used it both for working and relaxing and six per cent of the households used the living room for working (either office work /school work / home work).

Kitchen: All the surveyed households used the kitchen for the purpose of work only.

Dining Room: A majority of 75 per cent of the households used the dining room for the purpose of relaxing (eating in a relaxed manner, having a chat with family) and the rest (25 per cent) used it for the dual purpose of working (preparation for cooking, office work, studying, and writing) and relaxing.

Bedroom: A majority of 64 per cent of the surveyed households used the bedroom only for resting (sleeping) and 36 per cent used the bedroom both for working (studying, office work) and resting.

ii. Regularity of Use

Of all the above mentioned rooms, the kitchen and the bedroom were used regularly and every day. The living room, in 96 per cent of households, was used everyday but in four per cent of the households it was used only sometimes. The dining room, in 83 per cent of the households was used every day but in 17 per cent of the households it was used only sometimes.

5. Regularity/ Duration of Painting the House:

Since all the surveyed houses were constructed within the past five years (2006-2011) only 30 per cent of the oldest houses in the lot (constructed in 2006-2007) were repainted in 2011. Amongst the remaining, while 25 per cent intended

to repaint their house in five years 45 per cent of the households preferred to repaint it after three years.

6. Expenditure Incurred in Painting the House

Table 10 presents the expenditure incurred in painting the house.

Table 10: Expenditure Incurred in Painting the House

Amount spent (in Rs.)	Percentage (N=100)
10.001 - 20,000	6
20,001 - 30,000	26
30,001 - 40,000	22
40,001 - 50,000	14
50,001 - 60,000	14
60,001 - 70,000	10
70,001 - 80,000	2
80,001 - 90,000	4
90,001 - 1,00,000	2

The difference in the amount of money that the households spent for painting their houses are large and are revealed clearly in Figure 18. The amount ranges from a minimum of Rs.10,001 to a maximum of Rs. 1,00,000. Of the selected households, 68 per cent spent below Rs. 50,001 and the rest spent above Rs. 50,000.

C. Preference of Colour for Rooms

This head includes the users of the rooms, the selection of colour schemes and the reasons for selection of the colours, interior finish used on the wall, number of colours used in rooms and preference of colour for the walls, floors and ceilings of the rooms.

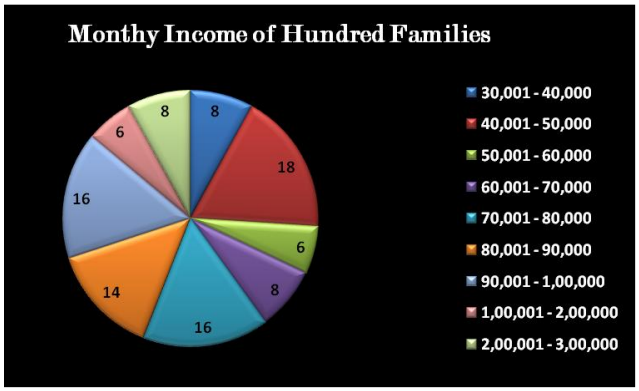
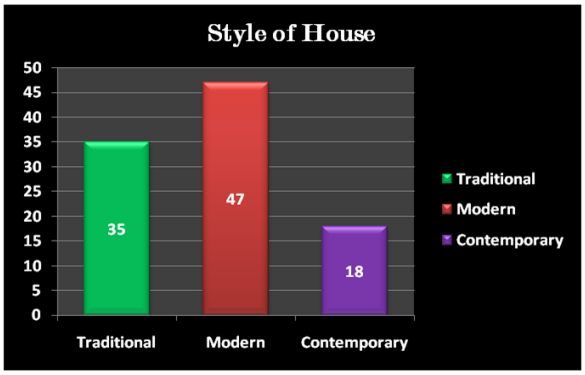


Figure 15

Figure 16



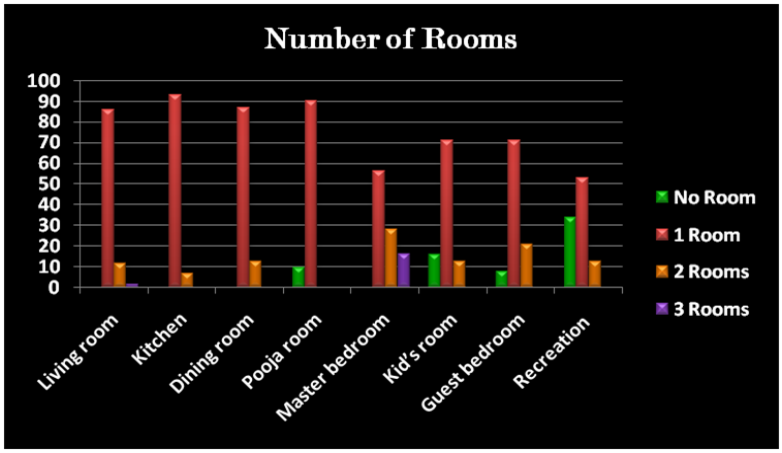
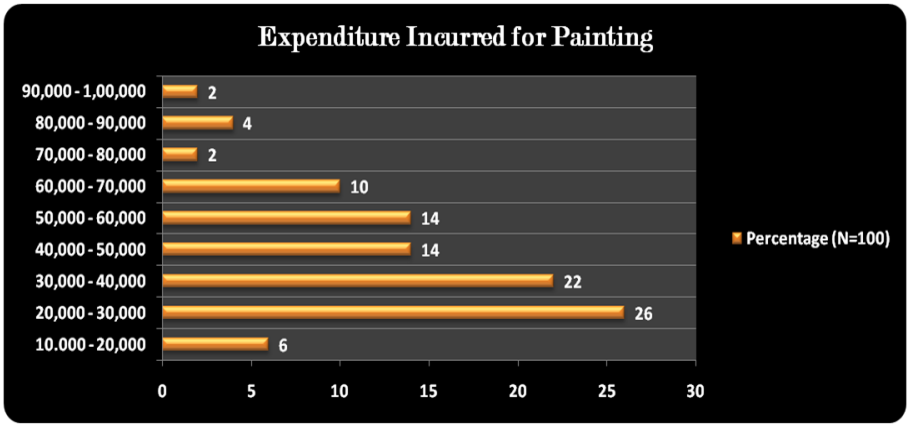


Figure 17

Figure 18



1. Users of the Rooms

For choosing or selecting a colour scheme for any room, it is important to keep in mind, the people who are using, or going to use the room, and their choice of colour. Table 11 displays the possible users of the rooms in the selected households.

Table 11: Users of the Rooms

Room	Percentage (N=100)		
	Elders in the house (in-laws)	Adults (head and homemaker)	All the family members
Living room	0	10	90
Kitchen	0	88	12
Dining room	6	6	88
Bedroom	0	100	0

Amongst the surveyed households, **the living room** was used by all the members of the family in 90 per cent of the households and, was used only by the adults in the house in 10 per cent of the households.

The Kitchen was used by the homemaker in 88 per cent of the households, but, it was pleasantly surprising to see that in 12 per cent of the surveyed households all the members of the family used the kitchen.

The Dining Room, in 88 per cent of the households was used by all the members of the family; in six per cent of the households each, it was used only by the adults; and by the elders in the house.

The Bedroom, as expected, was used only by the people for whom it was meant in all the 100 per cent of the households.

2. Selection of Colour Schemes and the Reasons for Selection of the Colours

Table 12 shows the members responsible for choosing the colour schemes for the rooms and the reasons for choosing the colour.

Table 12: Member Responsible for the Selection of Colour Schemes and the Reasons for Selection

Details	Percentage (N=100)
Selection of Colour	
By the head of the family	44
By the specific users	33
Suggested by Interior Designer / Architect	12
Suggested by Colour Consultant	6
By the painter	2
Magazines/Catalogues	2
Influenced by the colour choice of friends or relatives	1
Reasons	
Durable	33
Ease in maintenance	19
Aesthetic	17
Economical	16
All the above	15

a. Selection of Colour Schemes

The colour schemes for the rooms were chosen by the head of the family in a majority of 44 per cent of the households. Next in line, with 33 per cent, were the households where the colour schemes were chosen by the specific users of the rooms. Twelve per cent consulted interior designers and architects to choose the

colour schemes and six per cent used the services of colour consultants to choose the colour schemes. The colour schemes were chosen by the painters (2 per cent); by family members referring to magazines and catalogues (2 per cent) and were influenced by the colour choice of friends and relatives (1 per cent).

b. Reasons for Selection of the Colours

The reasons that were given by the homemakers for choosing the particular colours were; durable (33 per cent), ease in maintenance (19 per cent), aesthetic (17 per cent) and economical (16 per cent). These percentages reveal that for the people, quality matters more than money. Fifteen per cent of the surveyed homemakers said that all the above stated reasons were considered while choosing the colour schemes for the rooms.

3. Interior Finish Used on the Wall

Table 13 presents information on the various interior wall finishes that were used in the rooms.

