Exploration of luminaries' with led's as light source.

Industrial Design Project III

Guide
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Guide

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Acknowledgement

My profound thanks to my guide Prof. U. A. Athavankar who, through his guidance and support constantly gave directions to project

I would also like to thank all the other professors at IDC who gave constructive criticism and guidance whenever I needed it.

Extra special thanks to the enjoyable people and all batch mates who sit around me in my class. Thank you people for making life at IDC a pleasure during this period.

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1. Abstract

Light is an essential part of everyday life and the only medium which causes visual sensation. Initially light has extensively used for task oriented works. Today when every product around us is a commodity, can 'light' become an experience? Can we use light for creating ambience? Can it create different environments?

In present world, where light sources are becoming as small as LED's, we have opportunity of creating artificial ambience in living spaces.

The project aims at exploring LED's as a light source for creating ambience in living spaces with the help of different principles of managing light rays. These explorations have resulted in creating three different products for three different environments.

The objective of the project is to explore innovative ideas and designs, with LED's as light source and develop new way to look at mood lighting for indoor usage.

What is light? Seems like a silly question at first, but after some thought most of us will agree we don't know much. It comes out of the sun, lets us see things, and makes us warm. We can't grab it, can't outrun it, and can't seem to define it. But one thing surely we can do and that is experiencing it. Light is recognized as a principle medium that puts man in touch with his environment.

While working on the project of exploration, I studied the physics of lights for attractive better result. Each exploration contains at least one principle of light i.e. reflection, refraction, interference, etc. along with the principles various reflecting materials were also studied.

LED's as a light source are the most recent technology in the mode of illumination. The benefits of LED technology are well-recognized and sought after across multiple industries. Their color-changing qualities make them ideal in architectural and entertainment lighting. Their small footprint gives more room for creativity. Additionally, their energy efficiency makes them attractive to green-conscious and cost-conscious consumers.

This Project focuses at making lighting units consisting of one or more LED's with all of the necessary parts and wiring. These products are specifically for creating ambience in living spaces. There are enormous possibilities in the LED's but I have narrowed it down to make three products for three different environments.

The three types of lights are as follows:

Night lamp:

Chandelier:

Low illumination task light:

- Study of light:
  - Study of light principles
  - What is light
  - Types of indoor lighting
- Study of LED's:
  - Technical information
  - What are LED's?
  - Types of LED's
  - Applications
- Market study:
  - Form in which LED's are available
  - Areas in which LED's are used.

4.1 Study of light:

Light is simply a name for a range of electromagnetic radiation that can be detected by the human eye. What is electromagnetic radiation, then?

Electromagnetic radiation has a dual nature as both particles and waves. One way to look at it is as changing electric and magnetic fields which propagate through space, forming an electromagnetic wave. [illustration] This wave has amplitude, which is the brightness of the light, wavelength, which is the **color** of the light, and an angle at which it is vibrating, called **polarization**. This was the classical interpretation, crystallized in **Maxwell's Equations**, which held sway until Planck, Einstein and others came along with **quantum theory**. In terms of the modern quantum theory, electromagnetic radiation consists of particles called photons, which are packets ("quanta") of energy which move at the speed of light. In this particle view of light, the brightness of the light is the number of photons, the color of the light is the energy contained in each photon.

4.2 Study of light properties:

Refraction of light:

Refraction is the change in direction of a wave due to a change in its speed. This is most commonly observed when a wave passes from one medium to another.

Reflection of light:

Reflection is the change in direction of a wave front at an interface between two different media so that the wave front returns into the medium from which it originated.

Interference of light:

Interference is the addition of two or more waves that result in a new wave pattern.

4.3 Lighting:

Lighting has several functions. The functions of lighting include:

Illumination: The simple ability to see

Focus: attention to an area

Mood: Setting the tone of a scene

Location and time of day: Establishing or altering position in time and space

Composition: Lighting may be used to show only the areas which the designer wants to see

Lighting is used for specific purposes other than allowing one to see. The goal of good lighting is to create a beautiful environment in which your eyes are directed towards key objects rather than simply the light itself. To do this, different types of lighting methods are used.

(FIG 4.4 -1)

(FIG 4.4 -3)

(FIG 4.4 -2)

(FIG 4.4 -4)

4.4 Types of indoor lighting:

Ambient lighting:

This type of lighting is also called as general lighting. It provides the overall brightness required for the room. This light is essential for everyday life as it helps us to see and carry out routine jobs. (FIG 4.4 -1)

Task oriented lighting:

Task lights are used for specific purposes. It provides sufficient localized light. For example lamps for reading provides task light. (FIG 4.4 -2)

Accent or featured light:

These lights are used to create focal point in a room by highlighting a particular object. (FIG 4.4 -3)

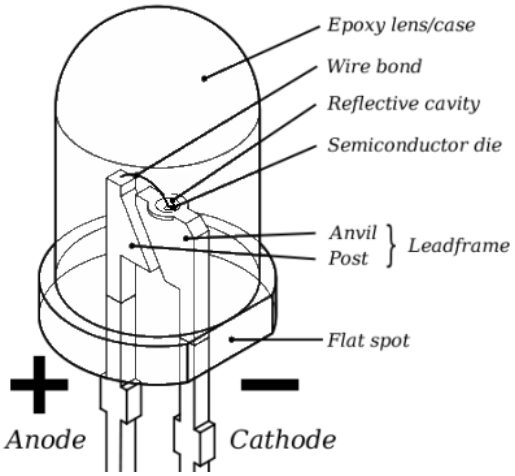
Layering light:

These are the lights which combine number of lighting fixtures to build up layer of light. (FIG 4.4 -4)

(FIG 4.4 -5)

Mood lighting:

Mood lights allow you to control your own light scenarios. You can change colour, intensity, light sequence etc. main purpose of these lights is to create ambience. (FIG 4.4 -5)



Details of LED
(FIG 4.5 -1 ref1)

4.5 STUDY OF LED's:

What is LED?

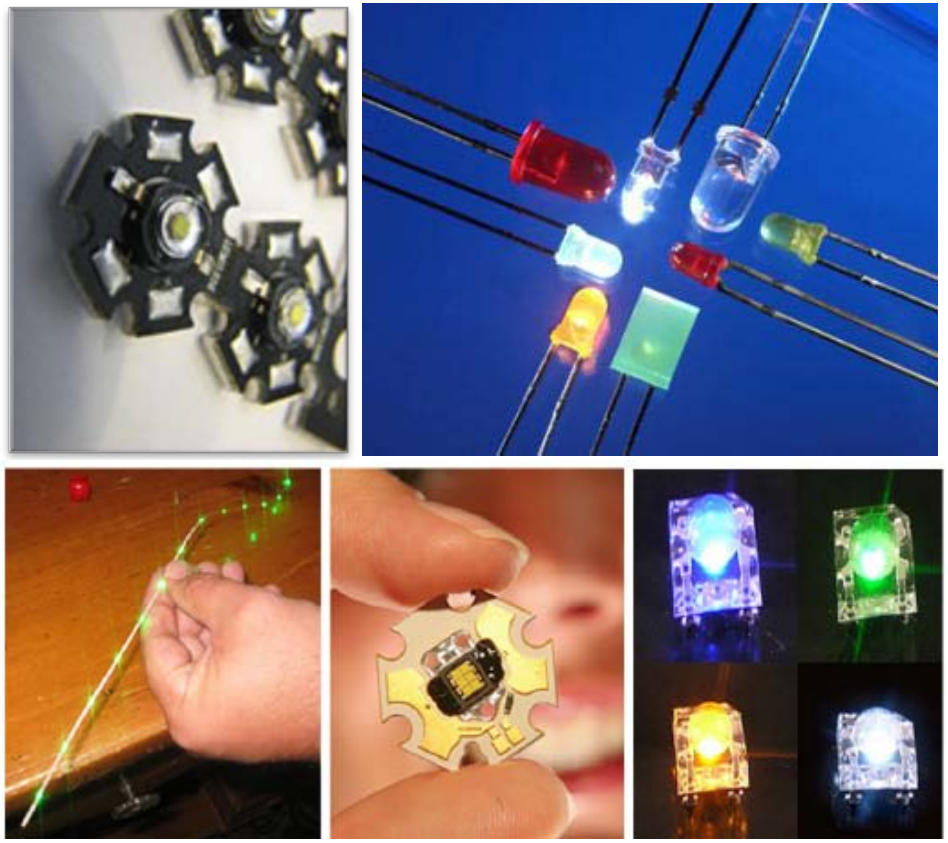
A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet (about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an infrared-emitting diode (IRED). (FIG 4.5 -1)

Types of LED's:

LEDs are produced in an array of shapes and sizes. The 5 mm cylindrical package is the most common, estimated at 80% of world production.

The color of the plastic lens is often the same as the actual color of light emitted, but not always. For instance, purple plastic is often used for infrared LEDs.

There are also LEDs in extremely tiny packages, such as those found on cell phone keypads. (FIG 4.5 -2)



(FIG 4.5 -2)

4.6 Applications of LED's

Automotive Applications with LEDs

Instrument Panels & Switches, Courtesy Lighting, CHMSL, Rear Stop/Turn/Tai, Retrofits, New Turn/Tail/Marker Lights

Consumer Electronics & General Indication with LEDs

Household appliances, VCR/ DVD/ Stereo/Audio/Video devices, Toys/Games Instrumentation, Security Equipment, Switches

Illumination with LEDs

Architectural Lighting, Signage (Channel Letters), Machine Vision, Retail Displays, Emergency Lighting (Exit Signs), Neon and bulb Replacement, Flashlights, Accent Lighting - Pathways, Marker Lights

Sign Applications with LEDs

Full Color Video, Monochrome Message Boards, Traffic/VMS, Transportation - Passenger Information,

Signal Application with LEDs

Traffic, Rail, Aviation, Tower Lights, Runway Lights, Emergency/Police Vehicle Lighting,

Mobile Applications with LEDs

Mobile Phone, PDA's, Digital Cameras, Lap Tops, General Backlighting,

Photo Sensor Applications with LEDs

Medical Instrumentation, Bar Code Readers, Color & Money Sensors, Encoders, Optical Switches, Fiber

4.7 Advantages of LED's:

Lower energy consumption:

LEDs are highly efficient. In traffic signal lights, a strong market for LEDs, a red traffic signal head that contains 196 LEDs draws 10W versus its incandescent counterpart that draws 150W. Various estimates of potential energy savings range from 82% to 93%. With the red signal operating about 50% of the day, the complete traffic signal unit is estimated to save 35-40%.

Longer lifetime:

LEDs have a functional lifetime far superior to more traditional lighting technologies. An LED can last from 30,000 to 100,000 hours, almost 50 times longer than most incandescent light sources (2000 hours) or up to 10 times longer than fluorescent sources (10,000 hours).

Efficiency:

Compared to conventional lighting systems, LEDs consume less energy, emit little heat, and operate at a low wattage without sacrificing performance. High performance LED optics can drastically increase fixture efficiency whereas incandescent and fluorescent sources often require external reflectors to collect the produced light and direct it in a usable manner.

Color benefits

LEDs utilize a simple RGB color mixing approach that enables them to produce millions of different colors by simply adjusting the intensity of each grouping of red, green or blue device. The colors they produce can be highly saturated, at a variety of color temperatures. Additionally, when dimming LEDs the color tone is not changed while the current passing through them is lowered, unlike incandescent lamps, which produce a yellowing color. LEDs emit no ultra-violet or infrared radiation, which makes them perfect for museums and galleries.

Form as a liberty:

Due to the extremely small size of LEDs, fixture designs can be drastically smaller than conventional lighting alternatives. This opens up a world of creative solutions and installation options for lighting designs. The solid state technology of LEDs also makes them shock and vibration resistant.

Dynamic nature and faster switching:

When LED's used in applications where dimming is required, LEDs do not change their color tint as the current passing through them is lowered. LEDs are ideal for use with occupancy sensors, since they are unaffected by frequent on-off cycling, unlike fluorescent lamps that burn out more quickly when cycled frequently. This property of LED's makes it dynamic in nature.

LEDs light up very quickly. A typical red indicator LED will achieve full brightness in microseconds. LEDs used in communications devices can have even faster response times.

Present LEDs have these **advantages** over traditional light sources, including emitting denser light by grouping together or creating rare lighting by placing them apart.

However, they are relatively expensive and require more precise current and heat management than traditional light sources.

(5.1 -1.Pictures are from the international exhibition 'lighting' held in Goregaon, Mumbai on Feb. 09)

Market study was done for knowing two important factors first was to know how LED technology is used in existing lighting products and other reason was to know what are the forms, specifications, colors and other features in which LED's are available in market.

5.1 Existing products with LED technology:

During the course of the project I attended various exhibitions and visited various lifestyle showrooms to know, available products in market with LED technology.

This market study helped me knowing atmosphere in which LED's can be used, there effects in surrounding, way the y are integrated in products, etc.

(5.1 -2.Pictures are from the international exhibition 'lighting' held in Goregaon, Mumbai on Feb. 09)

Observations:

Though the light source used in these luminaries were conventional LED's, the way they were used was very traditional.

There were few lamps in which LED's were used in group which was giving a feeling of old light source 'bulb'.

In few cases LED strips were used, which were looking as an option for tube lights.

Individual LED's were not used extensively.

(5.1 -3. Pictures are from the, LED house, Mumbai on Feb. 09)

5.2 Market study for LED's:

There are various forms of LED's in market. Earlier they were available as a single unit, but these days they are available in strips, circular disks, LED pipes, *torans,* etc.

There are various kinds of coded LED ray slides which can change colour, illumination, pattern of illumination etc. as per user's requirements.