Table 13: Interior Wall Finishes Used in the Rooms

Room	Percentage (N = 100)						
	Distemper (Paint)	**Emulsion (Paint)**	**Acrylic (Paint)**	**Wallpaper**	**Tiles**	**Wood**	**Natural Stone**
Living room	12	52	16	8	0	6	6
Kitchen	6	50	16	4	24	0	0
Dining room	4	46	24	16	0	6	4
Bedroom	12	40	18	14	8	4	4

A majority of the households used emulsion paints in all the chiefly important rooms namely, living room (52 per cent), kitchen (50 per cent), dining room (46 per cent) and bedroom (40 per cent). Acrylic paints were preferred and used next, in 16 per cent of the living rooms and kitchens, 24 per cent of the dining rooms and 18 per cent of the bedrooms. Twelve per cent of the living rooms and bedrooms, six per cent of the kitchens and four per cent of the dining rooms amongst the surveyed households used distemper paints.

Wallpapers were used in eight per cent of the living rooms, four per cent of the kitchens, 16 per cent of the dining rooms and 14 per cent of the bedrooms. Tiles were used in 24 per cent of the kitchens and eight per cent of the bedrooms of the surveyed households. Wood was used to finish the walls in six per cent of the living rooms and dining rooms and four per cent of the bedrooms. Natural stone was used in six per cent of the living rooms and in four per cent of the dining rooms and bedrooms each.

It was noticed that the use of wood and natural stone was completely avoided in the kitchens of the selected households.

4. Number of Colours Used in Rooms

The information for the number of colours used on the four walls of the rooms was important to know the colouring or painting pattern or trend accepted mostly by the families. Table 14 shows the number of colours used in rooms.

Table 14: Number of Colours Used in Rooms

Room	Use of Colour in Percentage (N =100)			
	Single colour	Two colours	Three colours	Four colours
Living room	62	33	5	0
Kitchen	84	12	4	0
Dining room	76	20	4	0
Bedroom	73	23	3	1

A majority of living rooms (62 per cent), kitchens (84 per cent), dining rooms (76 per cent) and bedrooms (73 per cent) had a single colour on all the four walls. Next in line was the preference and use of two colours in 33 per cent of the living rooms, 12 per cent of kitchens, 20 per cent of the dining rooms and 23 per cent of the bedrooms. Three colours were used in less than six percent of all the mentioned rooms in the households. It was also astounding to see that one ambitious household used four colours (one for each wall) to beautify their bedroom.

5. Preference of Colour for the Walls, Floors and Ceilings of the Rooms

The colour preferences for the rooms include the colours preferred and used for the walls, the floors and the ceilings.

a. Preference of Colour for Walls

Figure 19 demonstrates the colour preference for the walls of the living room, kitchen, dining room and bedroom in detail.

A majority of 32 per cent of households preferred cream colour for their living rooms. The preference of the colours cream and white for kitchens was shared equally by 28 per cent of the households. A majority of 32 per cent of the households preferred cream for the walls of their dining rooms. A majority of

bedrooms also used white (24 per cent) and cream (24 per cent) for the walls. Various other colours like violet, blue, green, yellow, orange, red, pink and beige were preferred by less than 21 per cent of households for their rooms.

b. Preference of Colour for Floors and Ceilings

Though the preference of colours for the walls exhibited versatility, the preference of colour for the floors and ceilings were simple. Table 15 presents information regarding the colour preference for floors and ceilings in the selected households.

Table 15: Colour Preference for Floors and Ceilings

Colour	Percentage (N =100)	
	Floor	Ceiling
White	53	67
Cream	21	29
Beige	17	4
Grey	6	0
Black	3	0

A majority of 53 per cent and 67 percent of the households preferred white for the floors and ceilings respectively, followed by cream colour for floors (21 per cent) and ceilings (29 per cent). Even beige was preferred by 17 per cent of the households for floors and by 4 per cent for ceilings. A minority percentage of the households even preferred grey (6 per cent) and black (3 per cent) for the floors of the houses, knowing that grey and black do not reflect light that fall on them; apparently, they said that they preferred dark colours because they were easy to maintain (Figure 20).

D. Effect of Texture on Colour

This heading comprises the textures used on the walls and the special textural finishes used in the rooms.

The texture of the wall has a great impact on the final visual effect that the wall will portray as surfaces with rough textures will absorb light, making the surface look dark and surfaces with smooth textures will reflect light, making the surface look bright. Figure 21 clarifies that while 74 per cent considered and agreed to the above mentioned fact, 26 per cent of the households were ignorant and had not considered the influence of texture on colour. Though they were ignorant about the impact of texture and colour, it was interesting to see that all the surveyed households used some kind of texture to beautify their walls.

1. Textures Used on the Walls

Table 16 focuses on the textures used on the walls in the selected households.

Table 16: Textures Used on the Walls

Room	Percentage (N =100)		
	Rough/absorbs light	Grainy/absorbs and reflects light equally	Smooth/reflects light
Living room	6	18	76
Kitchen	6	10	84
Dining room	20	30	50
Bedroom	16	24	60

A majority of the households preferred a smooth texture for their living rooms (76 per cent), kitchens (84 per cent), dining rooms (50 per cent) and bedrooms (60 per cent). Grainy texture was used maximum in dining rooms (30

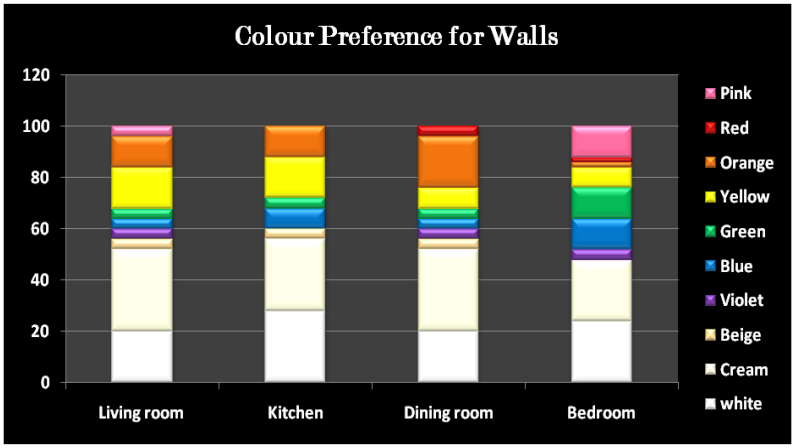


Figure 19

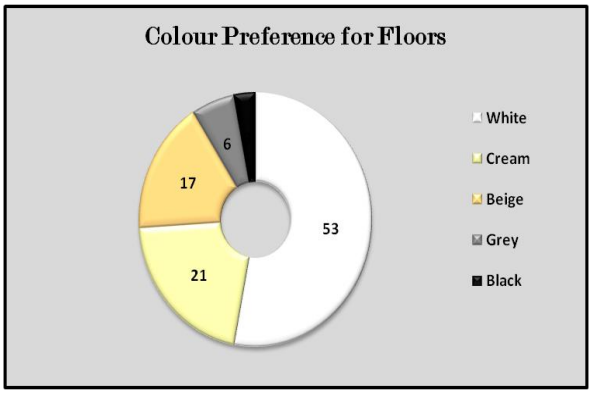


Figure20

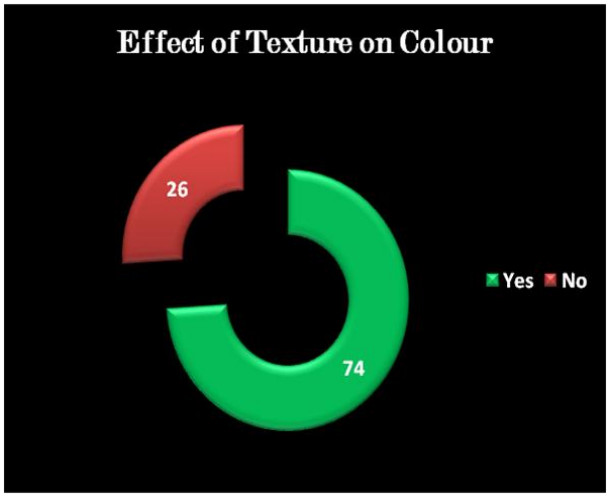


Figure 21

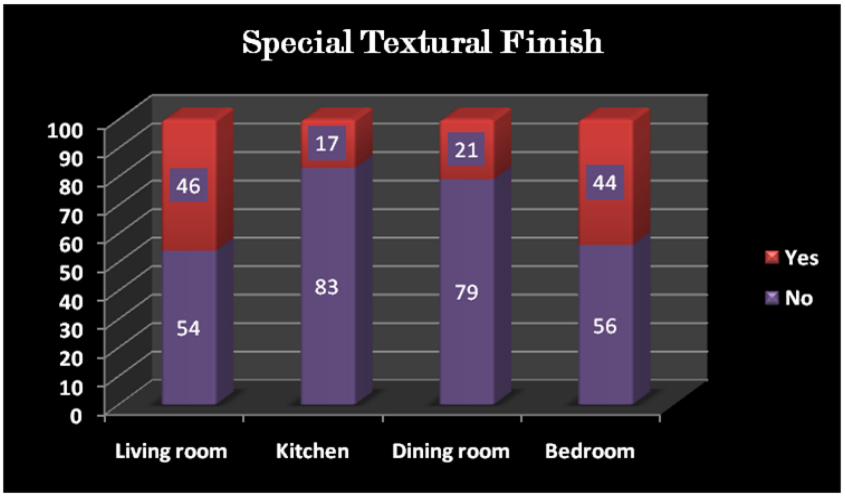


Figure 22

per cent) and minimum in kitchens (10 per cent). Rough texture was preferred maximum for dining rooms (20 per cent) and minimum for living rooms and kitchens (6 per cent).

2. Special Textural Finishes Used in the Rooms

Figure 22 illustrates the special textural finishes on the walls in 46 per cent of the living rooms, 17 per cent of the kitchens, 21 per cent of the dining rooms and 44 per cent of the bedrooms in the selected households.

E. Effect of Light on Colour

This head includes the orientation of the rooms according to the cardinal directions and the period of use of the room and the source and colour of light.

Light and the colour of light influence the visual effect of the colour of the wall significantly. It was comforting to discern that 72 per cent of the homemakers acknowledged the fact and considered it essential. However, 28 per cent were ignorant of the fact.

1. Orientation of the Rooms

Light that affects the colour can either be natural light or artificial light or both. Natural light is provided by the sun. It is a universal fact that the sun rises in the east and sets in the west. The journey of the sun from east to west during the day influences the amount of natural light during each phase of the day namely, morning, afternoon, evening and night. Of course, the phase after evening does not receive the light from the sun. Therefore, Figure 23 clearly demonstrates that the rooms that are oriented towards the East, North-East and South-East will receive a good amount of natural light during the morning and afternoon, thereby eliminating the need for artificial light during the day. The rooms in the West, North-West and South-West do not receive much natural light in the morning and

afternoon; hence, they might require artificial light even during the day for comfortable viewing.

During the evening and night, natural light has no role to play therefore; rooms that are used in the evening and night require good and sufficient artificial light for comfortable viewing. The orientation of the rooms according to the cardinal directions is revealed in Table 17 and Figure 24.

Table 17: Orientation of Rooms According to the Cardinal Directions

Room	Percentage (N =100)		
	East, North-East, South-East	North, South	West, North-West, South-West
Living room	36	48	16
Kitchen	48	16	36
Dining room	48	20	32
Bedroom	28	44	28

A maximum percentage of living rooms (48 per cent) were located in either the North or South direction in the surveyed households. Forty eight per cent of kitchens and dining rooms in the selected households were either in the East, North-East or South-East direction. The bedrooms, in a majority of households (44 per cent) were oriented in the North or South direction.

2. Period of Use of the Room and the Source and Colour of Light

This heading includes the periods of the day when the rooms are used most and the source and colour of light.

Table 18 demonstrates the period when the rooms are used most and the source of light and Figure 25 illustrates the periods when the rooms are used most.

Table 18: Period of Use of the Room and the Source of Light

Room	Percentage (N =100)								
	Morning and Afternoon			Evening and Night			Entire day		
	Number	A*	N&A*	Number	A*	N&A*	Number	A*	N&A*
Living room	0	0	0	44	12	32	56	12	44
Kitchen	0	0	0	0	0	0	100	24	76
Dining room	4	0	4	12	8	4	84	20	64
Bedroom	0	0	0	48	16	32	52	4	48

* A- Artificial light, N&A- Natural and Artificial light

The Living Room, in 56 per cent of households was used the entire day and in 44 per cent of the households it was used during evening and night. Of the 56 per cent who used the living room the entire day 44 per cent used both natural and artificial light and12 per cent used only artificial light.

The Kitchen, in 100 per cent of households was used the entire day. Of the 100 per cent 76 per cent used both natural and artificial light and 24 per cent used only artificial light.

The Dining Room, in 84 per cent of households was used the entire day, in 12 per cent of the households it was used only during the evening and night and in four per cent of the households it was used only during the morning and afternoon. Of the 84 per cent who used the living room the entire day 64 per cent used both natural and artificial light and 20 per cent used only artificial light. All the four per cent who used the dining room only in the morning and afternoon used both natural and artificial light.

The Bedroom, in 52 per cent of households was used the entire day and in 48 per cent of the households it was used during evening and night. Of the 52 per cent

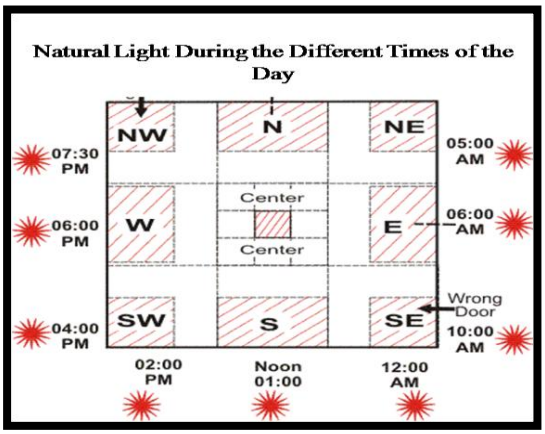


Figure 23

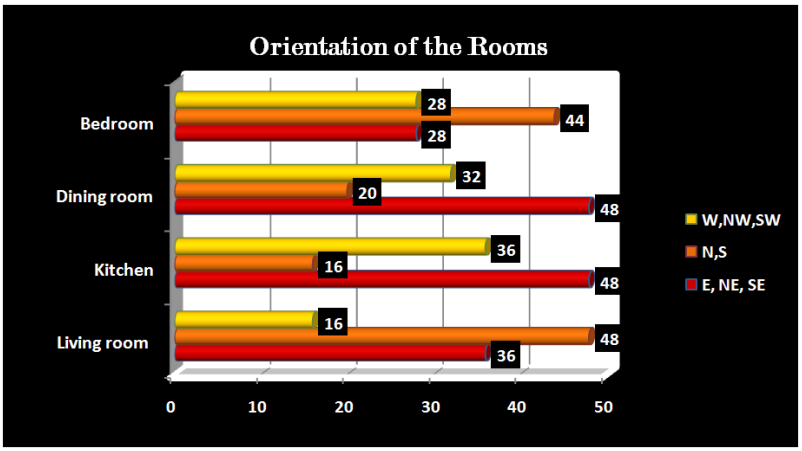


Figure 24

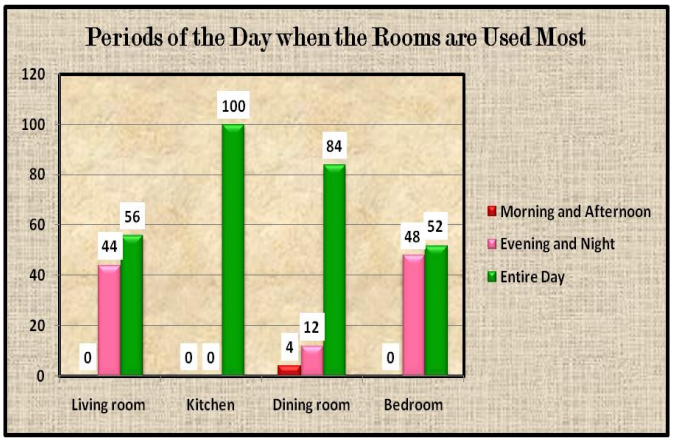


Figure 25

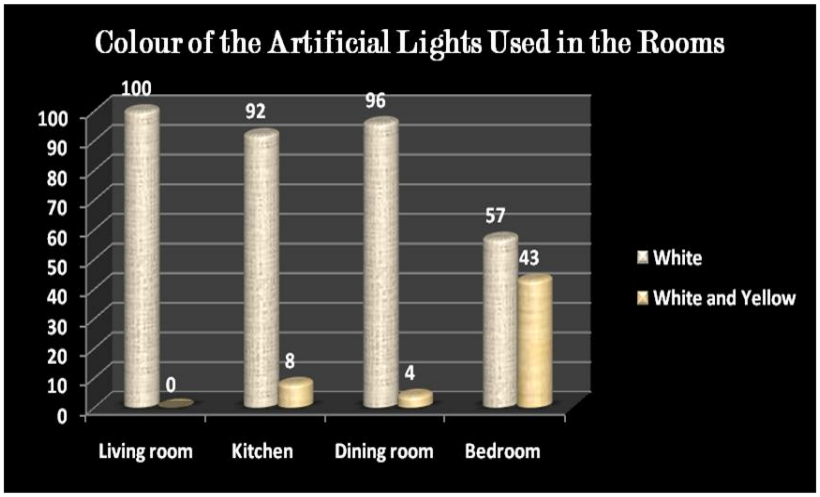


Figure 26

who used the living room the entire day 48 per cent used both natural and artificial light and four per cent used only artificial light.

In all the surveyed households, only artificial light was used by all who used the rooms in the evening and night only. The preference for the **Colour of Light** is exemplified in Figure 26.