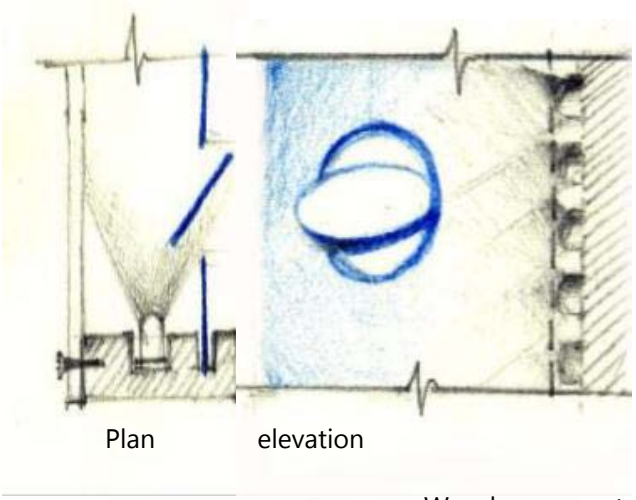
Observations:

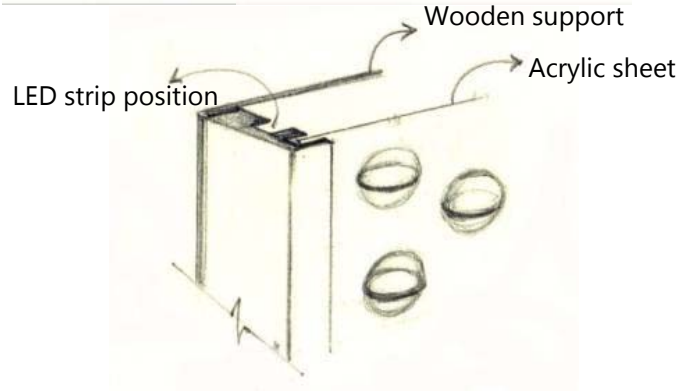
The way LED light sources were available in market was pretty familiar in terms of formal expressions. Though single Led's were available, other forms of LED's which almost look like bulb or tube lights were also available.

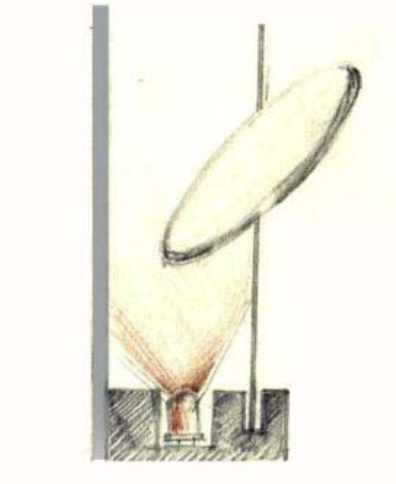
There were few innovative forms of LED's were also available in market in which we can set various functions with manual remote controls.

Earlier explorations were just thought of on papers but to know the actual feeling and appeal of light mockup models were made. Physical study of light was the basis of explorations; further other aspects like property of materials, light and shadow patterns, illumination level were also taken into account.

Each exploration was then documented in terms of quality of ambience it creates. After every exploration the environment which will be suitable for such product was also thought of.







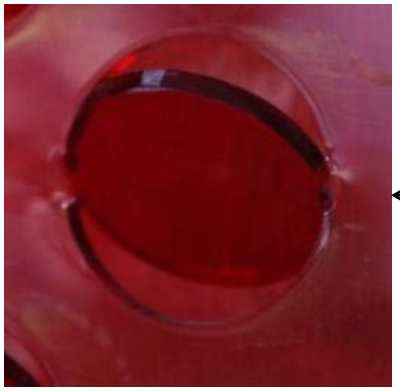
Sectional view

Exploration no 1:

Distributing light by introducing obstacle resulted in to surprising patterns on wall. Geometric patterns created on walls were visually appealing.

Property used	environment	context	user	material
Reflection and distribution of light	Interiors	Partitions, dividers,	Interiors of houses, pubs, bars	Colored Acrylic.

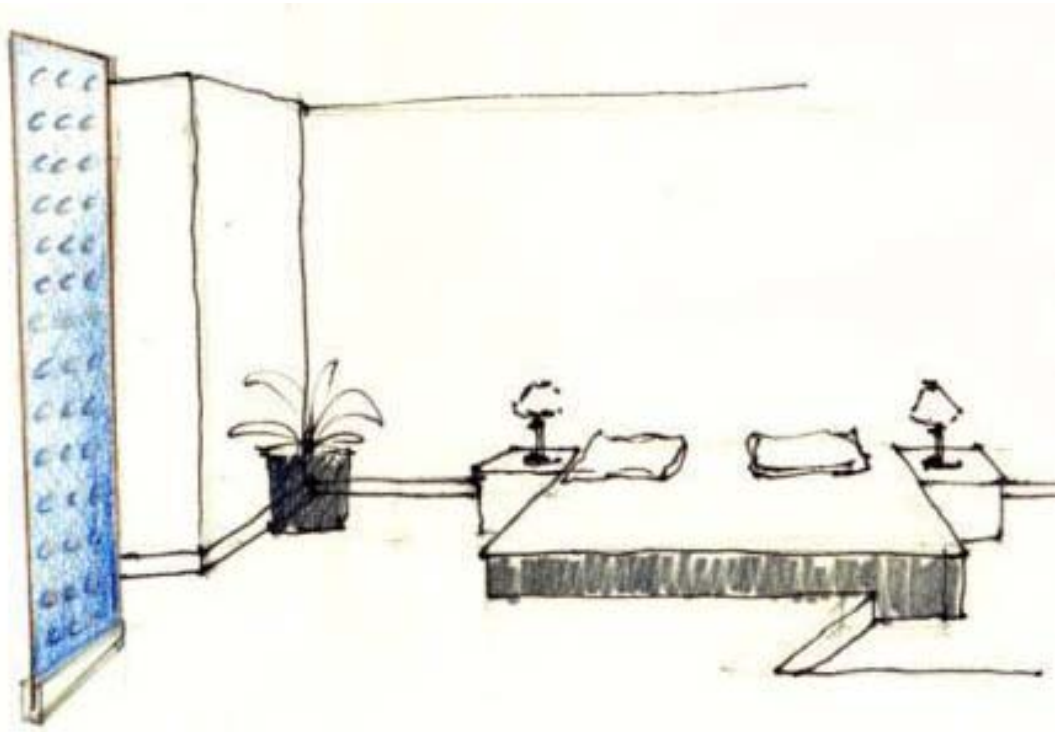
Pattern on wall



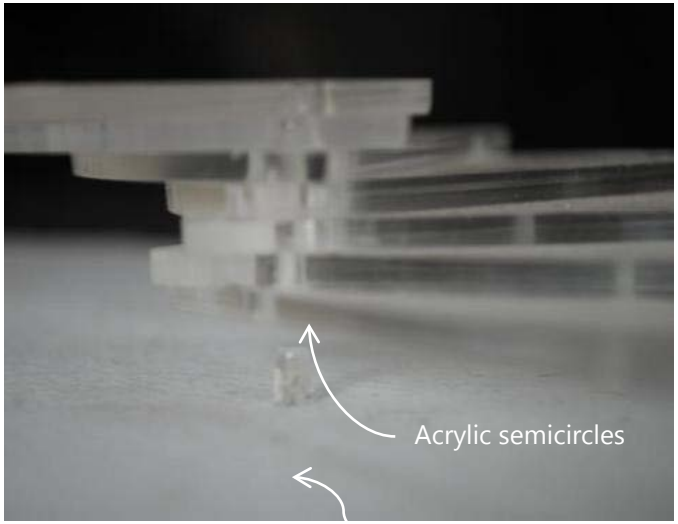
Details

Detailing of circle bending

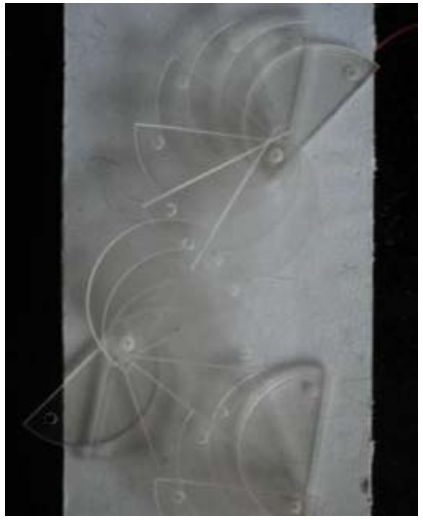
Exploration model



Environment:



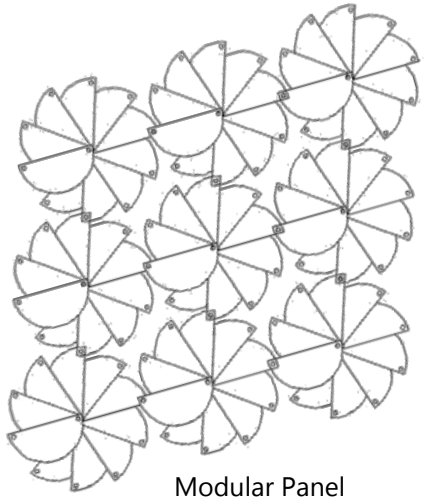
Front view



Panel of modular unit

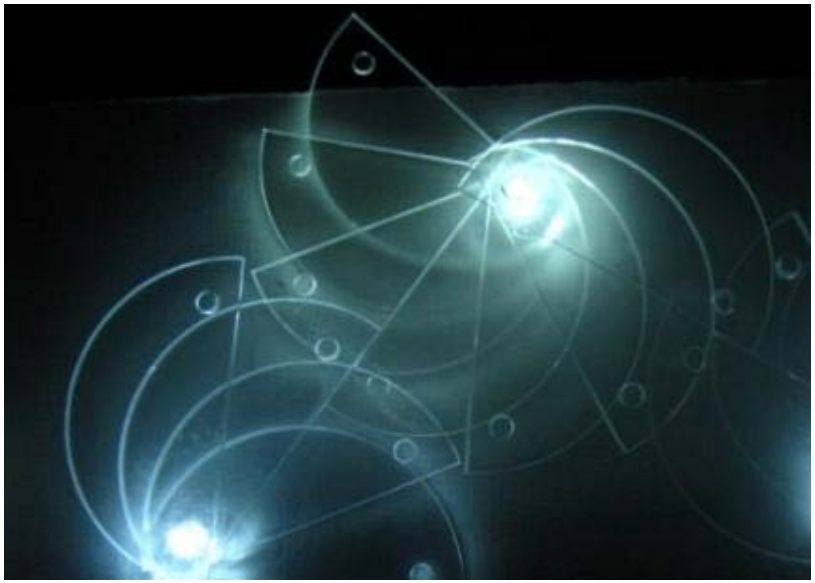
Exploration no 2:

Using internal reflection property of light and modular geometry was made which can be extended as per needs. Glowing edges of material were adding a surprise factor along with appealing.



Modular Panel

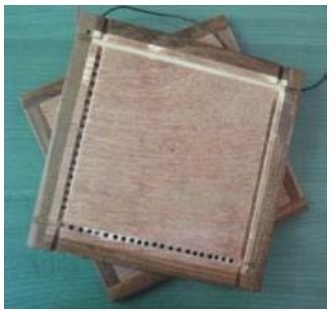
Property used	environment	context	user	material
Internal Reflection	Interiors	Exhibition areas, night lamp, used were less illumination is needed	Interiors of houses, pubs, bars, cafeterias, etc	Colored/ opaque Acrylic.



Photograph:

Environment:

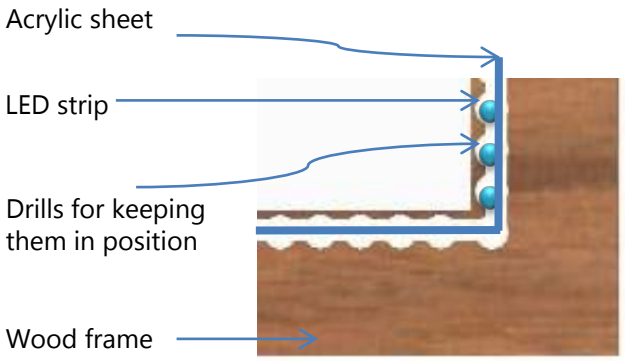
Detailing



Pattern created on wall

Exploration no 3:

Again using internal reflection engraved surface of acrylic sheet was bended in a rectangular form. LED source was hidden at the bottom of the frame; this exploration was giving an effect of water bubbles in air.



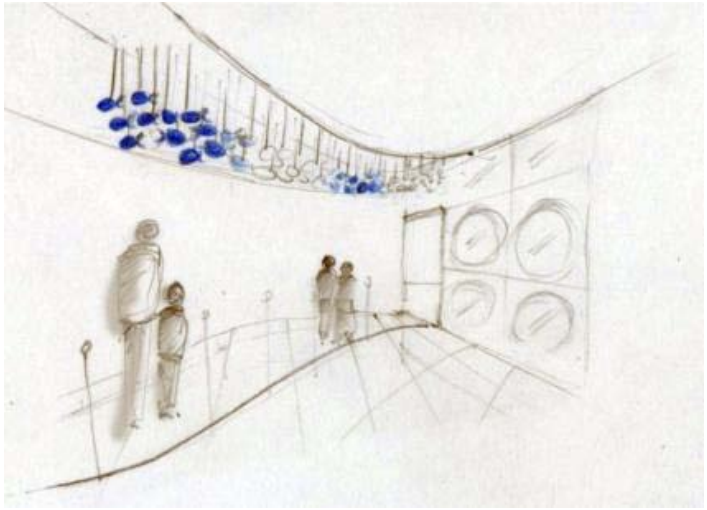
Plan

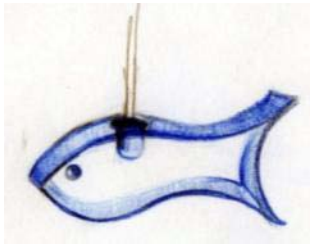
Environment:

Property used	environment	context	user	material
Internal Reflection	Interiors	Night lamps, low illumination lamps	Interiors of houses, hotels, gardens, malls, etc	Colored / opaque Acrylic.



Exploration Photographs

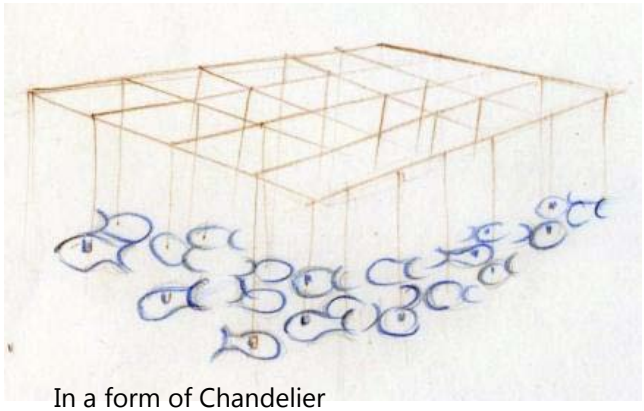




In case of suspended unit.

Exploration no 4:

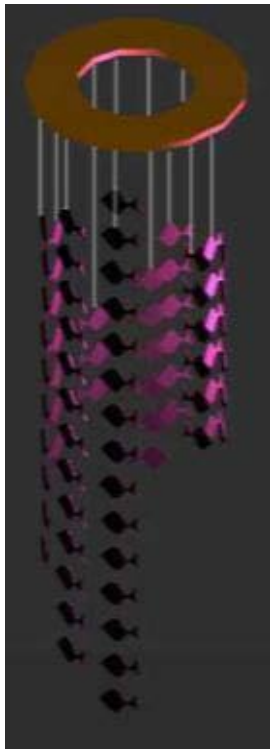
Using modular units dynamic sculpture were tried to explore. These interactive installations can guide along passageway. Unique point of this sculpture is, it will detect human bodies and will glow as soon as a person pass by.

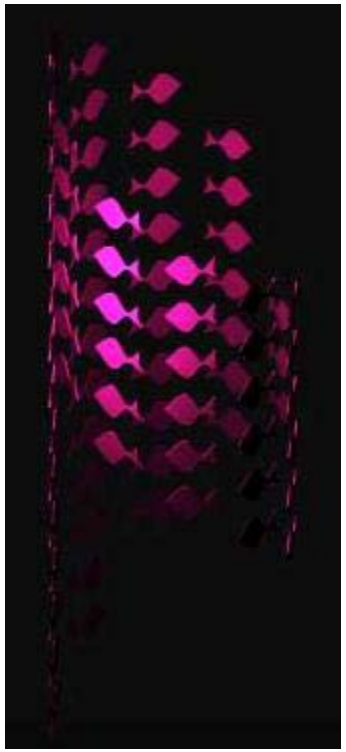


In a form of Chandelier

Environment:

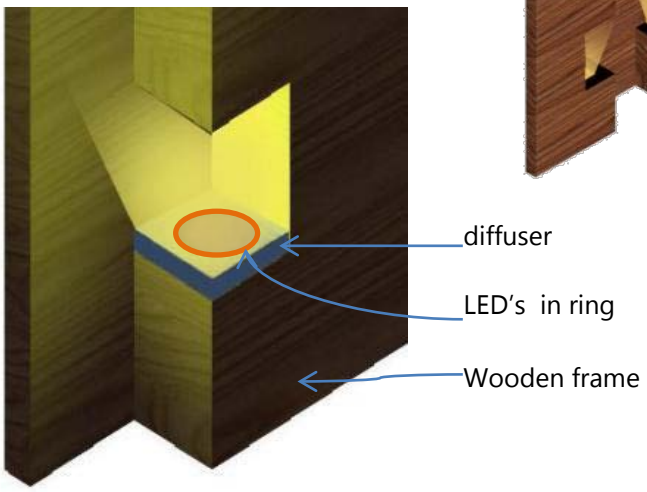
Property used	environment	context	user	material
Internal Reflection and distribution of light	Interiors , exteriors	Partitions, installations on larger surfaces, path indicator.	Interiors of grand hotels, airports, malls, theaters, etc.	Acrylic

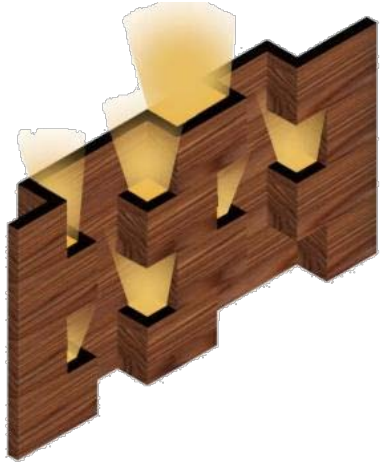




Dynamic sculpture

Along the pathway (stimulation)



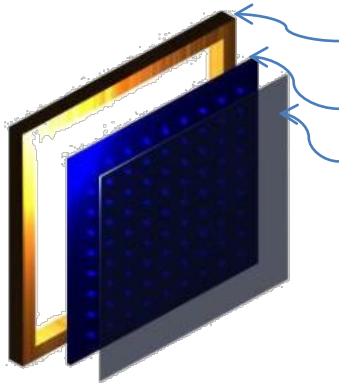


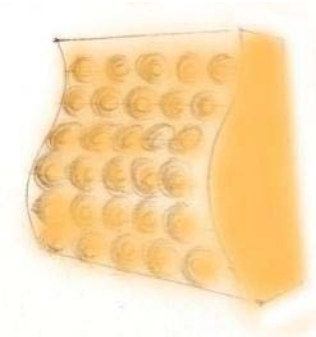
Exploration no 5:

This exploration was based on the principle of reflection and at the same time distribution of light was taken into consideration. Because of distributed light units hierarchy will occur on wall.

Environment:

Property used	environment	context	user	material
Reflection and distribution of light	Interiors	Wall washers,	Interiors of houses, as decorative task lights	Wood , diffuser





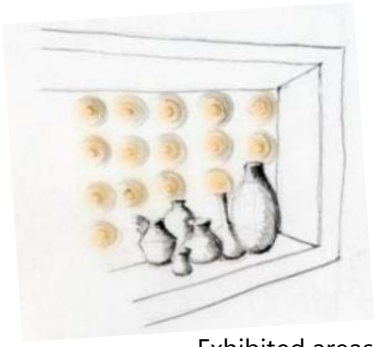
Various shapes possible

Exploration no 6:

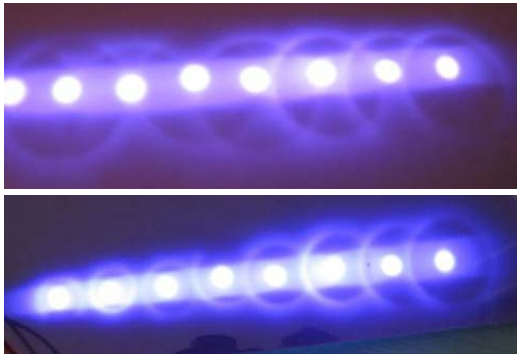
These kind of light units are multifunctional. These are created by mounting Led's at specific distance on mount board. A distinct distance is maintained between diffuser and LED's which results in to striking Circular pattern.

Section

front elevation



Exhibited areas



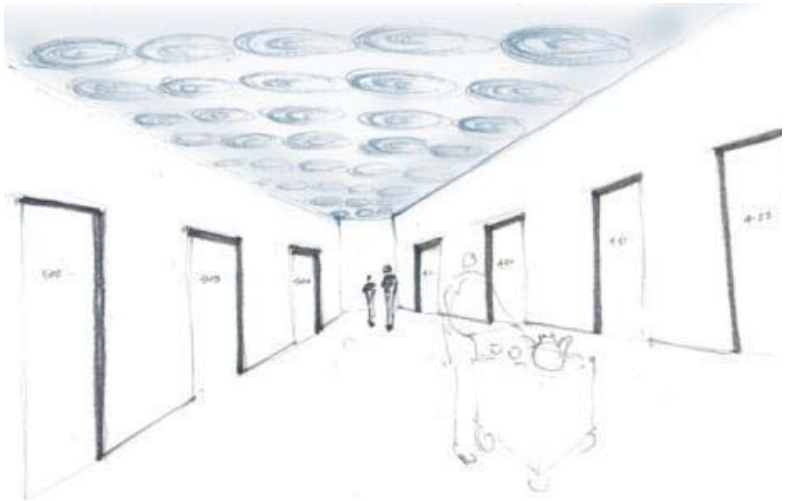
Photograph

Property used	environment	context	user	material
Diffusion and distribution of light	Interiors	Low illumination areas like toilets, staircases, corridor; can be used as a modular unit for flooring, ceiling, walls.	Interiors of houses, hospitals, hostels, corporate offices, conference rooms, etc.	Colored/ opaque Acrylic.

Environment:

Toilet light

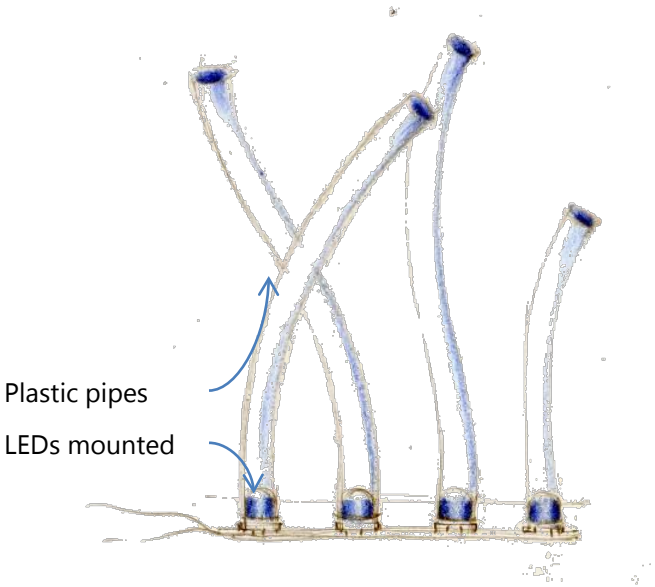
staircase light

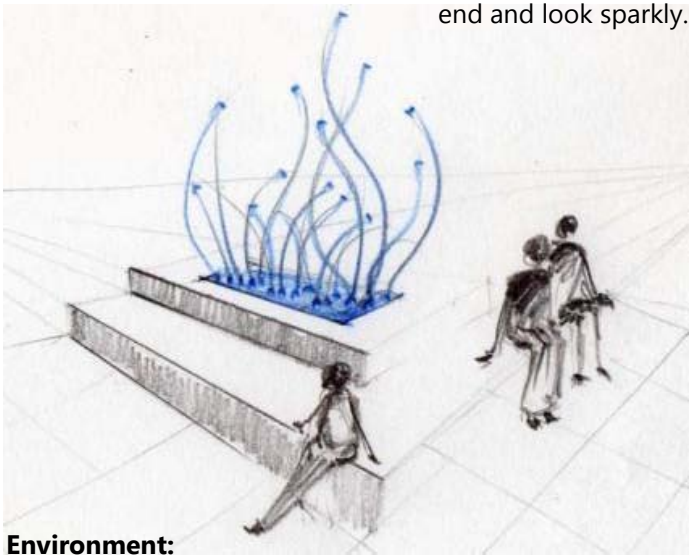


As false Ceiling

Exploration no 7:

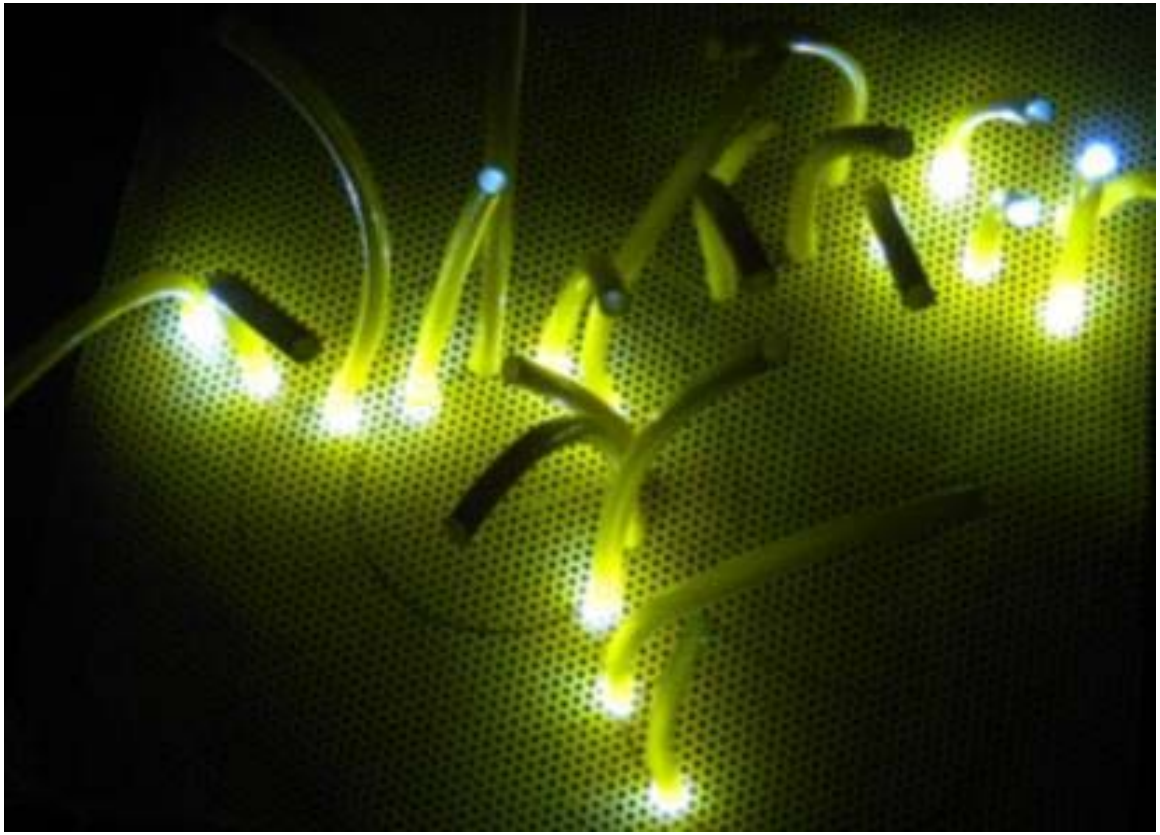
For reducing the brightness of LED's covering of plastic pipe was done surprisingly this pipe carries light till the other end and look sparkly.