All the surveyed households preferred white coloured light which is close to the colour of natural light for their living room. A majority of 92 per cent of the households used only white coloured light for their kitchen and the rest (8 per cent) used both white coloured and yellow coloured light in their kitchen. In the dining room, 96 per cent of the surveyed households used only white coloured light and four per cent used both white coloured and yellow coloured light.

Amongst the surveyed households 57 per cent preferred and used white coloured light and 43 per cent preferred and used both white coloured and yellow coloured light for their bedroom.

F. Relationship between Colour and Temperature

This heading encompasses the use of warm, cool and neutral colours in the rooms; the relationship of colour and size of room and the relationship of colour and time spent in the room.

The use of warm and cool colours manipulates the temperature effect of the room and the size and feeling of spaciousness of the room. Neutral colours are almost always neutral to both the above stated aspects.

1. Use of Warm, Cool and Neutral Colours

Table 19 and Figure 27 show the use of warm, cool and neutral colours in the various rooms of the selected households.

Table 19: Use of Warm, Cool and Neutral Colours in the Rooms

Room	Percentage (N=100)		
	Warm Colours	Cool Colours	Neutral Colours
Living room	32	12	56
Kitchen	28	12	60
Dining room	32	12	56
Bedroom	24	28	48

Amongst the surveyed households, 56 per cent used neutral colours, 32 per cent used warm colours and 12 per cent used cool colours for their living room. The preference for neutral colours was highest even in the kitchen (60 per cent), warm colours were preferred next with 28 per cent and cool colours were used least (12 per cent). In the dining rooms of the surveyed households 56 per cent used neutral colours, 32 per cent used warm colours and 12 per cent used cool colours. In the bedrooms, 48 per cent used neutral colours, 28 per cent used cool colours and 24 per cent used warm colours.

2. Relationship of Colour and Size of Room

Figure 28 illustrates the size of the rooms and the feelings experienced by the users.

Living Room: Thirty six per cent living rooms of the households belonged to the size range of 201-300 sq.ft., all of which were spacious according to its users; another 36 per cent belonged to the size range of 101-200 sq.ft., of which 28 users felt the room to be spacious while the rest felt that the room was cramped. Twenty four per cent belonged to the size range of 301-400 sq.ft. and four per cent belonged to the size range of 401-500 sq.ft., all of which were spacious according to its users.

Kitchen: Forty eight per cent of the kitchens belonged to the size range of 101-200 sq.ft., of which four users felt that the kitchen was cramped; 36 per cent belonged to the size range of 201-300 sq.ft., all of which were spacious according to its users and 16 per cent belonged to the size range of 1-100 sq.ft., of which14 users felt the room cramped.

Dining Room: A majority of 60 per cent of the surveyed households had dining rooms which belonged to the size range of 101-200 sq.ft., of which 12 users felt their dining room to be cramped. Forty per cent of the dining rooms belonged to the size range of 201-300 sq.ft., all of which felt spacious according to its users.

Bedroom: A majority of 56 per cent of the surveyed households had bedrooms which belonged to the size range of 201-300 sq.ft., of which two users felt their bedroom to be cramped. Twenty eight per cent of the bedrooms were in the size range of 301-400 sq.ft., all of which felt spacious according to its users and 16 per cent of the bedrooms were in the size range of 101-200 sq.ft., of which, six users felt their bedroom to be cramped.

The reason why some users felt cramped in a size range where, in the same size range many felt spacious was because, the people who felt the room spacious had cool colours on the walls, some of which were painted in cool colours unintentionally and the rest intentionally. Cool colours seem to recede and make the room seem and look spacious and larger and warm colours tend to advance and make the room look smaller.

3. Relationship of Colour and Time Spent in the Room

The time spent in a room is also a major criterion for selecting the colour of the room. When long hours are spent in a room, it should be painted in cool colours as they, psychologically and physiologically feel cool. The use of warm colours in a room, where long hours will be spent, will make the room hot and

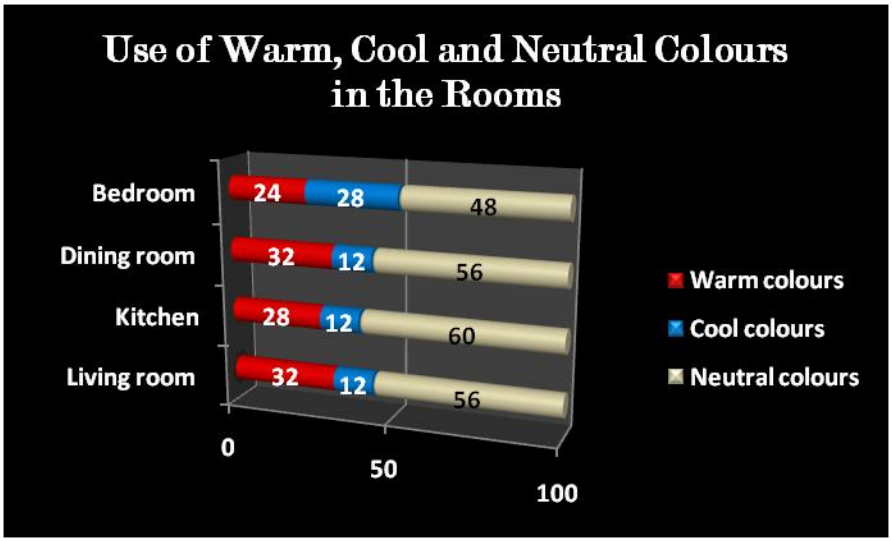


Figure 27

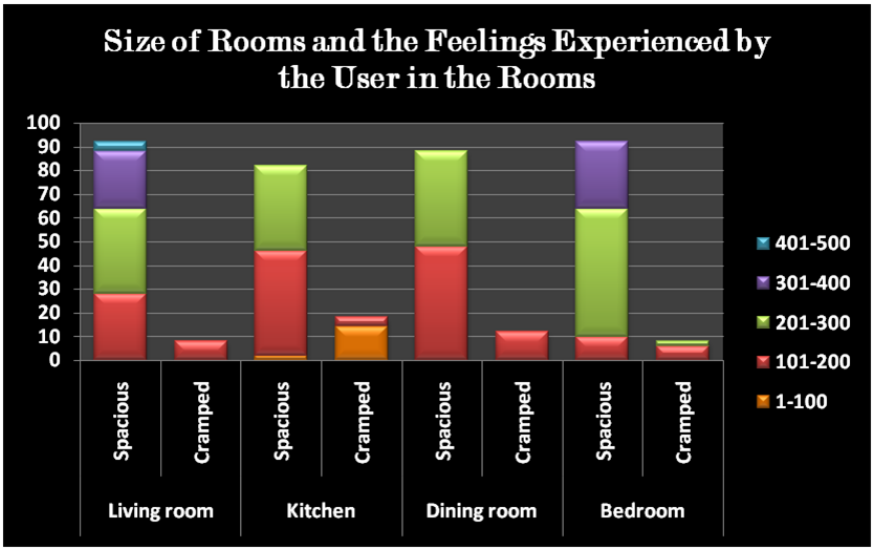


Figure 28

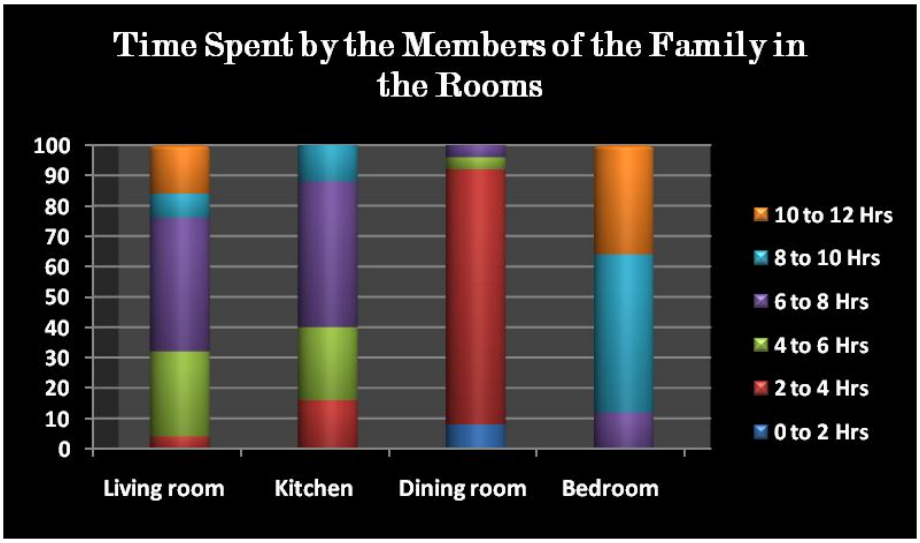


Figure 29

uncomfortable for use. Figure 29 illustrates the time spent per day in each room by the users.