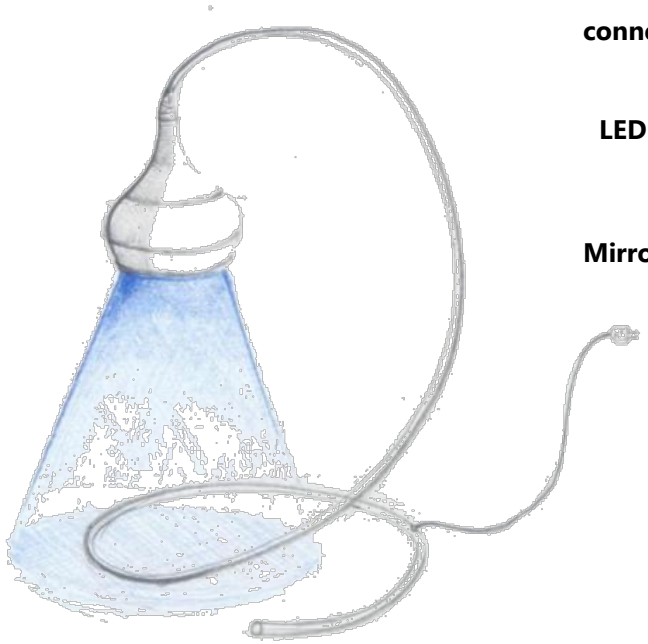


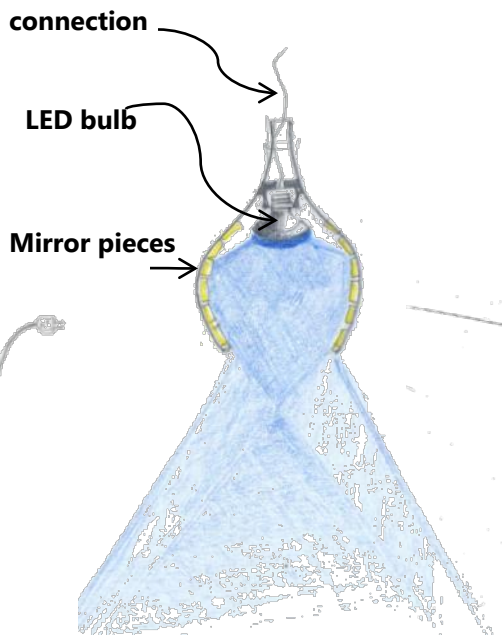
Environment:

Property used	environment	context	user	material
Diffusion and	Interiors , exteriors	Partitions, sculpture, public places as a decorative installation	Interiors of houses, malls, fun parks etc.	Plastic tube, mount board



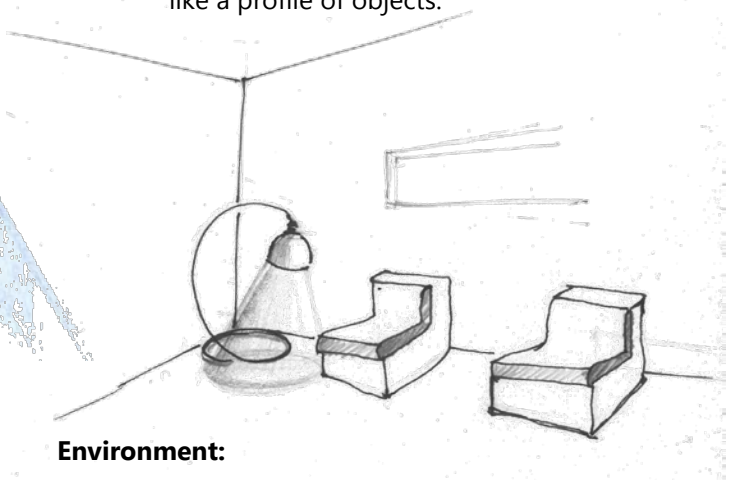
Photograph:





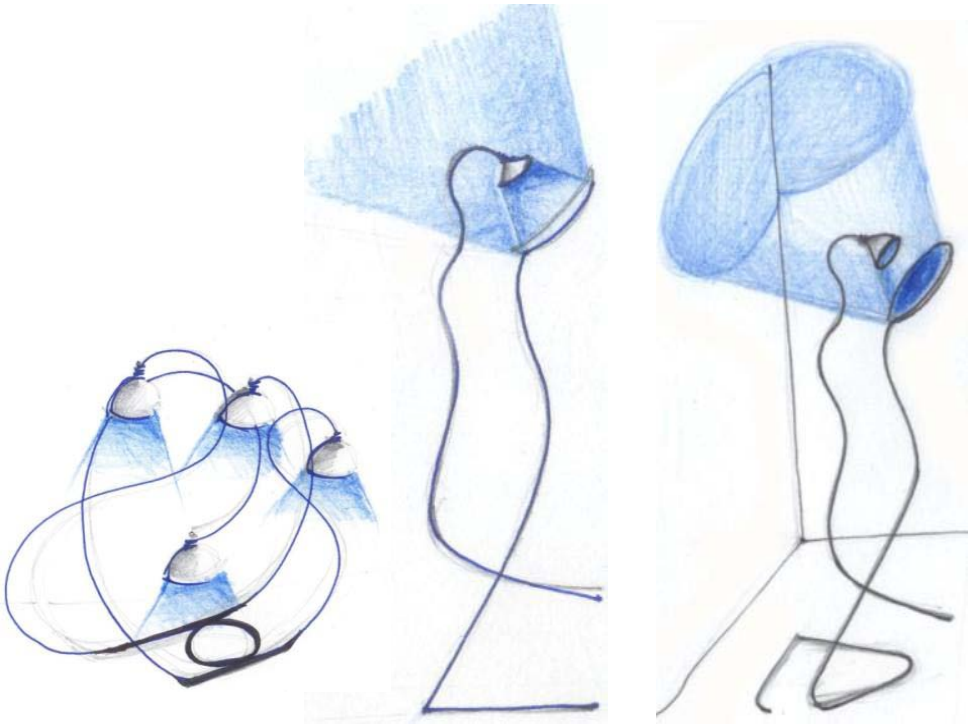
Exploration no 8:

This Night lamp is made by taking an analogy of any natural or usual thing. It will act as a showpiece when it is not functioning as a source of light. 2D wireframe contains two units' source and reflector. Both of them are composed in such a manner that it looks like a profile of objects.



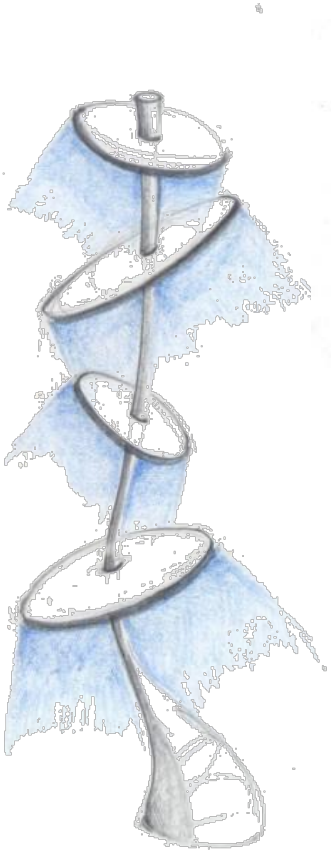
Environment:

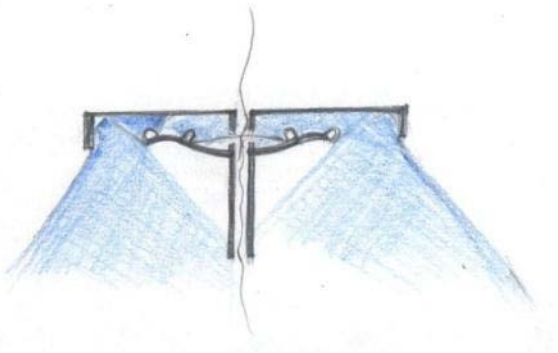
Property used	environment	context	user	material
Reflection and	Interiors	Decorative lamp	Interiors of houses, corporate offices	Metal tube, mirror



Other options

Photograph



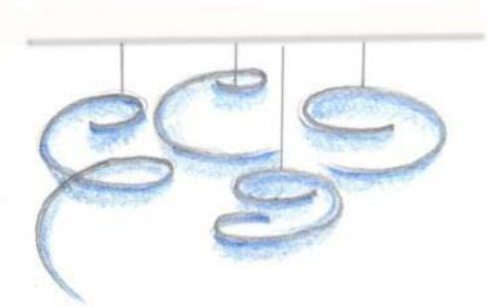


Exploration no 9:

Distributing light by introducing obstacle resulted in to surprising patterns on wall. Geometric patterns created on walls were visually appealing.

Photograph:

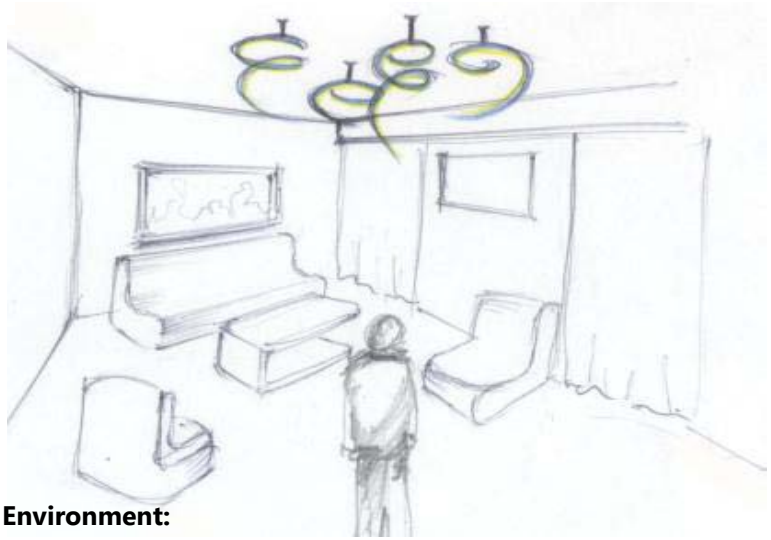
Property used	environment	context	user	material
Reflection and distribution of light	Interiors	Partitions, dividers,	Interiors of houses, pubs, bars	Colored Acrylic.



Photograph:

Exploration no 10:

Taking advantages of being smaller in size, we can mold LED in any required form. This exploration was an attempt to create free flowing light beam in space.



Environment:

Property used	environment	context	user	material
Reflection and distribution of light	Interiors	Partitions, dividers,	Interiors of houses, pubs, bars	Colored Acrylic.

6.2 Exploration of acrylic as materials:

Using a textured acrylic as diffuser reduces the intensity of light drastically but it gives a better ambient light. The distribution of light is much more uniform and there is no direct glare or hot spots.

Following are the pictures showing various textures of acrylic available in market.

7. Unique proposition

7. Unique proposition

Unique proposition:

The observation from the explorations were analyzed and intentionally extract key points that would form the overall framework of the product. This in turn led to formulation of a product brief with a strong Unique Selling Proposition.

Key points: light source used in explorations were concerning LED as an small individual light source unlike other products were LED's are used in group to create traditional bulb effect.

Explorations which are resulted in pattern making, are unique as introducing geometry in lighting and creating various forms on plain walls and ceilings is innovative idea.

Using LED's in dissimilar way to create mood lights for delivering ambience in living spaces.

8. Product brief

8. Product brief

Product brief:

Conclusion

From the explorations made and the data collection analysis, it is seen that the current lightings systems and luminaries provide little or no flexibility in terms of product to the user and are quite power consuming.

From the market study and case studies it is clear that the LED technology is ideal energy saving lamp but they are used as traditional light sources.

for designing an products with enough option in lighting outputs and which will be pleasing for the user,

The design brief will be

To design such a product which can create pleasing atmosphere.

I! should be easy to install.

I! should be modular in nature .

I! should be light in weight with resistant to heat and water.

I! should have less maintenance work and cost.

An aesthetic, energy efficiency luminary

The main aim of the project is to develop an Luminary for Luminary maker who wants to use LED as a light source, for creation ambience light.

The design brief

For interior environment- houses, malls, exhibition areas, pubs, bars, airports, etc.

Primary users - To be used by people of the family/ public area.

LED specifications-
Light source – white/colour LEDs - 3mm, 5mm, 8mm
angle 100 degree light emitting angle.
One led consumes 0.05 w
Volt 3.5

Environment for usage - external power supply

Lamp Material
It should be light in weight with resistant to heat and water.
Outer Casing material - will act as diffuser
Base materials should have high load caring capacity or should be stiff enough to take the expected weight.

Interface- Switch controlled.

10. Ideation

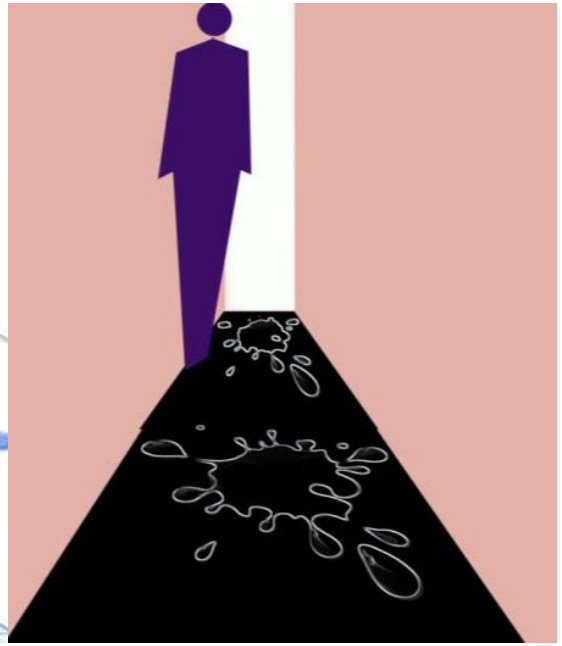
Ideation:

Ideation was done on the basis of explorations. Each exploration has certain uniqueness and appeal. Keeping the effect of appearance ideation was done for various explorations.

Few explorations can molded in to number of products, like it can be a series of products from one family. Main focus of ideation was on form exploration, functionality, appeal and aesthetics.

Flooring light;

These kind of lights will be fitted in floorings, specially in wooden flooring. They can be in different sizes and shapes. It even can act as path finders. There can be pressure sensors attach to each tile which will result in dynamic path which will glow along the user.



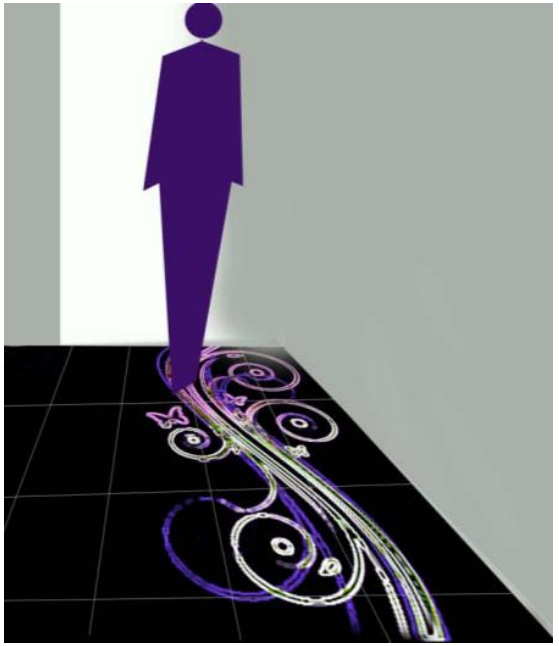
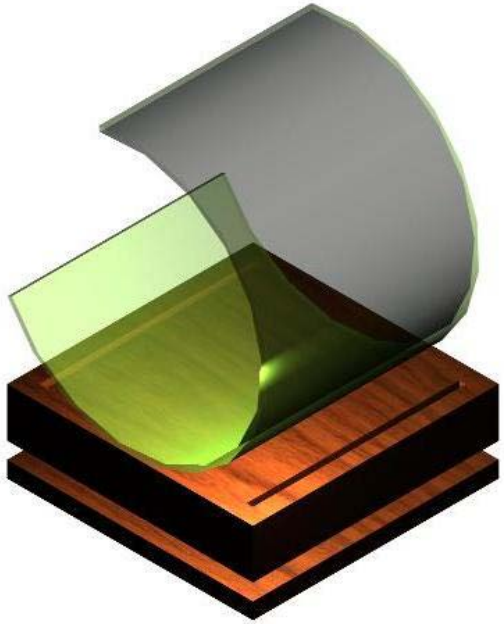
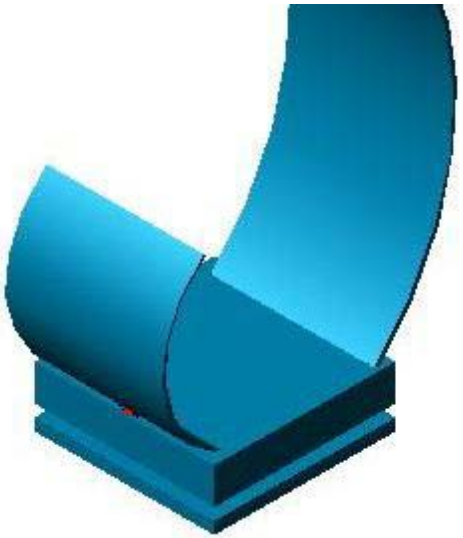


Table lamp :

These kind of table lights can be used for small tasks like reading books. It can also work as night lamp.





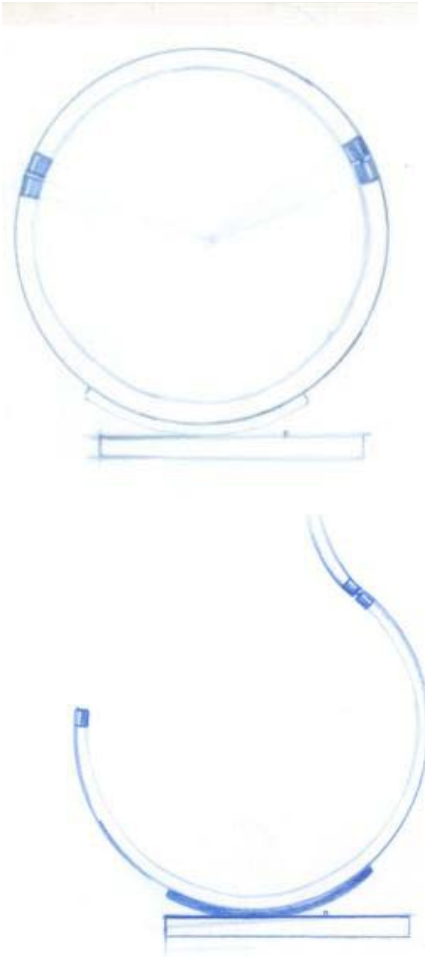
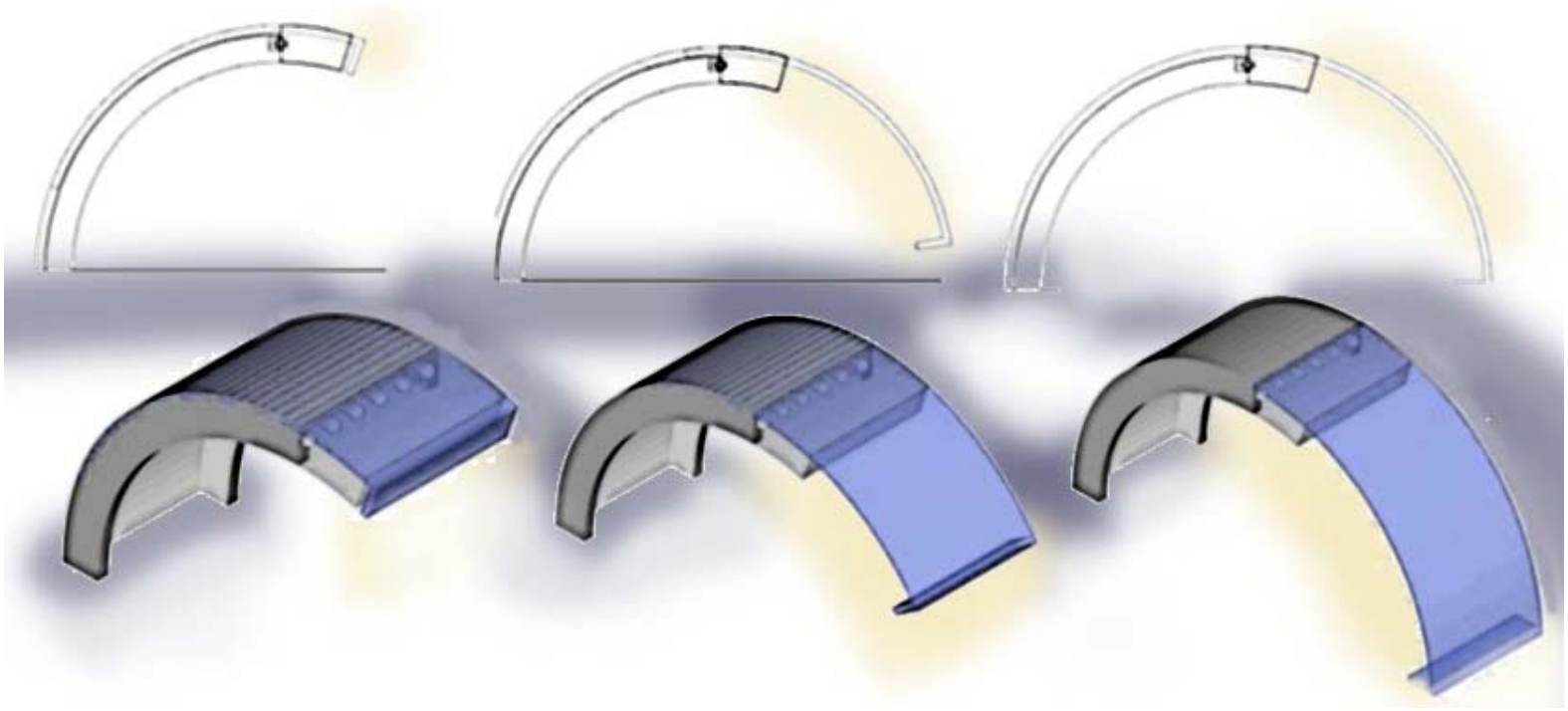


Table light:

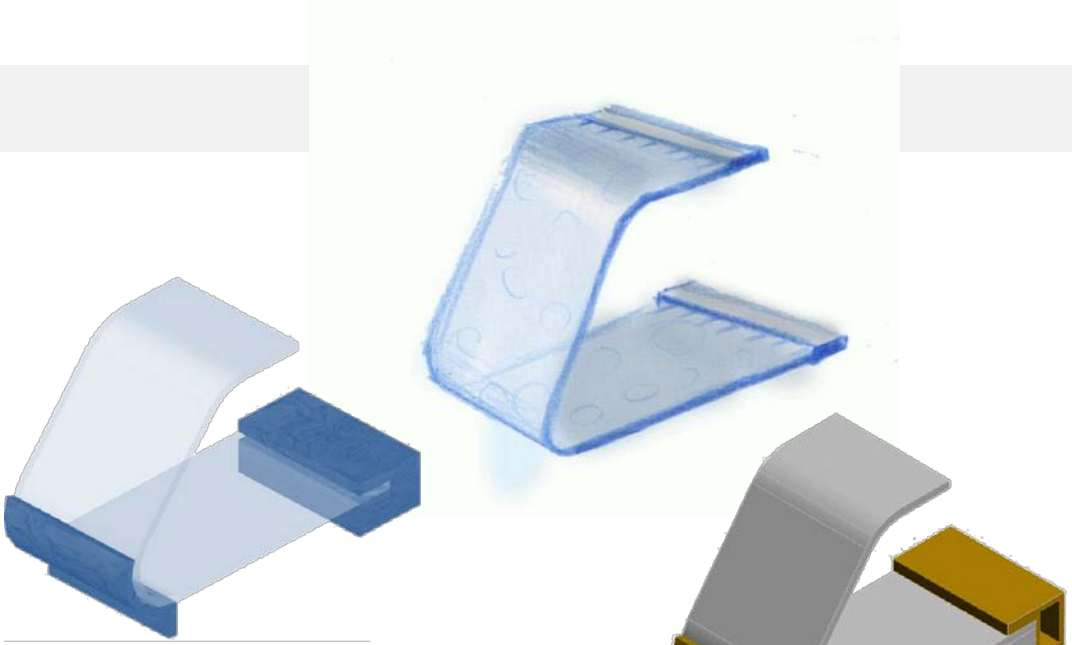
This lamp can function as a night lamp specially for bedrooms. The important feature of this lamp is it will have on/off function in such a way that, simply sliding the upper part of lamp it will glow.

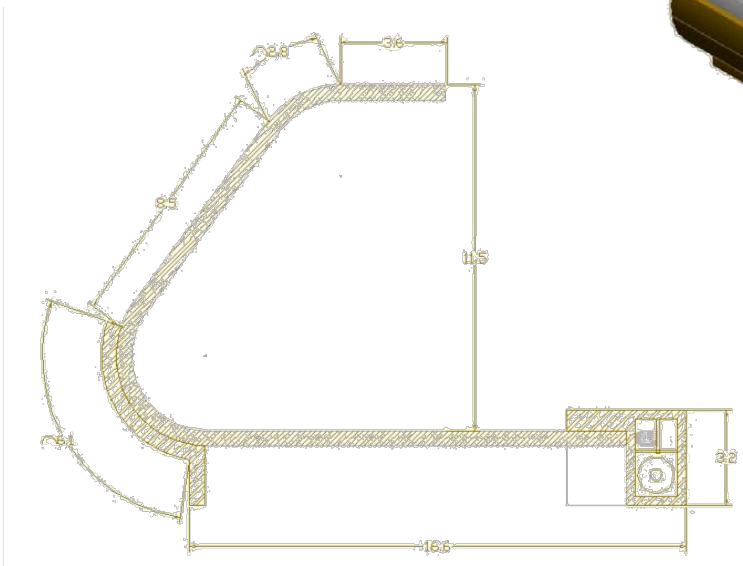
Desk lamp:

This lamp will be installed on the desks and can act as a small light source for personal tasks like reading, typing or wring etc.



Ideation





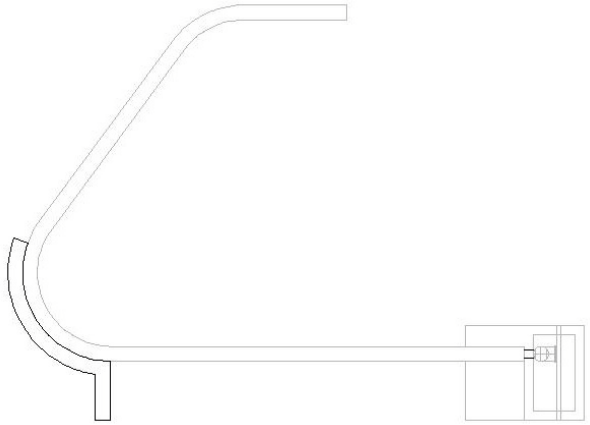
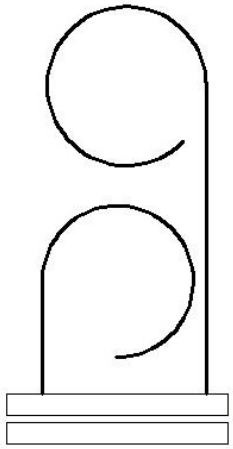
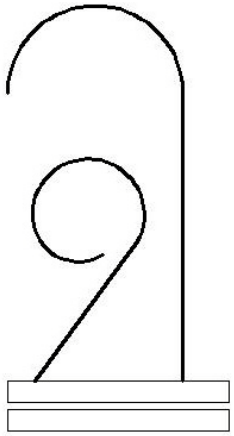


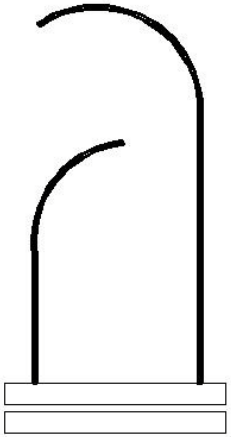
Table lamp:

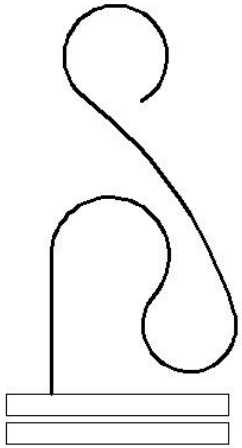
This lamp prominently contains acrylic as important material. This is based on the material property of acrylic. It can have various etched surfaces which will glow when led lights will penetrate trough material.