Living Room: A majority of 44 per cent amongst the surveyed households spent 6 to 8 hours in the living room, 28 per cent spent 4 to 6 hours, 16 per cent spent 10 to 12 hours, eight per cent spent 8 to 10 hours and the remainder spent 2 to 4 hours in the living room.

Kitchen: A majority of 48 per cent amongst the surveyed households spent 6 to 8 hours in the kitchen, 24 per cent spent 4 to 6 hours, 16 per cent spent 2 to 4 hours and 12 per cent spent 8 to 10 hours in the kitchen.

Dining Room: A majority of 84 per cent amongst the surveyed households spent 2 to 4 hours in the dining room, eight per cent spent less than 2 hours in the dining room, four per cent spent 4 to 6 hours and the remainder (4 per cent) spent 6 to 8 hours in the dining room.

Bedroom: A majority of 52 per cent spent 8 to 10 hours in the bedroom, 36 per cent spent 10 to 12 hours and 12 per cent spent 6 to 8 hours in the bedroom.

G. Psychological Effect of Colour in Rooms

Colours affect the psychology of the users using the room. Forty six per cent of the surveyed samples were aware of the psychological effect of colour whereas 54 per cent of them were unaware of the same.

Every colour affects the user's psychology in its own special way, sometimes positively and sometimes negatively. Table 20 and Figure 30 reveal the diverse psychological effects of the various colours that were used by the selected sample in their residential interiors.

Table 20: Psychological Effects of Colours

Colour	Percentage
Violet	
Regal and Dramatic	56
Lonely	44
Blue	
Calm and Relaxing	88
Depressing	12
Green	
Fresh and Natural	87
Tiresome	13
Yellow	
Cheerful and Optimistic	89
Overpowering	11
Orange	
Lively and Energetic	97
Overbearing	3
Red	
Warmth and Intensity	93
Danger	7
White	
Pure and Spiritual	83
Blank	17
Brown	
Warm and Earthy	46
Sad	54

The colours violet, blue, green, yellow, orange, red, white and brown were used on the walls of the surveyed households and they influenced the users, both positively and negatively. The colours blue, green, yellow, orange, red and white influenced its users positively in above 80 per cent of the households where they were used. The colour violet also influenced its users positively in 56 per cent of the households where it was used. Brown was the only colour that failed to

influence its users positively as, the majority (54 per cent) felt sad when they saw the colour for a long time.

H. Ergonomic Aspects in the Use of Colour

Colour Ergonomics includes everything concerned with the effect of paint during and after application. Table 21 and Figure 31 depict the ergonomic aspects in the use of colour.

Table 21: Ergonomic Aspects in the Use of Colour

Ergonomic Aspects	Percentage (N=100)	
	Yes	No
Discomfort while Painting	0	100
Comfortable to View	90	10
Easy to Combine	96	4
Easy to Maintain	88	12
Affects Productivity	46	54
Enhances Aesthetics	76	24

None of the surveyed households experienced any discomfort to the eyes, nose of any part of the body while painting; 90 per cent expressed that viewing the colour on the walls was comfortable while 10 per cent disagreed with the majority. It was found that 96 per cent of the households felt that the colour they chose was easy to combine and match with the other elements in the room. Eighty eight per cent of the sample felt that the selected colour was easy to maintain without much difficulty. Though a majority of 54 per cent felt the colour they used did not affect the productivity, it was encouraging to know that 46 per cent felt and realized that the colours they used affected their productivity. While 76 per cent acknowledged that the colour they used added to the aesthetic appeal of the room 24 per cent mentioned that the colour they used was only useful as a finish and protection to the wall and did not add to the aesthetic appeal of the room.

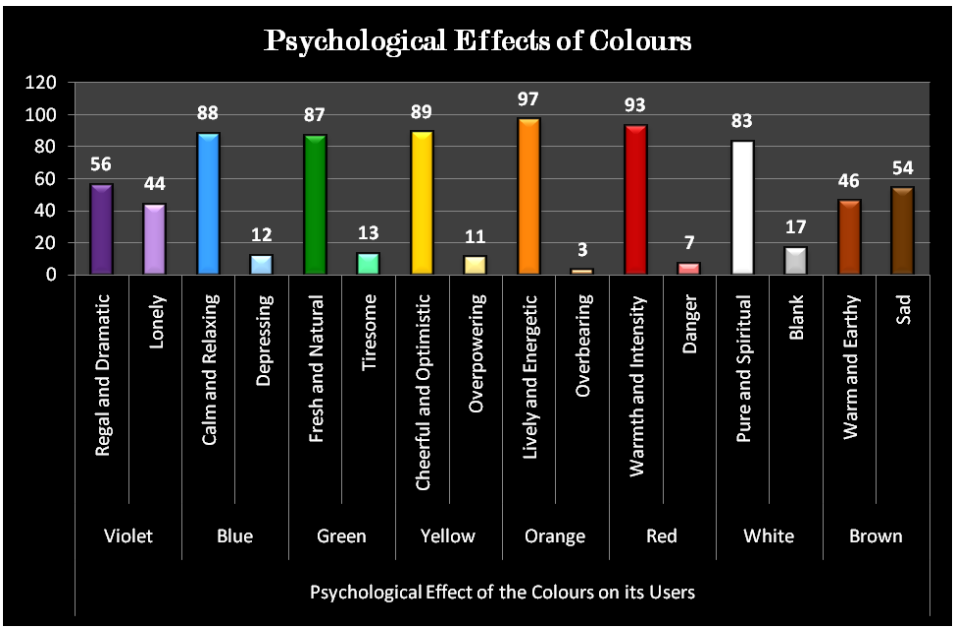


Figure 30

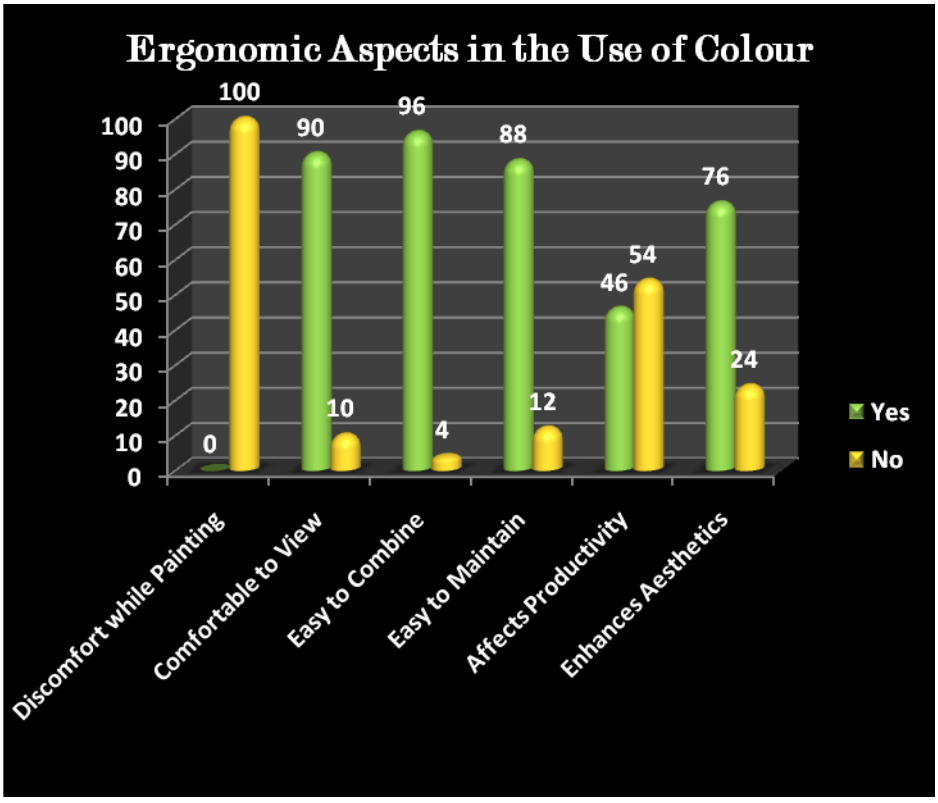


Figure 31

Phase 2: Presentation of Case Study

A case study is an intensive investigation of a social unit. Instead of collecting information about few factors from a large number of units, the researcher makes a depth and intensive study of a limited number of representatives. It is narrower in scope but more informative in nature than a survey. To provide qualitative data, the case study is often used (Koul, 2009).

A case study was done to analyse the impact of colour of the interiors in the two selected residences. The various aspects that contributed towards the impact were studied in relation to the feelings experienced by the users and the reasons for the experienced feelings were interpreted. The investigator approached two residences, whose dwellers consented to spend time and share their feelings and their experiences with her. The details of the households are given below:

RESIDENCE 1	**RESIDENCE 2**
Owner : Mr.Premchand	Owner : Mr. Harish
Occupation: Businessman	Occupation: Businessman
Address : 18, Valluvar Street, Sivananda Colony, Coimbatore – 641012	Address : 8, Bhashyakaralu Road, R.S. Puram, Coimbatore – 641002

The aspects contributing towards the impact of colour are studied in relation to the feedback from its users and the reasons are interpreted by the investigator. Four important spaces in every residence; The Living Room, Kitchen, Dining room and Master Bedroom, used by the head and homemaker, were considered for the case study. The findings of the case study are presented under the following headings:

A. Impact of Colour – Contributing Aspects and

B. Feelings Experienced by the Users and Reasons Interpreted

A. Impact of Colour – Contributing Aspects

This heading includes the various aspects contributing towards the impact of colour in the living room, kitchen, dining room and bedroom. Tables 22(a) and 22(b) and Plates 1 and 2 reveal the various aspects contributing towards the impact of colour in various rooms.