Ideation



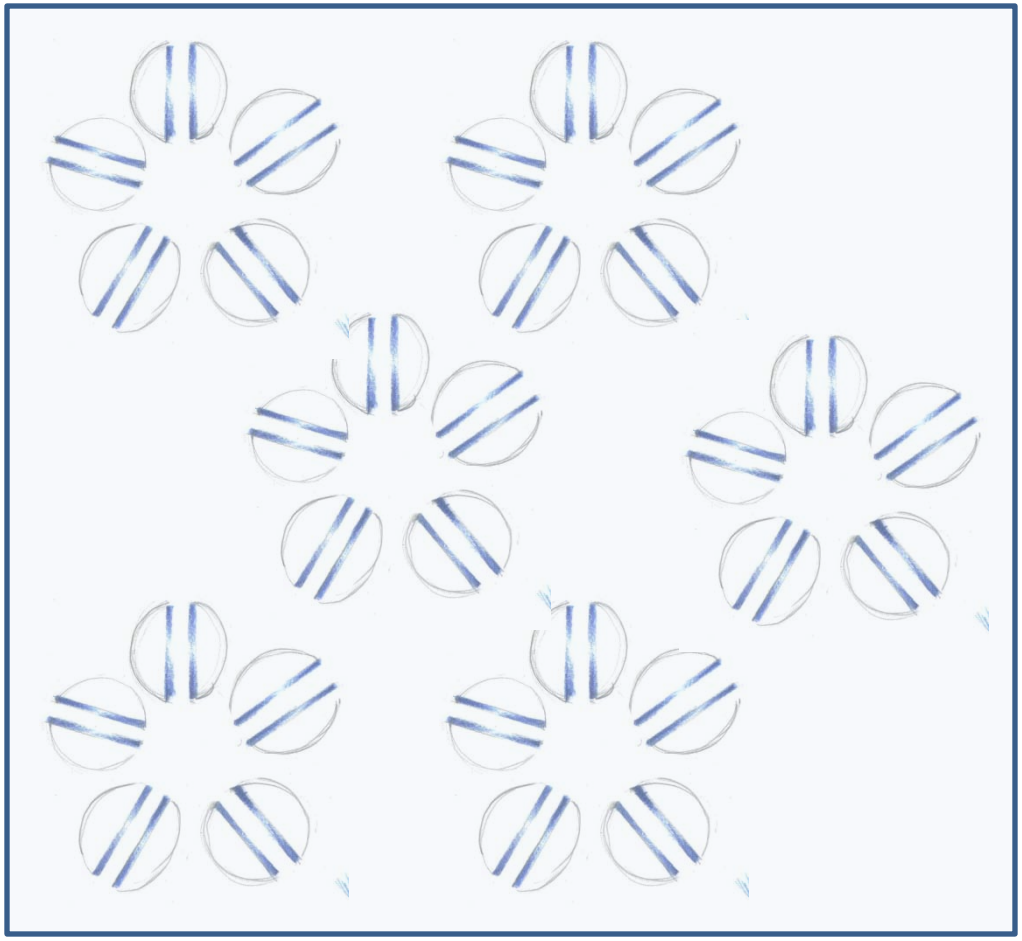






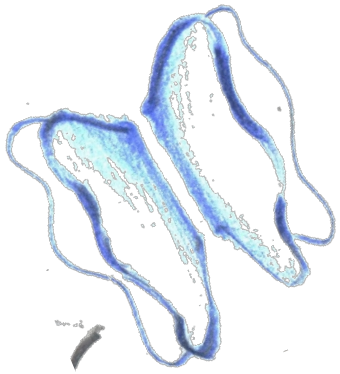
Sculpture:

This idea was about creating light sculpture. The lamp contains acrylic sheets bended in various directions. These sheet can even form an abstraction of any natural thing. Base of the structure is made out of wood which has internal fittings for LED's and battery. The acrylic sheets can have various patterns of etching on it which will further enhance the appeal of the product.



Partition panel:

This particular panel is with LED lights embedded at the bottom. It will create various patterns on the walls and ceilings.

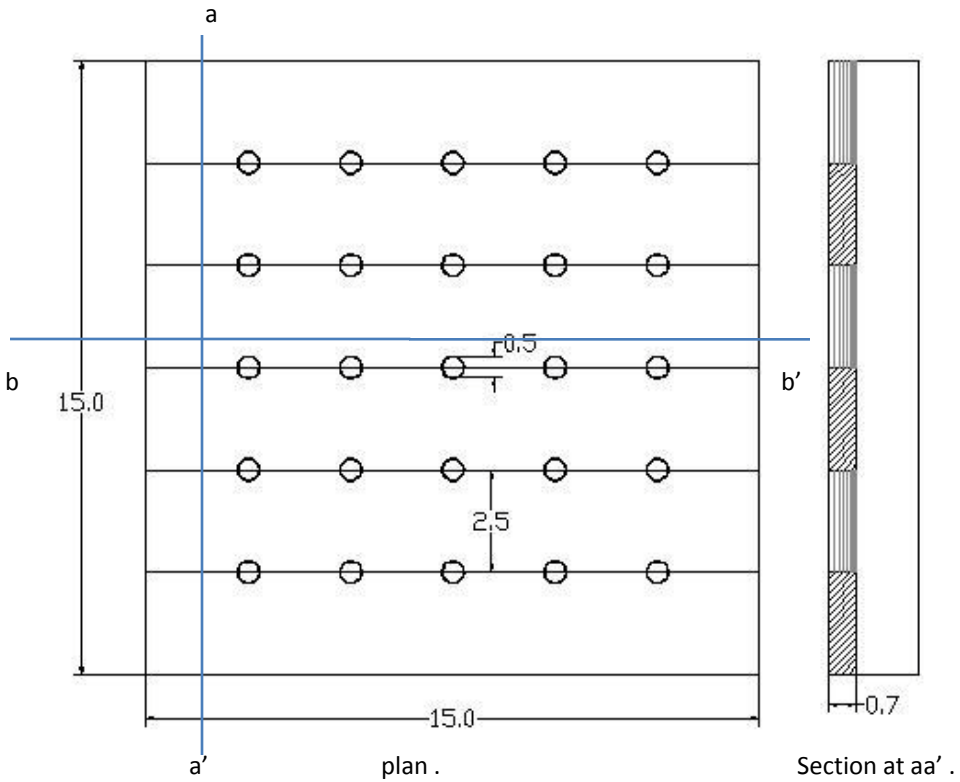


11.Concepts

Concepts:

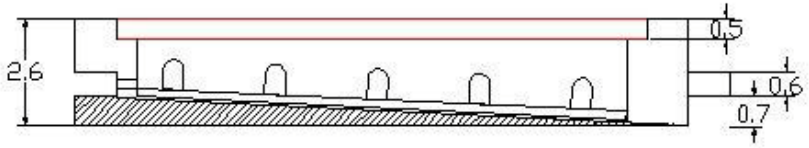
The relationship between light and visual appeal is not only essential to creation of an artwork but also to its subsequent perception with the aim of ensuring a vast public enjoyment.

The final concepts I have chosen are based on appeal, practical applications and manufacturing.



plan .

Section at aa' .

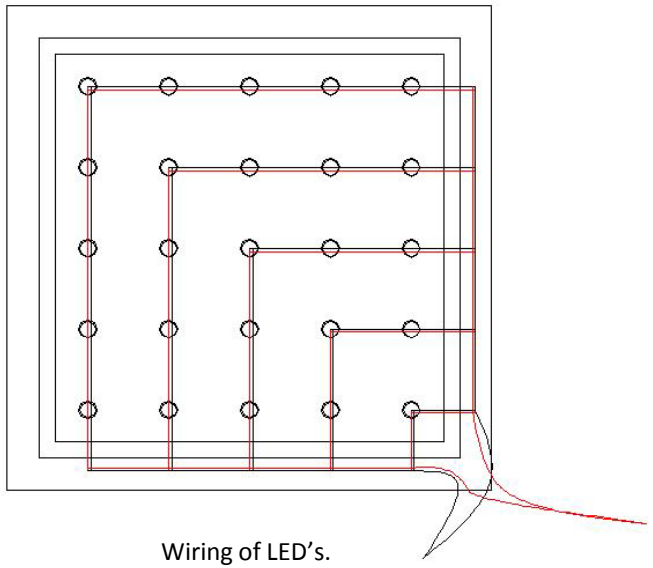


Section at bb' .

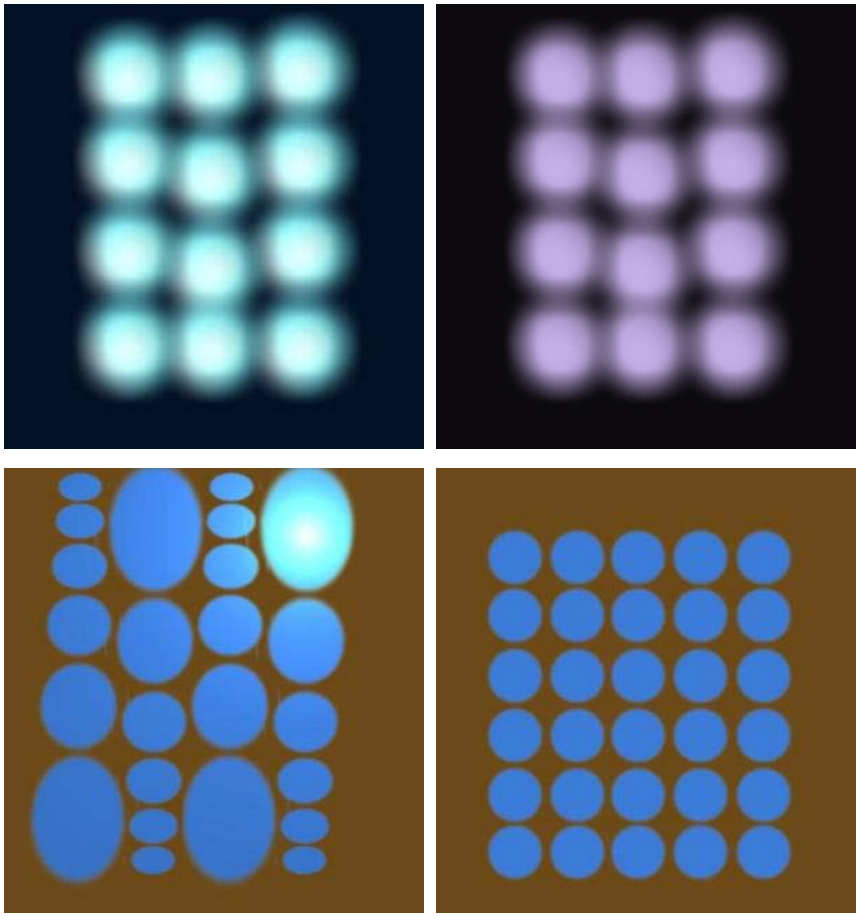
Concepts 1

Concept 1 is based on using Led's for making panels and creating geometrical pattern on the external surface.

These kind of panels can be made in various shapes and sizes.



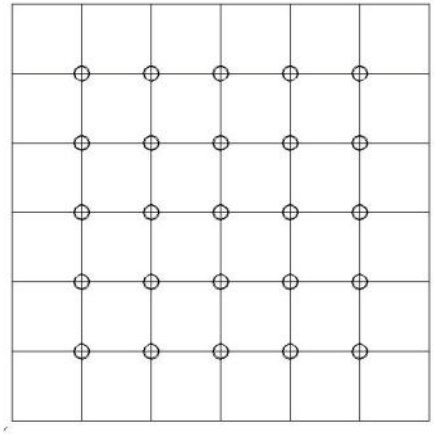
Wiring of LED's.



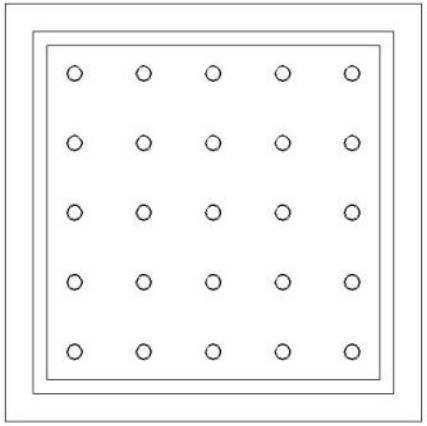
Pattern when LED's are at different heights

Pattern when LED's are at same heights

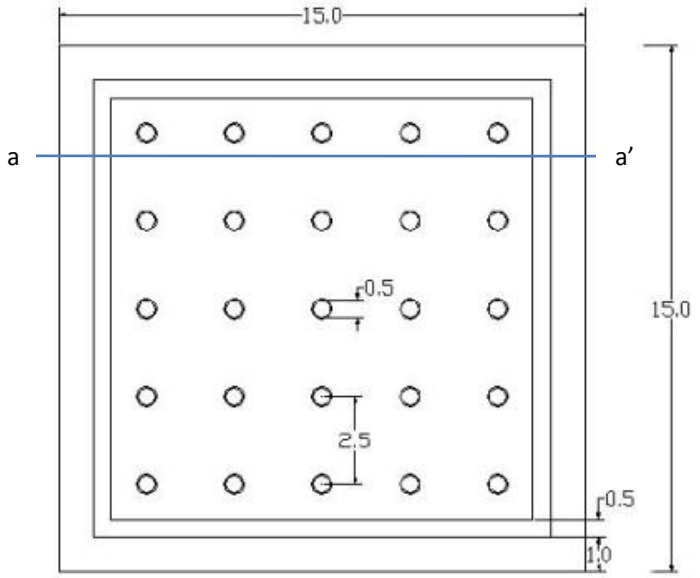
Floor light



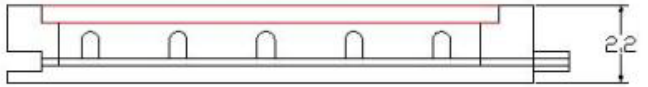
Plan showing placements of Led's



Plan showing frame

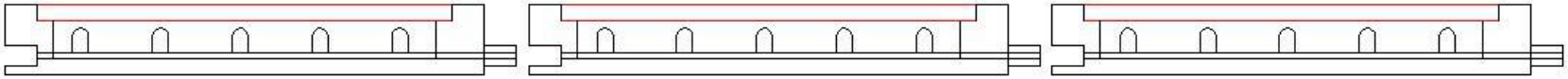


Plan



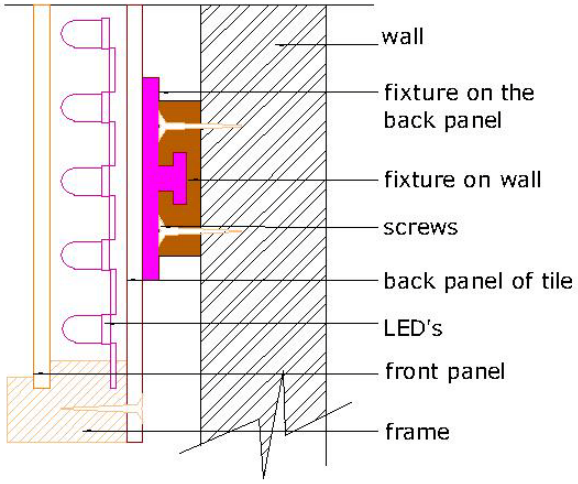
Section at aa'

Modular connections:

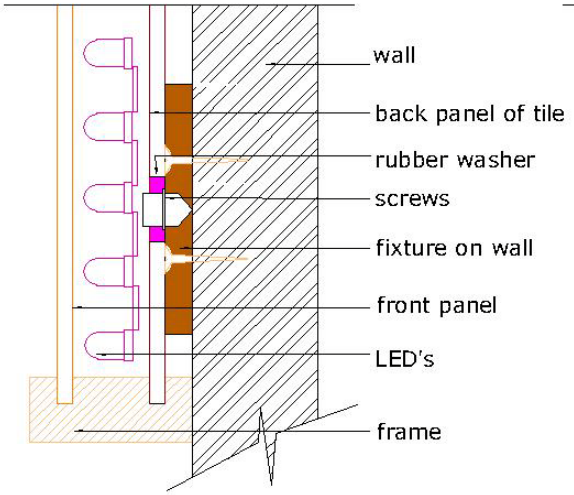


Fixing details:

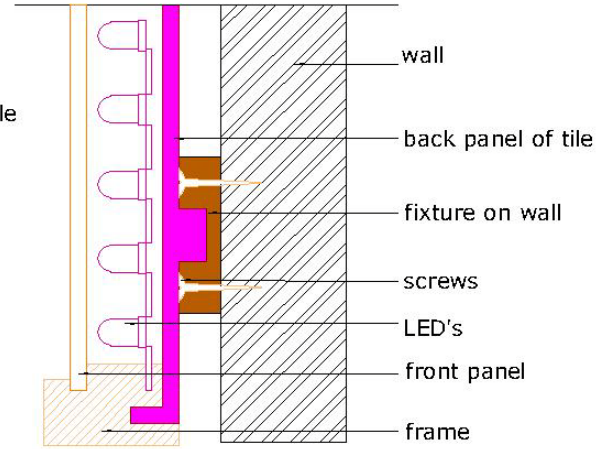
Various details for mounting the tiles on wall.