Table 22(a): Aspects Contributing towards the Impact of Colour in Living Room and Kitchen

Contributing aspects	Living Room		Kitchen	
	Residence 1	Residence 2	Residence 1	Residence 2
Colour of the Walls	White (3 walls), Peach (1 wall)	Pink (4 walls)	White (walls) and Brown (Cupboards)	Brown (Walls) and Light Brown (Cupboards)
Finish Used	Emulsion	Emulsion	Tiles	Tiles
Texture of the Walls	Grainy	Smooth	Smooth	Smooth
Colour of the Floor	White (Marble)	Grey (Tiles)	Cream (Marble)	Cream (Tiles)
Colour of the Ceiling	White	White	White	White
Number of Windows	2	2	2	1
Colour of Artificial Light	Yellow (for general and accent lighting)	White (general) and yellow (accent)	White	White
Colour Chosen by	Head of the Family	Homemaker	Homemaker	Head of the Family
Reason for Choice	Sophisticated	Favourite Colour	No specific Reason	Ease in Maintenance

Living room – Residence 1

Living room – Residence 2

Kitchen – Residence 1

Kitchen – Residence 2

Plate 1

Aspects Contributing towards the Impact of Colour in Living Room and Kitchen

Table 22(b): Aspects Contributing towards the Impact of Colour in Dining Room and Bedroom

Contributing aspects	Dining Room		Bedroom	
	Residence 1	**Residence 2**	**Residence 1**	**Residence 2**
Colour of the Walls	Orange (4 Walls)	Light Yellow-green (4 Walls)	Blue (4 Walls)	Orange (1 Wall), Brown (3 Walls)
Finish Used	Emulsion	Emulsion	Acrylic Paint	Emulsion
Texture of the Walls	Smooth	Smooth	Grainy	Smooth
Colour of the Floor	Brown (Wooden)	Light Brown (Tiles)	Brown (Wooden)	White (Tiles)
Colour of the Ceiling	Light orange	White	White	White
Number of Windows	1 (Picture window)	Nil	1	2
Colour of Artificial Light	Yellow	White	Yellow	White
Colour Chosen by	Head of the Family	Head and Homemaker	Head and Homemaker	Head and Homemaker
Reason for Choice	Liking for the colour	Liking for the Colour	Liking for the colour	Liking for the colour

Dining room – Residence 1

Dining room – Residence 2

Bedroom – Residence 1

Bedroom – Residence 2

Plate 2

Aspects Contributing towards the Impact of Colour in Dining Room and Bedroom

Phase 3: **Developing Ergonomic Colour Scheme Modules for Residential Interiors**

Home decor is often viewed as simply a matter of aesthetics - what looks attractive. But proponents of colour psychology believe that the colours used to decorate homes can have a profound effect on the emotional well-being of families.

"Colour is a universal, nonverbal language, and we all intuitively know how to speak it."

- Leslie Harrington

Throughout recorded history, humans have had the desire to decorate their living space. Colour has been investigated and used for more than 2000 years. Many different civilizations have experimented, have learned and have used colour. The ancient Egyptians looked at nature and copied it in many aspects of their lives. The floors of their temples were often green - as the grass which then grew alongside their river, the Nile. Blue was a very important colour to the Egyptians too; the colour of the sky. Today, we are still learning how colour affects us and its importance in our lives.

Today colour is used to create an emotionally healthy home. What colour we paint our walls isn't just a matter of aesthetics. It's a tool that can be leveraged to affect emotions and behaviour. Among all the factors the important factor is use of the room. Colour can help to emphasize the purpose of a room in addition to actually contributing to its efficiency.

The investigator therefore developed **Ergonomic Colour Scheme Modules** using 3-D designing software for the living room, the kitchen, the dining room and the bedroom to use colours to the optimum thereby benefitting the user and serving its function at the workspace.

A. Living Room

It can be easily said that a living room is the heart of any home. It is one of the most important rooms in the house. After all, it is this room that creates a lasting first impression on everyone who enters the house.

A living room should express cheer and hospitality along with restfulness and relaxation. This is the room that should reflect the taste and style of the dwellers of the house. The most important ingredient in living room decoration is color. The choice of the right living room color schemes is the easiest way to spruce up the image of the living room and give it character.

Therefore the color scheme for a living room needs to be cheerful but not over stimulating, and should show character but should not be obtrusive; fairly light, warm colors are usually the most desirable for living rooms for creating a warm and inviting feeling. The colour used, should therefore be stylish yet practical hence a colour scheme with **yellow and grey/white** is the best choice for living rooms (Figure 32), the reasons are:

- The colour yellow is a warm and inviting colour and is said to stimulate conversation, perfectly fitting in the criteria for the function of the room, as it is the room where we entertain guests, spend family time, converse with family and guests etc.,
- The colour yellow though the least warm colour may become monotonous and overpowering if used on all the four walls of the room ,if the room is very big and if the inmates spend long hours in the room; hence it can be used with a combination of grey or white.
- Grey can be used if the room is too bright with light and if the room is very big; white can be used if the room is dull and there is paucity of natural light.
- While yellow adds style, the neutral colour will offer a look of sophistication to the living room.

B. Kitchen

The kitchen is a workspace where the homemaker or the user spends long hours working hard. Choosing the right color schemes for kitchen is important, as they are one of the most visited places in the home as it is the space that is used for many different activities. Today, the kitchen is used not only for cooking but it is used for all sorts of other activities as well; it may become a dining area and sometimes also becomes a second living room for the family.

A kitchen color scheme should be cheerful, light, and bright. It should not be psychedelic but should be sober. Hence the colour **green** in combination with **brown or white** is the perfect colour for kitchens (Figure 33). The reasons for the preference are as follows:

- Green is a colour that is cool, but since it is placed next to yellow in the colour wheel it borrows a small amount of warmth from yellow, making the combination of heat and cold perfect for any kitchen.
- Green is refreshing as it is the colour of nature, and being a cool colour will counteract the heat that is generated while cooking. Highly cool colours like blue, though will counteract the heat make will make the user feel cool and lazy as the color is sedative. Hence a little effect of warm colours is a must for the kitchen to keep the user going.
- Of course the same colour cannot be used everywhere as it will become monotonous and overpowering and also because the room is used by the user for a very long time, hence its use with other colors will avoid balance becoming total inactivity.
- The brown or white can be used for the cabinets and cupboards as they are the most expensive features of the room and occupy a large area of the kitchen. This will break the monotony and will make identification and working easy.

Figure 32 : Living Room – Yellow with Grey

Figure 33 : Kitchen – Green with Brown

Ergonomic Colour Scheme Module For

Living Room and Kitchen

C. Dining Room

The dining room is a place where the members of a family gather for cosy meal and where they relax for a short span of time. The dining room should therefore provide a warm environment that is energetic and vibrant.

The dining rooms in most homes are informal, therefore can have a versatile décor. In homes where the dining room is a formal space earthy tones tend to be the most popular choice. They convey a feeling of warmth but are too formal for an informal family affair. Therefore **orange** is the perfect colour for a dining room décor (Figure 34). The reasons for the choice are as follows:

- The colour orange is a warm colour therefore; it has a refreshing and delicious implication.
- Using the psychology of color, orange tends to be stimulating and is thought to increase a person's appetite and encourage conversation.
- Orange is a bright colour and may be irritating to look at, after viewing it for long hours but, in this case the dining room is used only for short periods of time and therefore the colour may be used.
- Different tints and shades of orange may be used to break the monotony.

D. Bedroom

The bedroom is the most private and comfortable place in any house. The bedroom is a personal room and is expected to be a very relaxing place. It is a place where a person wants to be.

Bedroom wall colors should be chosen in such a way that they reflect the mood and personal interests of the user. Color trends in the bedroom are all about creating a personal space that expresses the innermost desires. For many, it means

a retreat where one can relax and rejuvenate after a tiring day. A bedroom should therefore be comfortable yet stylish.

Using cool colors is the best approach for bedrooms, because they are thought to have a calming effect. The colour **blue** is hence the best choice for bedroom décor (Figure 35), the reasons for which are as follows:

- Blue is the coolest colour and consequently has a calming effect.
- Being a cool colour blue provides a cool atmosphere to relax.
- Cool colours recede making the room feel spacious and airy.
- The colour blue if used too much will act as a sedative and therefore it is best to use it with either white or use the colour with its tints and shades to break the monotony and add interest.