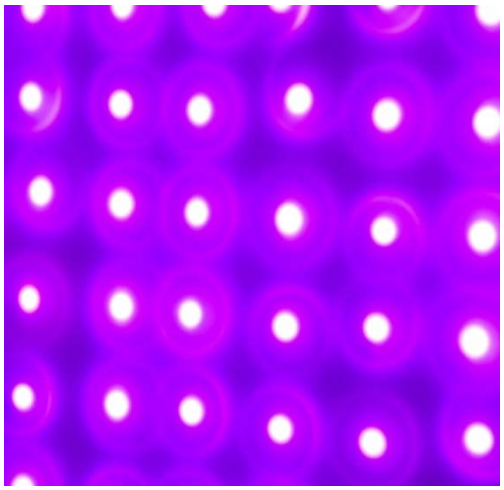
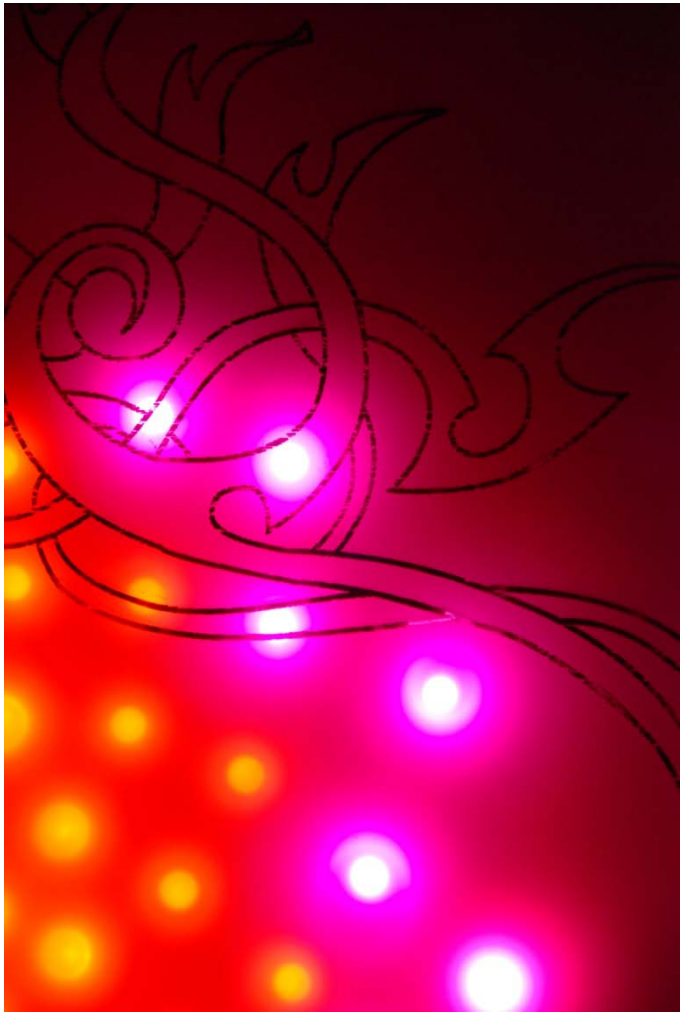
mounting based on sliding mechanism.

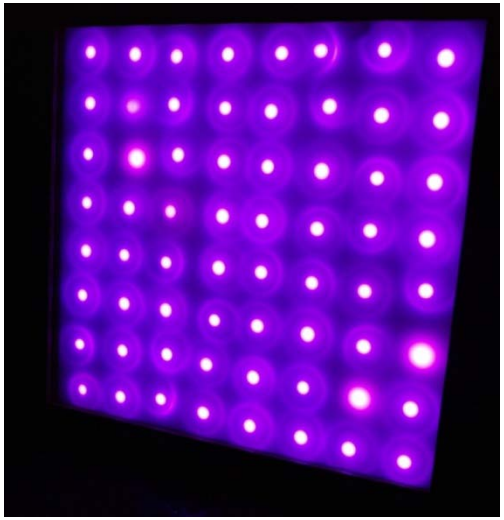


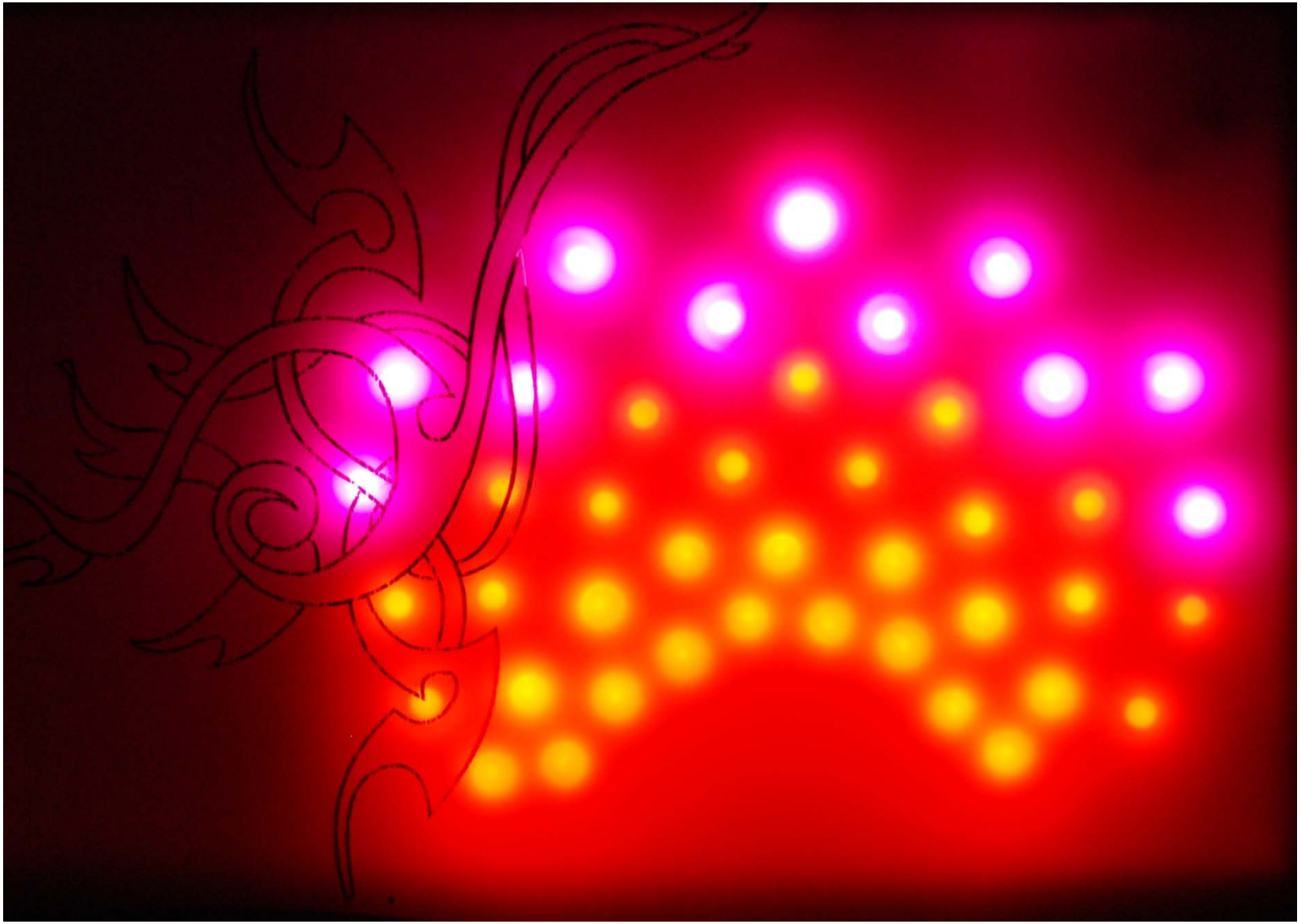
mounting based on screwing



mounting based on sliding mechanism.

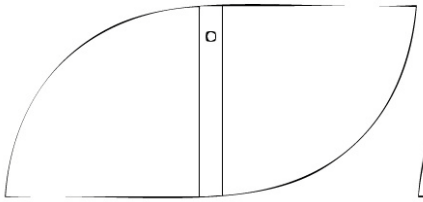




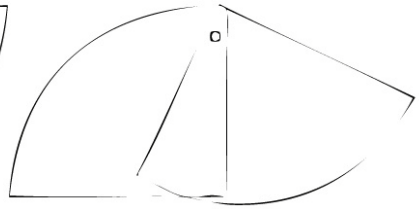
Concept 2:

Desk lamp:

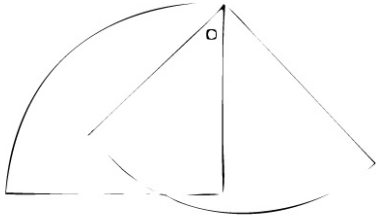
This lamp is for individual use. It can be installed or kept on a table. Main use of this lamp is for reading, wring, typing etc.



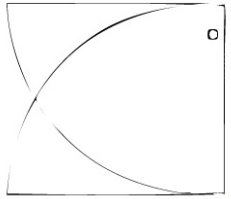
When flap is open



When flap is partially closed

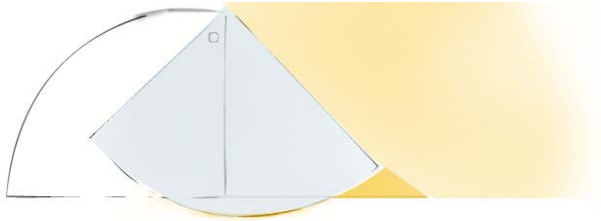


When flap partially open

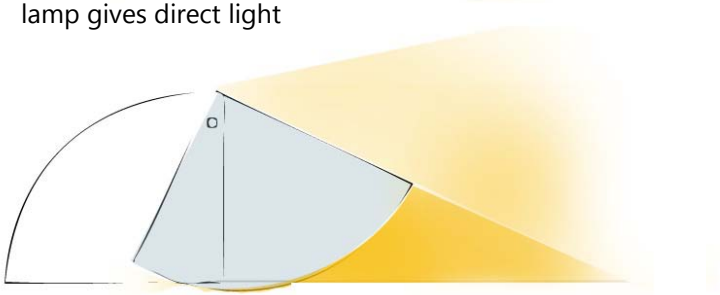


When flap is closed

1. When flap is open
lamp gives direct light

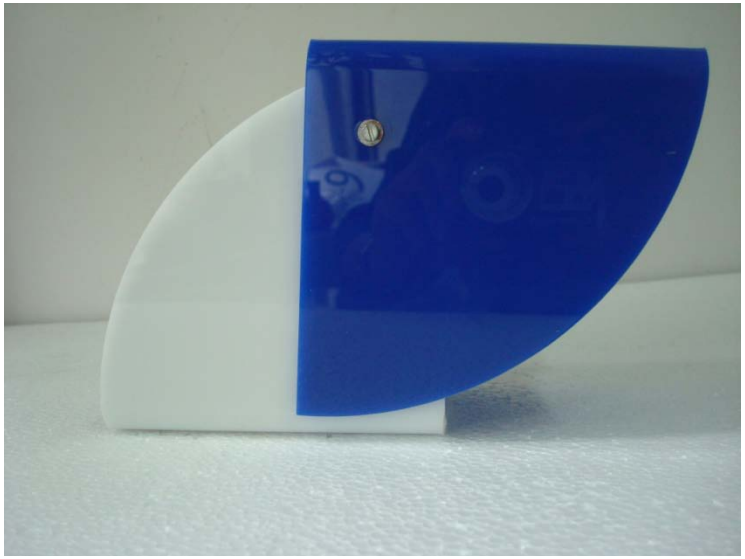


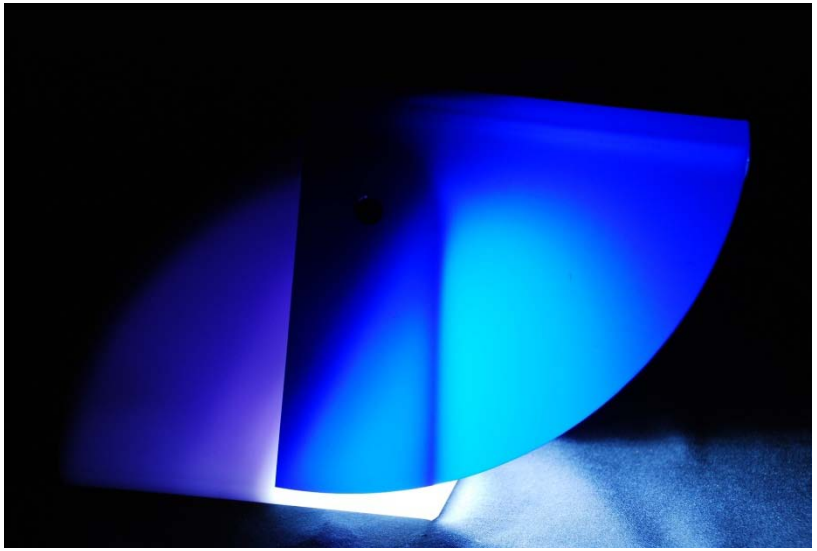
3. When flap partially open lamp gives
less direct light and more diffused light