Note: The use of too much of the same colour can become monotonous and can also give negative effect. Therefore they might be used in the following ways

- Use the colour with neutrals.
- Use one color, but with varying tints and shades of that color throughout the room
- Use two or more colors that are similar to each other, or complement each other, to give a tranquil and warm feeling to the room.

Though the function of the room is the main criterion for the choice of the dominant colour in the colour scheme developed by the investigator, the user's personal favourite should also be used as a complement to the dominant colour so that the room displays the personality and taste of the user. The personal favourite colour of the user can be used in furnishings and accessories in the room thereby providing contrast and character to the room and making it vibrant and alive.

Figure 34 : Dining Room – Orange with its Tint

Figure 35 : Bedroom – Blue with its Tint

Ergonomic Colour Scheme Module For

Dining Room and Bedroom

Summary and Conclusion

V. SUMMARY AND CONCLUSION

"The craving for colour is a natural necessity just as for water and fire. Colour is a raw material indispensable to life. At every era of his existence and his history, the human being has associated colour with his joys, his actions and his pleasures."

- Frenand Leger, "On Monumentality and Colour"

Man has a strong urge to express his creative and aesthetic instincts in visual form. Since his home is the center of all his activities, his way of life and thoughts spring from within his protective shelter. The internal space of the building must therefore be functional and comfortable to man, to perform his various functions. A comfortable house has proper composition of natural element and manmade elements where the man can perform various functions in the best possible ways and feel pleasant. By the help of **interior decoration** and **ergonomics** we can create that environment and the use of colour is the easiest and best way to create a functional environment with character and beauty.

The study entitled **"Impact of Colour in Creating Ergonomically Efficient Residential Interiors"** is designed to ascertain the function and importance of colour in making the residential spaces ergonomically efficient. Hundred residences in Coimbatore, that were - individual houses or bungalows; constructed between 2006 and 2011 and owned by High Income Group families were selected by purposive sampling method to assess the views of the homemakers of the selected households on the impact of colour in terms of comfort and productivity and to analyze the preference of colours for residential spaces among the selected homemakers by adopting personal interview cum observation method for the **household survey**.

A **case study** was then conducted to analyse in depth, the impact of colour of the interiors in two selected residences to examine the benefits and problems encountered by the users as a result of their choice of colour schemes for the residential spaces and to offer suggestions regarding the selection and use of colour in relation to the principles of ergonomics.

Based on the interaction with the homemakers and the other members during the case study, it was found that there was the necessity to develop Colour Scheme Modules for Residential Interiors. Hence, **Ergonomic Colour Scheme Modules** were developed using 3-D designing software to use colours to the optimum thereby benefitting the user and serving its function at the workspace.

The Highlights of the Study are summarized below:

Phase 1: Household survey

A. General Family Background

- Fifty per cent of the homemakers and 43 per cent of the heads of the families belonged to the age group of 31-40 years. Thirty nine per cent of the homemakers were high school pass outs and 33 per cent of the heads of the families were under graduates by qualification.
- The occupation of the homemaker and head of the family is an important criterion as it will determine both the income of the family and their standard and style of living. Seventy per cent of the homemakers were full time homemakers, 63 per cent of the heads of the families were successful and accomplished businessmen by occupation.
- The monthly income of the selected high income group families ranged from Rs. 30,000 to Rs. 3.00,000. Eighteen per cent earned monthly an income between Rs. 40,001 and 50,000. Fourteen per cent of the families earned a monthly income of more than Rs. 1, 00,000.

B. Details of the House

- Among the selected houses, 36 per cent had a plinth area between 2,001 and 3,000 sq.ft. A meagre four per cent owned houses that had a plinth area even between 6,001 and 8,000 in the posh and busy areas of the city.
- Seventy four per cent of the houses were constructed by their present residents or owners while 26 per cent of the houses were purchased either from their past owners or from the land developers and promoters.
- Forty seven per cent of the houses exhibited modernity in their style of construction. With land and construction rates booming it was surprising that 28 per cent of the houses had three stories. Thirty six per cent of houses had 6 to 8 rooms and 20 per cent had more than ten rooms.
- Though a majority of all the houses had one living room (86 per cent), kitchen (93 per cent), dining room (87 per cent) and master bedroom (56 per cent) each, 12 per cent, 7 per cent and 13 per cent of the houses had two living room, two kitchens and two dining rooms respectively and 28 per cent and 16 per cent had two and three master bedrooms respectively.
- Eighty four per cent used the living room for relaxing, cent per cent used the kitchen for cooking only, 75 per cent used the dining room for the purpose of eating in a relaxed manner and 64 per cent used the bedroom only for sleeping.
- The kitchen and the bedroom were used regularly and every day in all the households. The living room, in 96 per cent of households and the dining room, in 83 per cent used every day.
- Sixty eight per cent spent below Rs. 50,001 and the rest spent above Rs. 50,000 for painting their houses previously.

C. Preference of Colour for Rooms

- The living room was used by all the members of the family in 90 per cent of the households, the kitchen by the homemaker in 88 per cent of the households,

the dining room, by all the members in 88 per cent of the households and the bedroom, in all the households was used by its user.

- The head of the family in a majority of 44 per cent of the households chose the colour schemes for all the rooms. Thirty three per cent stated that durability was their prime reason for selecting the colour of their rooms.
- Emulsion paints in all the important rooms namely, living room (52 per cent), kitchen (50 per cent), dining room (46 per cent) and master bedroom (40 per cent), to finish their walls in a majority of the houses.
- The living rooms (62 per cent), kitchens (84 per cent), dining rooms (76 per cent) and bedrooms (73 per cent) in a majority of houses had a single colour on all the four walls.
- Cream colour for their living rooms in maximum (32 per cent) houses. The preference of the colours cream and white for kitchens was shared equally by 28 per cent. Thirty two per cent cream for the walls of their dining rooms. Bedrooms also, had white (24 per cent) and cream (24 per cent) for the walls. Various other colours like violet, blue, green, yellow, orange, red, pink and beige were preferred by less than 21 per cent of households for their rooms.
- Fifty three per cent and 67 per cent of the households preferred white for the floors and ceilings respectively.

D. Effect of Texture on Colour

- Seventy four per cent considered that the texture of the wall has an impact on the final visual effect of the wall.
- A majority of the households preferred a smooth texture that reflected maximum light for their living rooms (76 per cent), kitchens (84 per cent), dining rooms (50 per cent) and bedrooms (60 per cent).
- Special textural finishes were used on the walls in 46 per cent of the living rooms, 17 per cent of the kitchens, 21 per cent of the dining rooms and 44 per cent of the bedrooms.

E. Effect of Light on Colour

- Seventy two per cent of the homemakers acknowledged the fact that light and the colour of light influence the visual effect of the colour of the wall significantly.
- Forty eight per cent of living rooms were located in either the North or South direction, 48 per cent of kitchens and dining rooms were either in the East, North-East or South-East direction. The bedrooms, in 44 per cent of households were oriented in the North or South direction.
- The Living Room, in 56 per cent of households was used the entire day of which 44 per cent used both natural and artificial light and12 per cent used only artificial light. The kitchen, in 100 per cent of households was used the entire day of which76 per cent used both natural and artificial light and 24 per cent used only artificial light. The dining room, in 84 per cent of households was used the entire day of which 64 per cent used both natural and artificial light and 20 per cent used only artificial light. The bedroom, in 52 per cent of households was used the entire day among which, 48 per cent used both natural and artificial light and four per cent used only artificial light.
- White coloured light for the living room by all the households. More than 90 per cent used only white coloured light for their kitchen and dining rooms. Fifty seven per cent of bedrooms used only white coloured light while 43 per cent used both white and yellow coloured light.

F. Relationship between Colour and Temperature

- More than 55 per cent of the used and preferred neutral colours for their living rooms, kitchens and dining rooms. In the bedrooms also 48 per cent used neutral colours revealing that people are still hesitant to use and experiment with colour.
- Thirty six per cent living rooms of the households belonged to the size range of 201-300 sq.ft., all of which were spacious according to its users; 48 per cent of the kitchens belonged to the size range of 101-200 sq.ft., of which four users felt that the kitchen was cramped; 60 per cent had dining rooms which belonged to

the size range of 101-200 sq.ft., of which 12 users felt their dining room to be cramped and 56 per cent had bedrooms which belonged to the size range of 201-300 sq.ft., of which two users felt their bedroom to be cramped. The reason why some users felt cramped in a size range where, in the same size range many felt spacious was because, the people who felt the room spacious had cool colours.

- When long hours are spent in a room, it should be painted in cool colours. Warm colours in a room, where long hours will be spent, will make the room hot and uncomfortable for use. Forty four per cent and 48 per cent spent 6 to 8 hours in the living room and kitchen respectively. Eighty four per cent spent 2 to 4 hours in the dining room and 52 per cent spent 8 to 10 hours in the bedroom.

G. Psychological Effect of Colour in Rooms

- Forty six per cent of the sample acknowledged that colours affect the psychology of the users. Blue, green, yellow, orange, red and white influenced its users positively in above 80 per cent of the households where they were used. The colour violet influenced its users positively in 56 per cent of the households where it was used. Brown was the only colour that failed to influence its users positively as 54 per cent felt sad when they saw the colour for a long time.

H. Ergonomic Aspects in the Use of Colour

- Cent per cent of the sample felt no discomfort while painting. More than 90 per cent felt that the colour was comfortable to view and easy to combine and use with other colours in the room. Eighty eight per cent felt that the selected colour was easy to maintain, 54 per cent felt that the colour they used did not affect the productivity. Seventy six per cent acknowledged that the colour they used added to the aesthetic appeal of the room.

Phase 2: Case Study

- Though, from the survey it was clear that majority of the people were hesitant to experiment with colours other than neutrals in their residences, from the case study it was realized that even among the minority who used bright and bold

colours, a high percentage gave no scientific or proper reasoning to back their colour choice. Among the two residences that were studied in detail, Residence 1 had more rooms that were ergonomically efficient due to the choice of appropriate colours. Hence, their dwellers were happy and satisfied with the effect of colours they chose and used when compared to Residence 2.

Phase 3: Developing Ergonomic Colour Scheme Modules for Residential Interiors

- Ergonomic Colour Scheme Modules were developed using 3-D designing software, using appropriate colours that will benefit the user and serve its function at the workspace.

Conclusion

"Of all God's gifts to the sighted man, colour is holiest, the most divine, the most solemn."

- John Ruskin

Homes and families have entered that threshold of the 21st century where life is neither calm nor easy. In the realm of his busy life "home" is the place where a man feels his self, hence in home planning and interior designing, it is extremely important to keep in mind that an ergonomically efficient home that is functional and beautiful home is the setting for a happy and satisfied family life.

The element of colour is one of the most fascinating tools to work with in order to create an environment that is functional and aesthetic so that it is ideal to confront the demands of a busy and productive life because.

"The purest and most thoughtful minds are those which love colour the most."

- John Ruskin

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Appendices

APPENDIX

INTERVIEW SCHEDULE TO ELICIT INFORMATION FROM HOMEMAKERS ABOUT THE ROLE AND EFFECT OF COLOUR IN RESIDENTIAL INTERIORS

A. General Family Background

1. Name of the interviewee:

2. Name of the head of the family:

3. Contact address:

4. Contact number:

5. E-mail id:

6. a. General information of the Family:

S. No.	Name of the family member	Relationship to the homemaker	Age (in years)	Sex	Educational qualification	Occupation	Monthly income in Rs.

b. Other sources of income:

☐ Interests from savings and deposits

☐ Dividends from shares and debentures

☐ Rent from properties

☐ Mutual funds

☐ Any other, please specify _____

7. Family type: ☐ Joint family ☐ Nuclear family

8. Religion followed _____

B. Details of the House

1. Plinth area of the house (in sq.ft.):

2. Year of construction

☐ 2006-2007 ☐ 2007-2008 ☐ 2008-2009 ☐ 2009-2010 ☐ 2010-2011

3. Was the house ☐ constructed by self ☐ bought

4. When was the house last painted _____

5. Expenditure incurred for painting the house (in Rs.):

6. Style of the house: ☐ Traditional ☐ Modern ☐ Contemporary

7. Is the house ☐ single storied ☐ double storied ☐ any other _____

8. Number of rooms in the house _____

9. Details of rooms:

Room	Number	Purpose (work, relax, rest)	Coloured/painted		Regularity of use (E,S,R,N)*
			Yes	No	
a. Living room					
b. Kitchen					
c. Dining room					
d. Master bedroom					
e. Kid's room					
f. Guest bedroom					
g. Pooja room					
h. Recreation					

*E-everyday, S-sometimes, R-rarely, N-never

C. Preference of Colour for Rooms

1. By whom is the room used mostly:

Room	Members of the family					Any other
	Elders in the house (in-laws)	Adults (head and homemaker)	Teenagers/youngsters		All	
			Girls	Boys		
a. Living room						
b. Kitchen						
c. Dining room						
d. Bedroom						

2. How has the colour scheme been chosen for the rooms?

☐ By the users

☐ By the head of the family

☐ By the painter

☐ Suggested by Interior Designer / Architect

☐ Suggested by Colour Consultant

☐ Magazines/Catalogs

☐ Influenced by the colour choice of friends or relatives

3. Reasons for using the particular colour/colours:

☐ Economical ☐ Durable ☐ Aesthetic ☐ Ease in maintenance

4. What is the interior finish that is used on the wall?

Room	Paint			Wall-paper	Tiles	Wood	Natural stone	any other, specify
	Dis-temper	Emul-sion	Acrylic					
a. Living room								
b. Kitchen								
c. Dining room								
d. Bedroom								

5. How many colours have been used to colour the walls?

Room	Single colour	Two colours	Three colours	Four colours
a. Living room				
b. Kitchen				
c. Dining room				
d. Bedroom				

D. Effect of Texture on Colour

1. Have you considered the contribution of texture in the effect of colour in the rooms?

☐ Yes If yes, what is the outcome? _____

☐ No If no, why? _____

2. What is the texture of the walls in the rooms?

Room	Texture of the wall			Colour absorbs or reflects light	
	Rough	Grainy	Smooth	Absorb	Reflect
a. Living room					
b. Kitchen					
c. Dining room					
d. Bedroom					

3. Any kind of special textural finish on the wall?

Room	Yes	No
a. Living room		
b. Kitchen		
c. Dining room		
d. Bedroom		

4. Details of elements that contribute to the impact of the colour(s) used in the rooms:

Room	Element	Colour
a. Living room	i. Wall	
	ii. Floor	
	iii. Ceiling	
b. Kitchen	i. Wall	
	ii. Floor	
	iii. Ceiling	
c. Dining room	i. Wall	
	ii. Floor	
	iii. Ceiling	
d. Bedroom	i. Wall	
	ii. Floor	
	iii. Ceiling	

E. Effect of Light on Colour

1. Have you considered the contribution of lighting in the effect of colour in the rooms?

☐ Yes If yes, what is the outcome? _____

☐ No If no, why? _____

2. In which direction are the rooms oriented?

Room	Direction of the room							
	North	South	East	West	North east	North west	South east	South west
a. Living room								
b. Kitchen								
c. Dining room								
d. Bedroom								

3. Details on the lighting used in the rooms

Room	Time of the day when the room is used most			Source of lighting used in the room			Colour of the artificial light		
	M & A*	E & N*	Entire day	Natural	Artificial	Both	White	Yellow	Other
a. Living room									
b. Kitchen									
c. Dining room									
d. Bedroom									

*M- Morning; A- Afternoon; E- Evening; N- Night

F. Relationship between Colour and Temperature

1. Temperature and distance effect of the colour:

Room	Temperature effect of the colour			Distance effect of the colour	
	Cool	Warm	Neutral	Advancing	Receding
a. Living room					
b. Kitchen					
c. Dining room					
d. Bedroom					

2. Comfort of the user related to the size of the room:

Room	Size of the room (in feet)	Feelings experienced	
		Spacious	Cramped
a. Living room			
b. Kitchen			
c. Dining			
d. Bedroom			

3. What is the span of time spent in the rooms?

Room	Time spent(in hours) per day
a. Living room	
b. Kitchen	
c. Dining room	
d. Bedroom	

G. Psychological Effect of Colour in Rooms

1. Have you considered the psychological effect of colour while choosing the colour schemes for the rooms?

☐ Yes If yes, what is the outcome? _____

☐ No If no, reason _____

2. Feelings experienced when you look at the colour for a long period of time:

Room	Colour used on the wall	Psychological effect of the colour used
a. Living room		
b. Kitchen		
c. Dining room		
d. Bedroom		

H. Ergonomic Aspects in the Use of Colour

1. Safety:

a. Has the smell of the paint caused any kind of discomfort, inconvenience or illness?

☐ Yes ☐ No

If yes, what were the steps taken to overcome/reduce the effect?

_____

2. Comfort:

a. What is the colour used comfortable to view?

☐ Yes ☐ No

b. Are all the other objects like furniture, furnishings and accessories easily identifiable in relation the wall colour?

☐ Yes ☐ No

If no, what will be the plan of action to rectify the problem?

_____

3. Ease of Use:

a. Is it easy to use or combine the selected colour with the other furniture and furnishings in the room?

☐ Yes ☐ No

If no, would you like to bring about any change to make the colour more useable?

_____

b. Is it easy to clean/maintain the colour?

☐ Yes ☐ No

If no, what are the steps taken?

_____

4. Productivity/Performance:

a. Does the colour of the room affect the productivity or utility of the room?

☐ Yes ☐ No

If yes, then ☐ in a positive way ☐ in a negative way

If no, or in a negative way then how do you wish to enhance the utility of the room?

_____

5. Aesthetics:

1. Has any specific colour used in the room added to the aesthetic appeal of the room?

☐ Yes☐ No

If yes, specify the room, the colour used and the purpose of using that colour?

_____

6. Any other details or information worth mentioning:

_____

_____