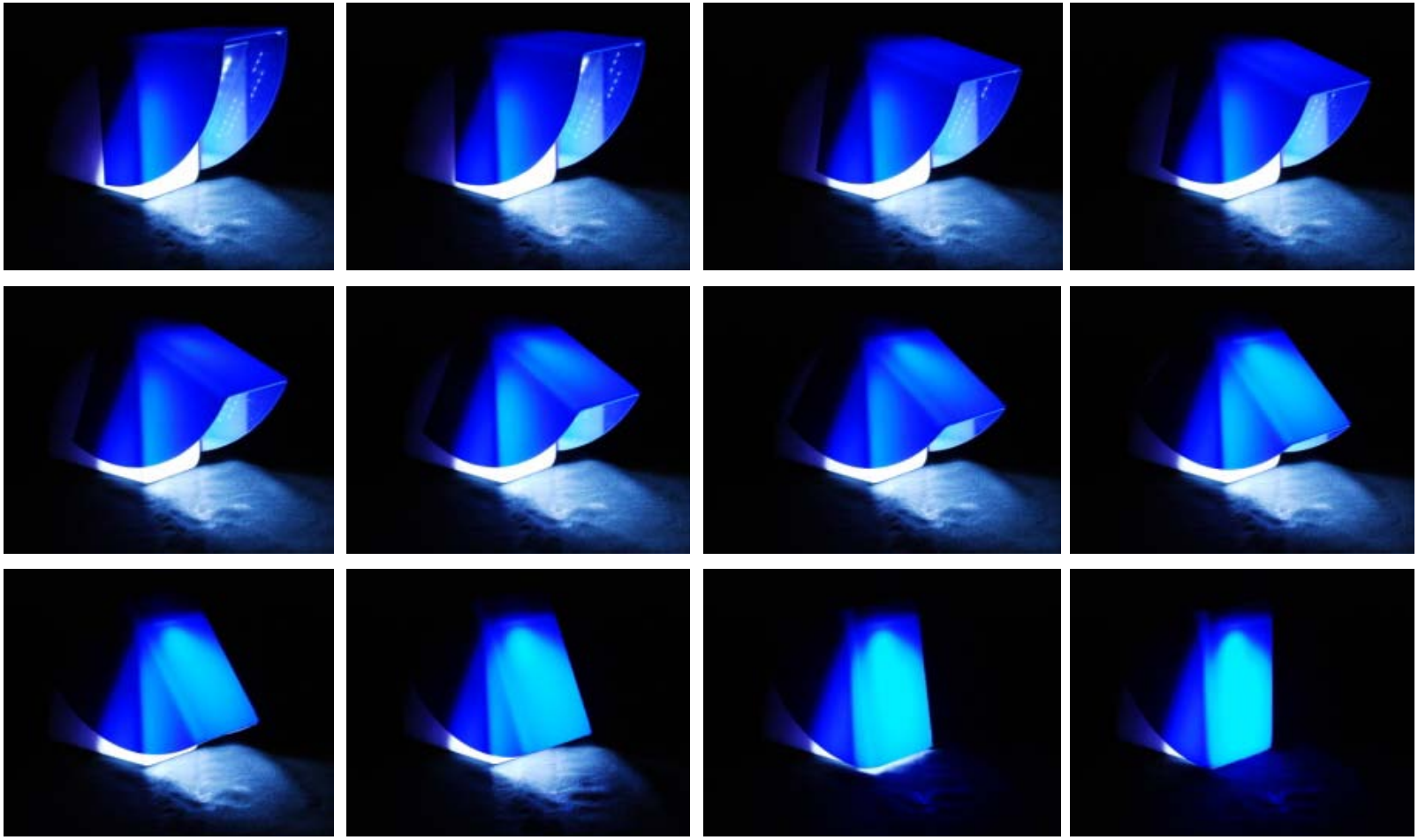


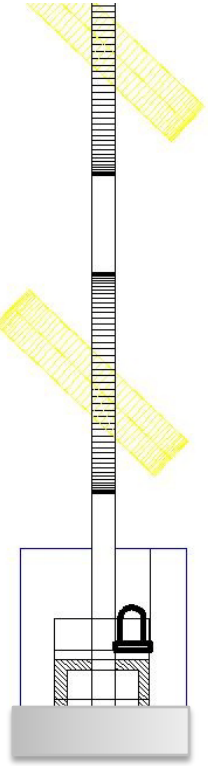
2.When flap is partially closed lamp gives
more direct light than diffused light

4. When flap is closed
lamp gives diffused light







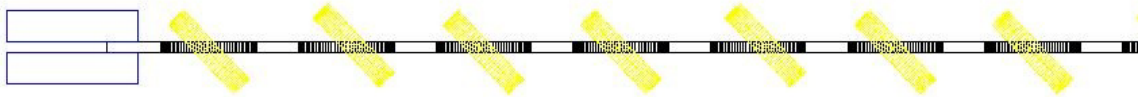


Section showing LED details

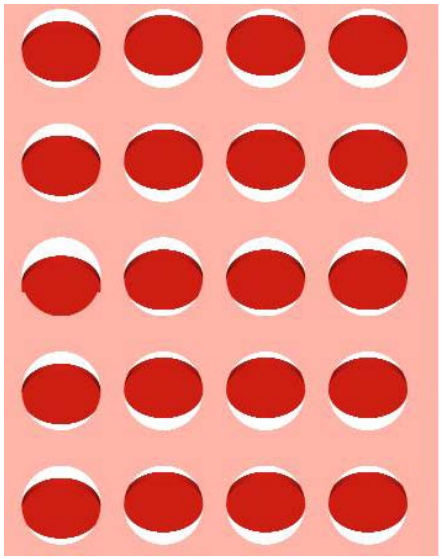
Concept 3:

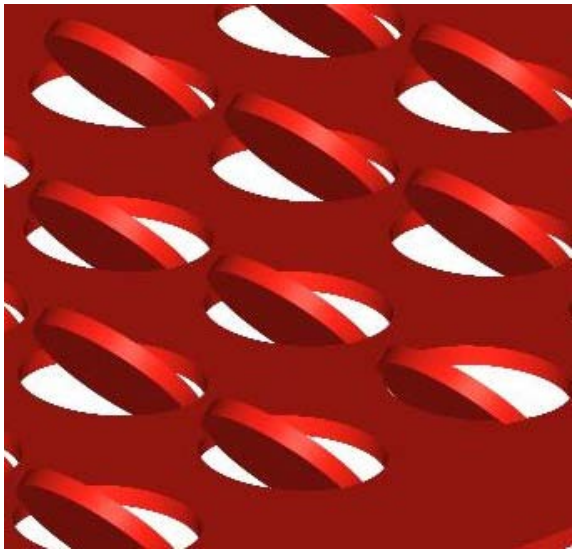
Partition panel :

This concept was about making shadow patterns on wall. Each LED in a circuit emits light so each LED is a light source, if we put multiple reflectors around, it will result into making patterns on wall.

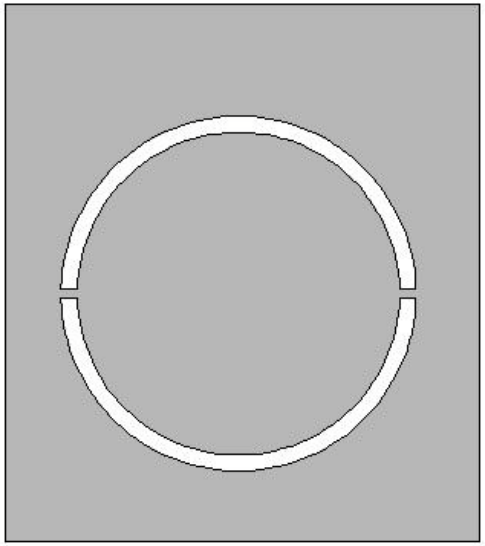


Section showing bending details

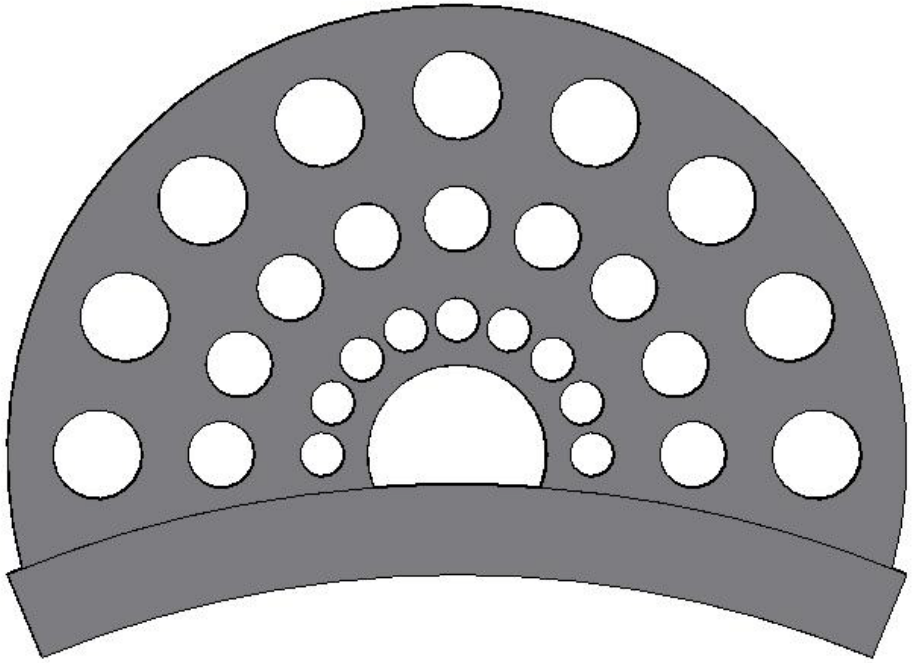


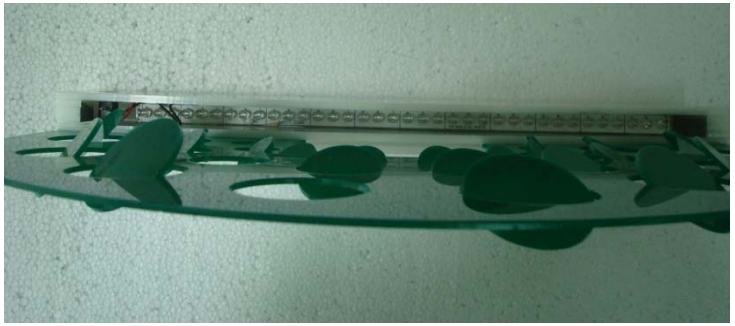


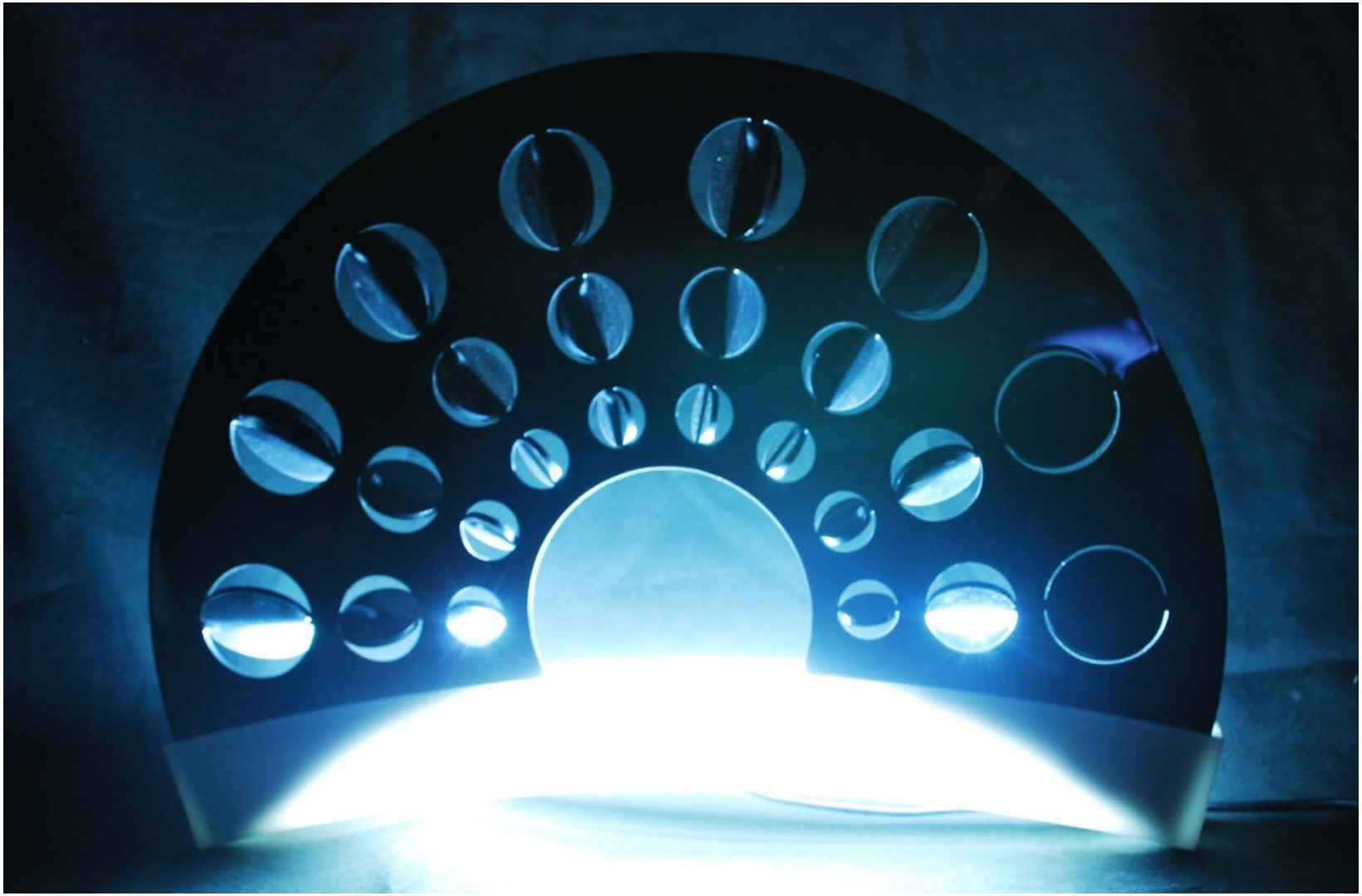
Acrylic bending



Detail of circular cuttings.







12. References:

12. References:

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Ref 1 -Fig 4.5 -1: *info@LightEmittingDiodes.org*

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Referred book: