

Design of Door Handle

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In

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CERTIFICATE

This is to certify that the thesis entitled “**Design of door handle**” is submitted by **Alok Ranjan Bairagi** (Roll No. 110ID0543) and **Vishal** (Roll No. 110ID0547) in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Industrial Design at the National Institute of Technology, Rourkela is an authentic work carried out by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

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Date-

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ABSTRACT

Doors are the most essential hardware used by human beings daily. Doors are used for sense of security to ourselves. To operate the door we need door handle and it's the most important part in door. Door handles are used for opening and closing of a door with minimum effort. Various types of door handles such as lever handle, doorknob and pull handles are the different kind of handles we came across in our day to day life. There are various designs of door handles are available so that we are unaware of door handles selection criteria. Different shapes can be designed on the basis of user reaction to the available door handle. How we operate on the door handle is one key factor for selection of door handle. There are various other factors associate with door handle such as style, comfort, cost etc. It's not just a device used for opening and closing of door but also for locking purpose. Door handles are divided on the basis of different types of door, finishes, and shapes.

Key words: *lever handle, pull handle, door knob, design, shape, finish, ease of use, comfort, style.*

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LIST OF ABBREVIATIONS USED

HTA- Hierarchical task analysis

Y- Yes

FG- Full gold

SS- Satin silver

SG- Silver gold

P- Patina

FC- Full chrome

SC- Silver chrome

BN- Black nickel

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CHAPTER 1

INTRODUCTION

Door handles are the only hardware used for opening and closing of doors. Doors are used by every individual and for its functionality door handles are used. Doors are used for security purposes of our belongings. There are many kinds of doors like passage, closet, dummy doors etc. similarly there are various kinds of door handles used for variety of doors and their functionality. Door handles are installed on doors to simply open and close the door with minimum effort. Sometimes door handles are equipped with locks for better sense of security and safety. Lockless door handles are also available in the market. In this project we have classified door handles into three categories such as (i) pull handles (ii) door knobs and (iii) lever handles.

1.1. Background:

In 1878 Osbourn Dorsey patented the doorknob for improvement on opening and closing of doors. Earlier the doorknob has a spindle running through it. Knob pulls the cylinder in the direction of the turn then a latch at the end of the cylinder then inserted into a hole present on the door frame. A spring mechanism is used to bring back the latch to its initial position when the doorknob is not in use. Earlier escutcheon plates were used for keyhole covers. Back plate was used to mount the doorknob [1].

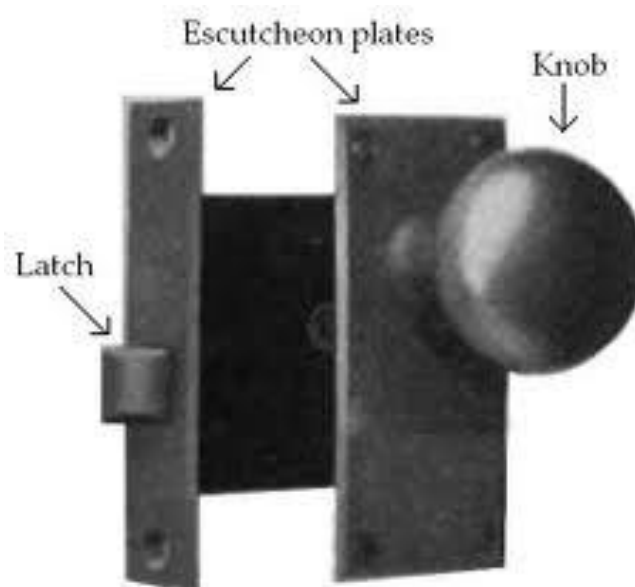


Fig.1.1 Basic parts of a doorknob [1]

1.2. Categorisation of door handles:

In this project we have categorised door handles into three categories such as

- Door levers
- Doorknobs
- Pull handles

1.2.1. Lever handles:



Fig.1.2 lever handle [2]

Further lever handles are categorised into the following categories.

Keyed entrance door levers:

These lever handles are generally used on the exterior doors with an additional locking option. The users need to have a key to disengage the latch from the hole and to open the door. Apart from the keyed hole mechanism another type of button is used in keyed door levers; it's called the panic button. From inside you can press the button and there is no need to use key to lock the door.

Passage and closet door levers:

There is no need of locking mechanism in passage door levers. Generally used in passage door and closet doors. These door lever can be used in the entrance door by using a deadbolt on the door.

Privacy door levers:

Used in bedroom and bath room doors. They do not require any key or any keyed hole but locking is required so simply a turn button is used to lock the doors.

Single or dummy door levers:

Dummy door levers are mounted on the door surface and they do not require any latch mechanism.

1.2.2. Pull handles:



Fig.1.3 Pull handle [3]

Pull handles are the most commonly used door handle used in our society. We need grip to hold the pull handle and exert force to shorten the distance between hand and our corresponding shoulder. There are various kind of pull handles available such as: drawer pull handles, automobile handle. These are categorised as the horizontal pull handles because we are pulling the door horizontally.

1.2.3. Doorknobs:



Fig.1.4 Doorknob [4]

Doorknob is another kind of handle used for many century. At first it was invented and patented by an American during the mid-nineties. Earlier doorknobs were a simple spherical ball shaped which was difficult for grip and not handy but later on various shapes of doorknobs came into existence. Very common shapes of doorknobs are oval or egg shaped which is easy for grip and feel is good. Materials like ceramic, brass, wood, plastic, glass and different types of material are used in the production of doorknobs.

1.3. Problem statement:

There are more than thousand door handles are available in the market. There are various categories of door handles are available. People always try to choose the best design of door handles but many are unable to do that. The main aim of this project is to design a suitable door handle which is user friendly and stylish. There are various parameters to be considered while designing the door handle. Importantly defining the various types of door handles their specifications, functionality and their looks.

People face difficulty while using a door handle like the sharp edges of the door handle, flashy colour of the handle, texture, grip force etc. these problems regarding the use of door handle are to be considered while designing door handle. Some of the available design in the market may have some ambiguity and may cause injury to human beings.

1.4. Objective:

Based on the problem identified the full objectives were framed for this research

1. To study different varieties of door handles available.
2. To categorise door handles based on their shapes, finishes and feel.
3. To understand users preferences for door handle.
4. To identify and implement design parameters determined by users.
5. To design a suitable door handle which is user oriented.

CHAPTER 2

LITERATURE REVIEW

Based on the study we received literatures on different topics. Literature review is an important phenomena for any research project. We gain different ideas and a very broad way of thinking about the project by reviewing numerous topics. The search for literature includes various websites, journals and books.

2.1. Door function & classification:

According to oxford English dictionary a door is a movable barrier of wood or other material, consisting either of one piece or of several pieces framed together, usually turning on hinges or sliding in a groove and serving to close or open a passage into a building, room etc.[5].

Door classification by human operating function:

1. Force normal to door: push/pull of hinged doors.
2. Force horizontal in plane of door: sliding or folding doors
3. Force vertical in plane of doors: lifting doors.

2.1.1. HTA use of hinged door:

	Task description	Task analysis
4.1 Operate locking device	Use key, ID card, or keypad to unlock door	Are devices visible to operator? Can these devices be operated when people's hands are not sufficiently agile?
4.2 Operate operating device	Remove knob, push crash bar, etc. to move latch	Do these devices let people know how to use them easily? Can these devices be operated when people's hands are not sufficiently agile?
4.3 Push door or pull interface	4.3.1 Push door with hand	Can people push door easily with any part of their body (heavy door or large torque)?
	4.3.2 Push door with foot	Do people cause any damage when they push, kick door (such as letting door hit people coming from other side or damaging door)?
	4.3.3 Push door with shoulder, hips, etc.	
4.4 Keep door in open position (if door will return automatically)	Use hand, shoulder, body, etc. to support door and keep it in open situation until whole body passes through door.	Is door too heavy (or has too much torque) to support?
4.5 Close door	Move door closed to its original state.	Will door hit other people who will pass through the doorway immediately after?

Fig.2.1 HTA analysis of hinged door [6]

2.2. Effects of door and user characteristics:

Necessary force is needed to exert for opening or closing of a door so force and force production capability is an important factor to be considered while designing a door handle. Generally male users are stronger than female users so the upper body weight exerted by male will be less than female user. Gender and stature are the two key factors determining the arm force required for an operation of a door [6].

2.3. Types of grips:

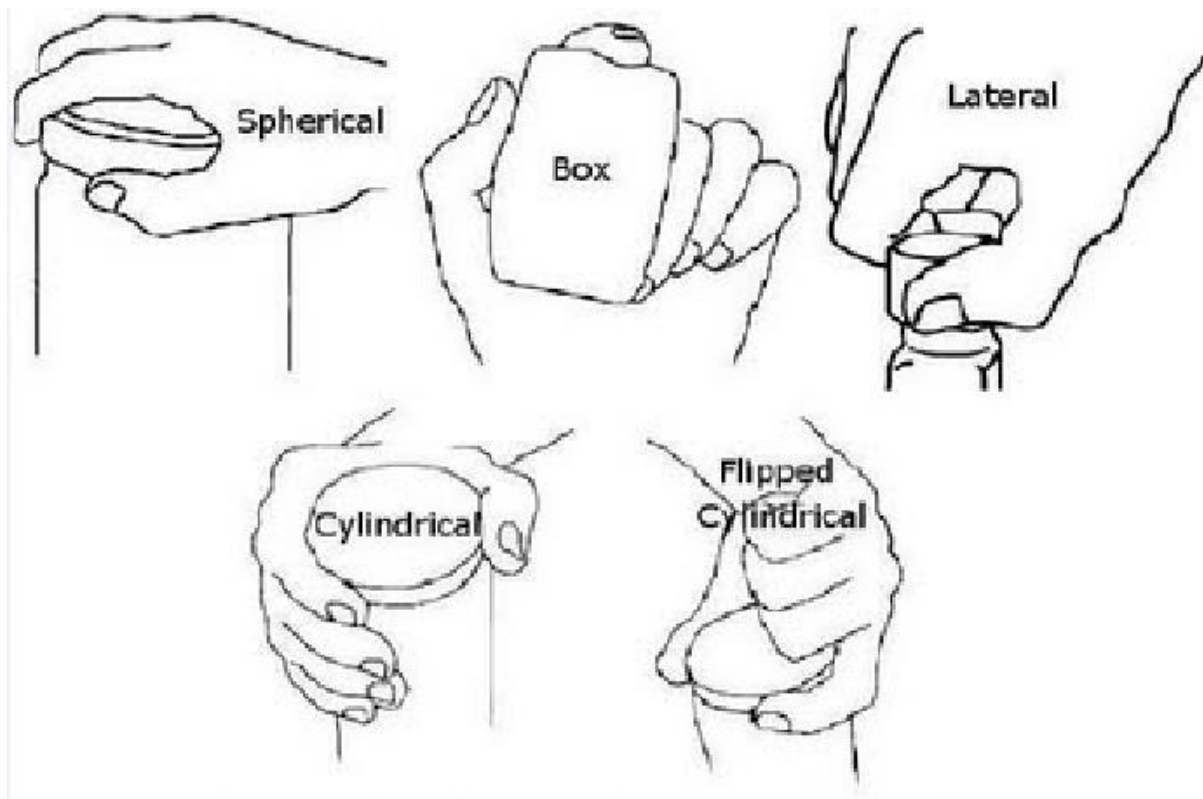


Fig.2.2 Types of grips [7]

Cylindrical: all the fingers are curled around the object and at right angle to the forearm and the thumb is wrapped around the object.

Spherical: all the fingers are wrapped around the object including thumb; it's more like cylindrical grip but here the fingers are more spread.

2.4. Product personality:

It's defined as a person's dynamic & organised set of non-physical characteristics that influences their cognition and behaviour in different situations (Ryckman, 2004) [8]. Personality is a very important phenomena while choosing a product it's similar to the human characteristics too. Product personality is the first characteristic of a designed product that came to our mind while watching it. Simply it's the view of a person about the product. Brand personality can be assessed by various adjectives used for determining the traits of the product in the design phase.

2.4.1. Designing product personality:

Product personality is not widely used. Govers et al (2004) [8] study reflects that he gave students to test two kinds of software. First of all they have to give them traits and then asses them accordingly. Similarly various study on products are done for example for a product they set three kinds of moods to describe the product such as happy, cute and tough. Based on the

traits they will design the better outcome of the personality or work more on the poor trait of the product. Another example of product personality is shown in table below.

Interaction dimension	Dominant interaction	Elegant interaction
Force	Heavy Energetic Rigid (requires strength)	Light Energetic Easy
Sound	Loud Fragmented Discordant	Soft Harmonious Clear
Motion	Slow Bumpy Firm	Extended Smooth Supple
Texture	Rough Irregular Solid	Fluid Refined Flexible
Performance	Restrictive Complicated Irregular	Balanced Graceful Accessible

Table 1. Subjective product attributes involved in interaction behaviour [8]

2.4.2. Selecting personality traits:

Its aim is to find the personality traits for describing the physical human interaction and selecting few of them to be used for design. The personality traits will be used as a reference. Example: cute, pretty, easy going, tough, provocative, cheerful, serious, boring, aloof etc. so an individual task is to be performed to sensitize users for personality in interaction. Participants are provided with various products and were asked to describe how they feel about the object in detail [8].

CHAPTER 3

METHODOLOGY

On the basis of our objective and the literature we have studied we planned on collecting different product sample and categorise them in our own terms and define a set of parameters based on the surveys conducted by us. Arithmetic analysis to be done to determine user preference. Based on the top results obtained conceptualise new design for door handles.

3.1. Case study of door handles:

Different types of door handles (lever, doorknob, pull handle) are used to illustrate the practical applications. It includes the following

- Selecting product domain
- Sample collection.
- Defining attributes.
- Adjective list for product personality.
- Questionnaires.
- Analysis.

3.1.1. Selecting product domain:

It includes definition of product type and market segment. Choosing a domain includes target groups, market research and specification of product. Based on market research product samples are collected and characteristics represent domain. The domain includes existing product and design concept.

3.1.2. Sample collection and screening:

Door handle samples marketed in India both Indian and foreign brands are collected using catalogues collected from internet.

List of foreign brands:

- HAGER
- NOVA
- SCHLAGE
- AMEROCK
- BALDWIN
- GRANDEUR
- EMTEK
- OMNIA
- WEISER
- WESLOCK
- INOX
- LINNEA
- NOVA
- KWIKSET

List of Indian brands:

- LINK
- DORSET
- KICH
- SANVI
- VICTOR
- EUROSET
- BALAJI DOOR HANDLE

3.2. Door knob market research (*refer Appendix-I*):

3.2.1. Finish wise classification of doorknobs:

Sl	Available finishes	Brands
01.	Polished chrome	Baldwin reserve ellipse knob, reserve round, reserve traditional knob, kwikset signature series circa, kwikset signature series hancock, kwikset signature series laurel, kwikset signature series copa, kwikset tylo, kwikset polo, Omnia S-432, Omnia S-442, Omnia S-137, Omnia S-198, Omnia S-405, Omnia S-415, Omnia S-426, Omnia S-430, Omnia S-433, Omnia S-441, Omnia S-443, Omnia S-472, Omnia S-473, Omnia S-723, Omnia S-860, Omnia S-970, sure-loc durango
02.	Matte antique nickel	Baldwin reserve ellipse knob, reserve round, reserve traditional knob
03.	Satin nickel	Baldwin reserve ellipse knob, reserve round, reserve traditional knob, Grandeur Chambord doorknob, versailles, hyde park, windsor, parthenon, grand victorian, fifth avenue, eden pririe, chambord, versailles, fontainbleau, kwikset signature series circa, kwikset signature series hancock, kwikset signature series laurel, kwikset signature series junno, kwikset signature series phoenix, kwikset signature series copa, kwikset signature series cameron, kwikset polo, kwikset cove, Omnia S-432, Omnia S-442, Omnia S-232, Omnia S-260, Omnia S-430, Omnia S-433, Omnia S-443, Omnia S-472, Omnia S-473, Omnia S-860, Omnia S-970, Schlage andover, Schlage bell, Schlage georgian, Schlage F-51 plymouth, Schlage orbit, Schlage siena, sure-loc Arapaho egg shaped, sure-loc durango, sure-loc canyon, Weiser phoenix, Weiser laurel, Weiser huntington, Weiser troy
04.	Venetian bronze	Baldwin reserve ellipse knob, reserve round, reserve traditional knob, kwikset signature series circa, kwikset signature series hancock, kwikset signature series laurel, kwikset signature series junno, kwikset signature series phoenix, kwikset signature series cameron, kwikset polo, kwikset cove, Weiser phoenix, Weiser laurel, Weiser troy
05.	Matte brass and black	Baldwin reserve ellipse knob, reserve round, reserve traditional knob, Schlage georgian, Schlage F-51 plymouth, Weiser troy

06.	Polished brass	Baldwin reserve ellipse knob, reserve round, reserve traditional knob, Grandeur Chambord doorknob, versailles, hyde park, windsor, parthenon, grand victorian, fifth avenue, eden pririe, chambord, versailles, fontainbleau, kwikset signature series circa, kwikset signature series hancock, kwikset signature series junos, kwikset signature series phoenix, kwikset signature series copa, kwikset signature series Cameron, kwikset tylo, kwikset polo, kwikset cove, Omnia S-432, Omnia S-442, Omnia S-59, Omnia S-137, Omnia S-198, Omnia S-232, Omnia S-260, Omnia S-294, Omnia S-405, Omnia S-415, Omnia S-417, Omnia S-426, Omnia S-430, Omnia S-433, Omnia S-440, Omnia S-441, Omnia S-443, Omnia S-472, Omnia S-473, Omnia S-723, Omnia S-860, Omnia S-970, sure-loc tahoe, Weiser phoenix, Weiser huntington, Weiser troy
07.	Dark bronze	Baldwin reserve rustic knob
08.	White bronze	Baldwin reserve rustic knob
09.	Antique pewter	Grandeur Chambord doorknob, Versailles, hyde park, Windsor, Parthenon, grand Victorian, fifth avenue, eden pririe, Chambord, Versailles, fontainbleau, Schlage andover, Schlage georgian, Schlage F-51 plymouth, Schlage orbit, Schlage siena
10.	Timeless bronze	Grandeur Chambord doorknob, versailles, hyde park, windsor, parthenon, grand victorian, fifth avenue, eden pririe, chambord, versailles, fontainbleau
11.	Vintage brass	Grandeur Chambord doorknob, versailles, hyde park, windsor, parthenon, grand victorian, fifth avenue, eden pririe, chambord, versailles, fontainbleau, Omnia S-442, Omnia S-405, Omnia S-860
12.	Bright chrome	Grandeur Chambord doorknob, versailles, hyde park, fifth avenue, eden pririe, chambord, versailles, fontainbleau
13.	Antique nickel	kwikset signature series circa, kwikset signature series hancock, kwikset signature series laurel, kwikset signature series copa, kwikset polo, sure-loc tahoe, sure-loc Arapaho egg shaped, sure-loc durango, Weiser phoenix, Weiser troy
14.	Satin chrome	kwikset signature series circa, kwikset signature series hancock, kwikset signature series phoenix, kwikset signature series copa, kwikset tylo, kwikset polo, kwikset cove, Omnia S-432, Omnia S-442, Omnia S-198, Omnia S-415, Omnia S-430, Schlage andover, Schlage bell, Schlage F-51 plymouth, Schlage orbit, Weiser laurel, Weiser huntington, Weiser troy
15.	Antique brass	kwikset signature series circa, kwikset signature series hancock, kwikset signature series junos, kwikset signature series phoenix, kwikset signature series copa, kwikset tylo, kwikset polo, kwikset cove, Omnia S-232, Schlage andover, Schlage bell, Schlage georgian, Schlage orbit,

		Schlage siena, Weiser phoenix, Weiser huntington, Weiser troy
16.	Iron black	kwikset signature series hancock, kwikset signature series laurel
17.	Rustic pewter	kwikset signature series hancock
18.	Rustic bronze	kwikset signature series hancock
19.	Shaded bronze	Omnia S-432, Omnia S-442, Omnia S-59, Omnia S-232, Omnia S-260, Omnia S-294, Omnia S-405, Omnia S-417, Omnia S-430, Omnia S-433, Omnia S-440, Omnia S-441, Omnia S-860
20.	Antique bronze	Omnia S-432, Omnia S-442, Omnia S-430, Omnia S-443, Omnia S-472, Omnia S-970
21.	Oil rubbed bronze	Omnia S-432, Omnia S-442, Omnia S-430, Omnia S-443, Omnia S-472, Omnia S-473, Omnia S-860, Omnia S-970, Schlage andover, Schlage F-51 plymouth, Schlage orbit, Schlage siena, sure-loc tahoe, sure-loc Arapaho egg shaped, sure-loc durango
22.	Polished nickel	Omnia S-432, Omnia S-442, Omnia S-260, Omnia S-430, Omnia S-443, Omnia S-472, Omnia S-473, Omnia S-970
23.	Max brass	Omnia S-432, Omnia S-260
24.	Max steel	Omnia S-432, Omnia S-442
25.	Satin brass	Omnia S-442, Omnia S-860
26.	Vintage copper	Omnia S-442, Omnia S-405, Omnia S-860
27.	Vintage iron	Omnia S-442, Omnia S-405, Omnia S-860
28.	Bright brass	Schlage andover
29.	Bright chrome	Schlage andover, Schlage georgian, Schlage orbit, Schlage siena
30.	Aged bronze	Schlage andover, Schlage georgian, Schlage siena, sure-loc Arapaho egg shaped, sure-loc durango, sure-loc canyon
31.	Bright brass	Schlage bell, Schlage georgian, Schlage F-51 plymouth, Schlage orbit, Schlage siena
32.	Satin stainless	Sure-loc tahoe
33.	Flat black	Sure-loc Arapaho egg shaped

Table 2. Finish wise classification of doorknobs

From the above categorisation it is understood that there are 33 different finishes are available for doorknob. This categorisation showed that many polished brass, satin chrome, satin nickel, polished chrome are the most common types of finishes available in the market. Popularity of such finishes shows the designed product should have either polished chrome, satin nickel, satin chrome or polished brass material finish.

Above table clearly narrowed down the finishes for doorknobs are

- Polished brass
- Polished chrome
- Satin nickel
- Satin chrome

3.2.2. Classification of doorknobs based on different shapes:

We have divided various brands of doorknobs into a few different shapes such as

- Round
- Egg shaped
- Circular-flat
- Square
- Bell

Brands	Round	Egg shaped	Flat circular	Square	Bell
Baldwin	Estate series 5000, Baldwin estate 5041	Baldwin reserve series ellipse, estate 5024, estate 5025, estate 5031, 5057, 5060, prestige series carnaby	Reserve round, series traditional, rustic knob, estate 5005, 5013, 5015, 5020, 5023, 5030, 5045, 5050, 5055, 5064, 5065, 5066, 5067, 5068, 5069, k001, k002, k003,k004, k005, prestige alcot	Estate 5011	Estate 5063, 5073, 5061s
Schlage	Plymouth F51, Orbit F51,	Siena, siena F51	Andover, andover F51, Georgian F51		Bell F51, bell
Sure-loc	Tahoe, durango	Arapaho, canyon solid, slick rock			Tulip
Weiser	Hunnington	Laurel	Troy		Phoenix
Weslock	Ball knobs, Hudson, barrington	Brandenn, julienne	Impressa, salem, savannah		Tulip, sonic, eleganti
Sanvi	All	All	All	All	All
Kich	All	All	All	All	All

Table 3. Shape wise classification of doorknobs

3.3. Lever handles market research (refer Appendix-II)

3.3.1. Finish wise classification:

Sl.	Available finishes	Brands
01.	Oil rubbed bronze	Sure-loc cedar, Sure-loc snowbird, Sure-loc helena, Sure-loc topaz, Sure-loc sandstone, Schlage accent, Schlage avanti, Schlage callington, Schlage champagne, Schlage st. anees, Baldwin soho, Baldwin wave Omnia solid brass S-171, Omnia solid brass S-226, Omnia solid brass S-227, Omnia solid brass S-237, Omnia solid brass S-368, Omnia solid brass S-914, Omnia solid brass S-220, Omnia solid brass S-225, Omnia solid brass S-236, Omnia solid brass S-281, Omnia solid brass S-282
02.	Satin nickel	Sure-loc cedar, Sure-loc snowbird, Sure-loc helena, Sure-loc topaz, Sure-loc basel, Schlage jazz, Schlage accent, Schlage avanti, Schlage callington, Schlage champagne, Schlage merino, Schlage st. anees, Schlage lattitude, Schlage birmingham, Baldwin soho, Baldwin reserve series curve, Baldwin reserve series decorative, Baldwin reserve series federal, Baldwin reserve series square, Baldwin reserve series tube, Baldwin wave Omnia solid brass S-171, Omnia solid brass S-226, Omnia solid brass S-227, Omnia solid brass S-237, Omnia solid brass S-368, Omnia solid brass S-914, Omnia solid brass S-916, Omnia solid brass S-220, Omnia solid brass S-225, Omnia solid brass S-236, Omnia solid brass S-251, Omnia solid brass S-281, Omnia solid brass S-282, Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke, Kwikset signature series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset balboa, Kwikset katara, Kwikset vedani, Kwikset halifax, Kwikset milan, Grandeur bellagio, Grandeur georgetown, Weiser toluca, Weiser galiano
03.	Antique nickel	Sure-loc cedar, Sure-loc snowbird, Sure-loc helena, Baldwin soho, Baldwin wave, Kwikset signature series brooklane, Kwikset signature series pembroke, Kwikset signature series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset signature series delta, Kwikset signature series dorian, Weiser toluca
04.	Polished bronze	Sure-loc cedar
05.	Vintage bronze	Sure-loc snowbird, Sure-loc helena, Sure-loc topaz, Sure-loc basel, Grandeur bellagio
06.	Polished brass	Sure-loc Helena, Baldwin soho, Baldwin reserve series curve, Baldwin reserve series decorative, Baldwin reserve series federal, Baldwin wave, Omnia solid brass S-368, Omnia solid brass S-231, Omnia solid brass S-233, Omnia solid brass S-235, Omnia solid brass S-251, Omnia solid brass S-252, Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series pembroke, Kwikset signature

		series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset signature series dorian, Kwikset signature series delta, Kwikset balboa, Grandeur bellagio, Grandeur georgetown, Weiser danen, Weiser toluca, Weiser galiano
07.	Flat black	Sure-loc topaz
08.	Distressed nickel	Sure-loc topaz
09.	Lifetime Polished chrome	Sure-loc basel, Baldwin reserve series decorative, Baldwin reserve series federal, Baldwin wave, Omnia solid brass S-226, Omnia solid brass S-237, Omnia solid brass S-368, Omnia solid brass S-914
10.	Satin stainless steel	Sure-loc Juneau, Sure-loc torino
11.	Polished chrome	Sure-loc juneau, Sure-loc torino, Baldwin soho, Baldwin reserve series curve, Baldwin reserve series square, Baldwin reserve series tube, Omnia solid brass S-171, Omnia solid brass S-227, Omnia solid brass S-916, Omnia solid brass S-220, Omnia solid brass S-225, Omnia solid brass S-236, Omnia solid brass S-281, Omnia solid brass S-282, Omnia solid brass S-362, Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series tustin, Kwikset signature series delta, Kwikset signature series delta, Kwikset signature series dorian
12.	Bright brass	Schlage elan, Schlage jazz, Schlage accent, Schlage accent, Schlage avanti, Schlage callington, Schlage champagne, Schlage st. anees
13.	Antique brass	Schlage elan, Schlage jazz, Schlage avanti, Schlage callington, Schlage champagne, Schlage st. anees, Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke, Kwikset signature series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset signature series delta, Kwikset signature series dorian, Kwikset balboa, Weiser toluca
14.	Bright chrome	Schlage elan, Schlage accent, Schlage avanti, Schlage callington, Schlage champagne, Schlage merino, Schlage st. anees, Schlage lattitude, Schlage birmingham, Kwikset katara, Kwikset vedani, Kwikset halifax, Kwikset milan, Grandeur bellagio, Grandeur georgetown, Grandeur georgetown, Weiser toluca, Weiser galiano
15.	Satin chrome	Schlage elan, Schlage jazz, Schlage callington, Schlage champagne, Schlage merino, Schlage st. anees, Schlage lattitude, Baldwin soho, Baldwin wave Omnia solid brass S-171, Omnia solid brass S-226, Omnia solid brass S-227, Omnia solid brass S-237, Omnia solid brass S-368, Omnia solid brass S-914, Omnia solid brass S-916, Omnia solid brass S-220, Omnia solid brass S-225, Omnia solid brass S-236, Omnia solid brass S-281, Omnia solid brass S-282, Kwikset signature series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset signature series dorian, Kwikset katara, Kwikset vedani, Kwikset halifax, Kwikset milan, Weiser danen, Weiser toluca, Weiser galiano

16.	Antique pewter	Schlage accent, Schlage avanti, Schlage champagne, Schlage st. anees, Grandeur bellagio, Grandeur georgetown
17.	Aged bronze	Schlage accent, Schlage avantia, Schlage callington, Schlage champagne, Schlage merino, Schlage latitude, Schlage birmingham
18.	Matte black	Schlage callington, Schlage merino
19.	Satin brass	Baldwin soho
20.	Polished nickel	Baldwin soho, Baldwin wave, Omnia solid brass S-251
21.	Venetian bronze	Baldwin soho, Baldwin reserve series curve, Baldwin reserve series decorative, Baldwin reserve series federal, Baldwin reserve series square, Baldwin reserve series tube, Baldwin wave, Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke, Kwikset signature series tustin, Kwikset signature series lido, Kwikset signature series delta, Kwikset signature series dorian, Kwikset balboa, Kwikset katara, Kwikset vedani, Kwikset halifax, Kwikset milan, Weiser toluca, Weiser galiano
22.	Satin black	Baldwin soho, Baldwin wave
23.	Distressed oil rubbed bronze	Baldwin soho, Baldwin wave
24.	Distressed venetian bronze	Baldwin soho, Baldwin wave
25.	Dark bronze	Baldwin reserve series arch lever, Baldwin reserve series taper
26.	White bronze	Baldwin reserve series arch lever, Baldwin reserve series taper
27.	Matte antique nickel	Baldwin reserve series curve, Baldwin reserve series decorative, Baldwin reserve series federal
28.	Matte brass & black	Baldwin reserve series curve, Baldwin reserve series decorative, Baldwin reserve series federal
29.	Satin brass & black	Baldwin wave
30.	Shaded bronze	Omnia solid brass S-231, Omnia solid brass S-233, Omnia solid brass S-235, Omnia solid brass S-251, Omnia solid brass S-252
31.	Max brass	Omnia solid brass S-251
32.	Rustic bronze	Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke
33.	Rustic pewter	Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke
34.	Iron black	Kwikset signature series ashfield, Kwikset signature series avelon, Kwikset signature series brooklane, Kwikset signature series pembroke

Table 4. Finish wise classification of door levers

3.3.2. Shape based classification of door levers:

The available door levers are then classified into various shapes such as:

- Straight
- Wavy
- Bend
- Whistle

Brands	Straight	Wavy	Bend	Whistle
Sure-loc	Cedar, Helena, Basel, Juneau	Snowbird, Topaz, Sandstone	Oslo, Torino	
Schlage	Elan, Jazz, Lattitude modern lever, Birmingham	Accent, Avanti, Callington, St. Anees	Champagne	Merino
Baldwin	Soho, RS decorative, RS federal, RS square, RS taper, RS tube	RS arch, curve, wave		
Omnia	Style- 237, 368, 914, 916, 229, 231, 235, 252, 362	Style- 220,233,251, 282	Style- 226,225,236, 281	Solid brass style-171, 227
Kwikset	Ashfield, Delta, Dorian, Vedani, Helifax, Milan	Avalon, Brooklane, Pembroke, Tustin, Balboa	Lido, Katara	
Grandeur		Bellagio, Portofino		
Nova	Venus stainless, Saturn stainless, Granata	Curve stainless steel	Mars	

Table 5. Shape wise classification of door levers

3.4. Indian brands and their classification (refer Appendix-III):

Luxury segment:

Finishes								
Brands	FG	SS	SG	P	FC	SC	BN	Epl finish
Elika	Y	Y	Y	Y	Y			
Ora	Y	Y		Y		Y		
Marquis	Y	Y		Y		Y	Y	
Canary	Y	Y		Y		Y	Y	
Magica	Y	Y	Y	Y		Y	Y	
Sleek		Y						
Siena	Y	Y		Y		Y	Y	
Madona	Y	Y	Y	Y		Y		Y
Solo						Y		
Luxe		Y						

Table 6. Available finishes for Dorset luxury segment

Premium segment:

Brands	SS	FC	P	Epl finish	FG	SG	SC
Agata	Y	Y	Y				
Chaira	Y	Y	Y				
Esta	Y	Y	Y				
Volante	Y	Y	Y				
Messy	Y		Y	Y	Y	Y	Y
Elixer	Y		Y		Y	Y	Y
Sana	Y		Y	Y	Y	Y	Y
Opera	Y		Y	Y	Y	Y	Y
Mystique	Y		Y	Y	Y	Y	Y
Ebony	Y		Y		Y	Y	Y
Yona	Y		Y			Y	
Nika	Y		Y	Y	Y	Y	Y
Cameo	Y		Y	Y	Y	Y	Y
Orient	Y		Y	Y	Y	Y	Y
Madona	Y		Y	Y	Y	Y	Y
Olive	Y		Y	Y	Y	Y	Y
Dana	Y		Y	Y	Y	Y	Y
Diana	Y		Y	Y	Y	Y	Y
Irish	Y		Y	Y	Y	Y	Y
Juliet	Y	Y	Y	Y	Y	Y	Y
Vatika	Y		Y			Y	
Lamoree	Y		Y		Y	Y	Y
Mirage	Y		Y	Y	Y	Y	Y
Gala	Y		Y	Y	Y	Y	Y
Icon	Y		Y	Y	Y	Y	Y
Versa	Y		Y	Y	Y	Y	Y
Zenith	Y		Y	Y	Y	Y	Y
Agata	Y	Y	Y				

Edge	Y						Y
Luisa	Y						Y
Terza	Y						Y
Gemma	Y						Y
Oria	Y						Y
Grazia	Y						Y
Preorse	Y						Y
Aria	Y						
Elda	Y						Y
Calla							Y
Morphos							Y

Table 7. Available finishes for premium segment

Standard segment:

Brands	Satin silver (SS)	Silver chrome (SC)
Eden	Y	
Primo	Y	
Elmo	Y	
Fabio	Y	
Nero	Y	
D type	Y	
L type	Y	Y
SLP	Y	
U type	Y	
SEP	Y	
SO	Y	
Nika	Y	
C type	Y	

Table 8. Available finishes for standard segment

3.5. Survey 1

Engineering surveys are of prime importance while designing any product. Questionnaires are the main components the surveys which include different kinds of rating scale. Various parameters are obtained by this questionnaire survey. Users were asked various question by showing different door handle images and were rated accordingly. For the ease of determining parameters various adjective list were prepared for the users. The adjectives prepared for this survey are based on the emotion of the product for example what the user will feel about the product while seeing it and what does the design lack will be obtained from questionnaire survey.

3.5.1. Adjective list used for users:

Elegant	Poor
Creative	Ordinary
Traditional	Classic
Simple	Luxurious
Antique	Modern
Fragile	Durable
Graceful	Awkward
Harmonious	Imbalanced
Dynamic	Dull
Like	Dislike
Adorable	Despicable
Amiable	Crabby
Charming	Bad, unfriendly
Extensive	Exclusive, restricted
Gentle	Irritable
Lovely	Ugly
Stunning	Ugly
Burly	Tiny
Comfortable	Un-comfortable

Table 9. Adjective list

3.5.2. Questionnaire:

Users were shown various selected pictures of the door handles (pull handle and doorknob) and the above mentioned questions were asked and adjective list were used for ease of users to give rating. From the obtained rating statistical analysis was done and designs were narrowed down.

1. Name the parameters based on which you will purchase a door handle?
2. How many different kind of door handles have you used?
3. Cost/Design which is important factor for choosing a door handle?
4. Previous experience with door handles?
5. Have you faced any problem using door handles?

3.6. Survey 2 (Individual parameter rating):

From the above mentioned questionnaires we decided three important parameters for the rating of various door handles (pull handles, doorknobs) on the basis of form.

Parameters obtained from survey 1 are:

- Apparent ease of use (**A**)
- Apparent comfort (**B**)
- Style/ looks (**C**)

Users were shown different models of door handles and they have to give rating for each category of handles including doorknob and pull handles. Users have to give individual rating for A, B and C for each model. A total of thirty people were chosen for this survey and ratings were recorded accordingly. The rating scale was from 1-10.

Pull handles were categorised into 7 different categories namely

- Straight.
- Semi-circular.
- Circular.
- Square.
- Spline.
- Curvy.
- Boomerang.

Doorknobs were categorised into 7 different categories namely

- Round
- Egg-shaped
- Flat circular
- Square
- Conical
- Polygonal
- Cylindrical

3.7. Survey 3:

In this survey door handles are categorised on the basis of shapes as well as feel or texture. Three shapes were finalised for this survey and three texture attributes were taken into consideration. The shapes include straight, curvy and circular/ semi-circular for pull handles and for doorknobs round, egg shape and square were taken. For texture or feel sharp, soft and semi were taken.

- **Sharp:** door handle containing a few sharp edges. It may give a feel of roughness of door handle.
- **Soft:** door handle without any sharp edges. It's somewhat curvy in shape or it may actually fit in user's hand.
- **Semi:** It's a hybrid of both sharp and soft. Handle may contain both the parameters such as sharp edges on the front and soft curve in the back of a door handle.

Sample space for this survey was 30. Users gave their rating out of 10 which is an overall rating based on the looks, functionality, shape, grip, comfort, ease of use and many other parameter according to the user. Users were shown at least 4 pictures in each categories of door handles and asked to rate accordingly.

The resultant of categorisation of door handles on the basis of shape and feel gives the following:

Pull handles:

- Straight-sharp
- Straight-soft
- Straight-semi
- Curvy-sharp
- Curvy-soft
- Curvy-semi
- Circular/semi-circular

Doorknobs:

- Round-sharp
- Round-soft
- Circular-sharp
- Circular-soft
- Square-sharp
- Square-soft

CHAPTER 4

RESULTS AND DISCUSSION

Results were obtained from applied methodology of this research project. It contains the result of the surveys taken by us for different categorisation of pull handles and doorknobs. The results are in the form of bar graphs showing the average rating of individual door handle. The arithmetic analysis of different models of door handles is done in this section. From this analysis we compute the winner model in each category and the design parameter to be implied in the conceptualisation and design section.

4.1. Results for survey 2:

In 2nd survey we have categorised door handles on the basis of common shapes and for each shape various models were taken and individual rating was done by the users. The rating of different users was plotted in excel sheet and arithmetic analysis was done and as result bar-graphs were obtained.

Pull handles:

4.1.1 category-straight:

A survey of 30 users was done by showing the pictures (*refer Appendix-IV*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

From this survey we obtained the following result as shown in the chart.

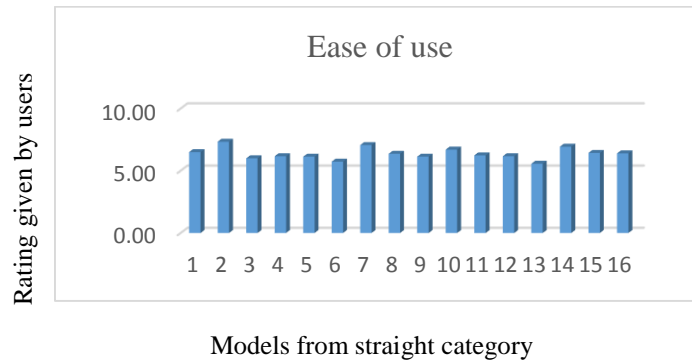


Fig. 4.1. Bar-graph analysis of straight category pull handles for apparent ease of use (A)

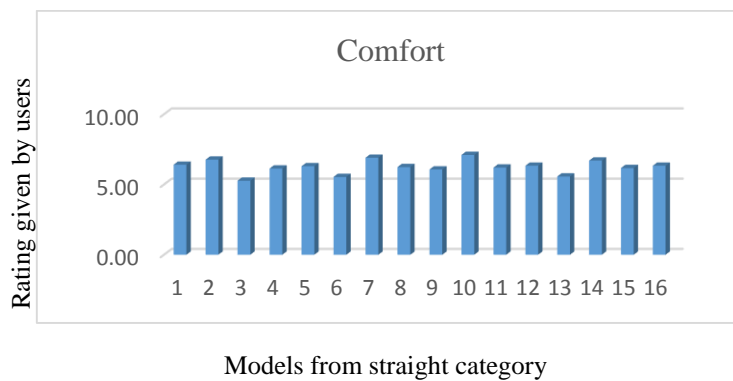


Fig.4.2. Bar-graph analysis of straight category pull handles for apparent comfort (B)

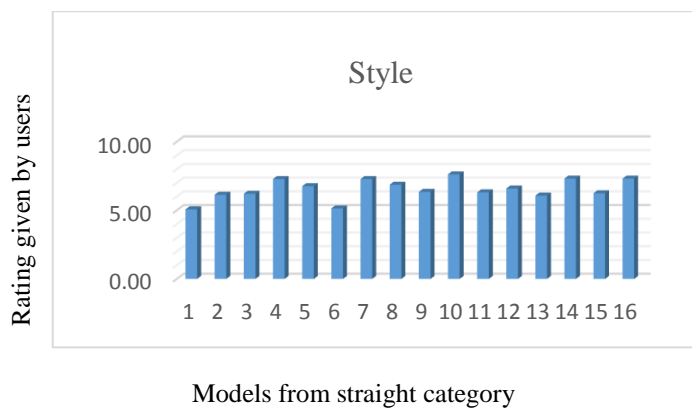


Fig.4.3. Bar-graph analysis of straight category pull handles for style/ looks (C)

4.1.2. Category- Semi-circular:

A survey of 30 users was done by showing the pictures (*refer Appendix-V*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

From this survey we obtained the following result as shown in the chart.

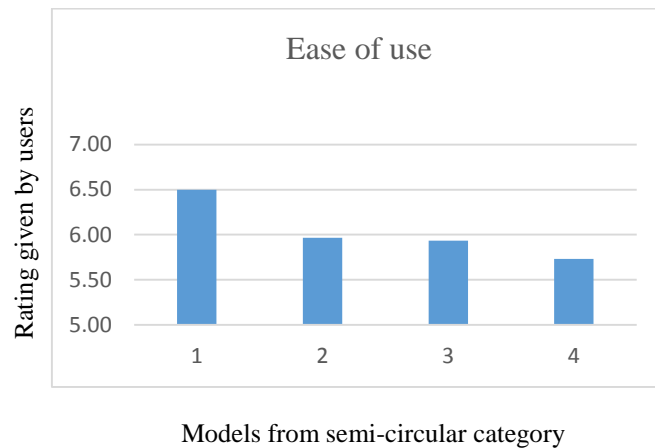


Fig. 4.4. Bar-graph analysis of semi-circular category pull handles for apparent ease of use (A)

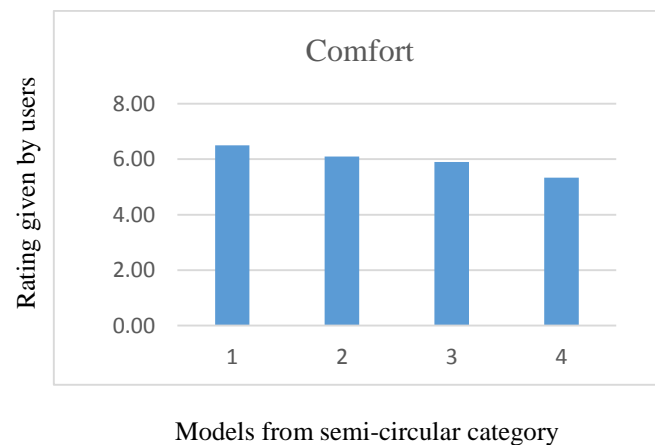


Fig. 4.5. Bar-graph analysis of semi-circular category pull handles for apparent comfort (B)

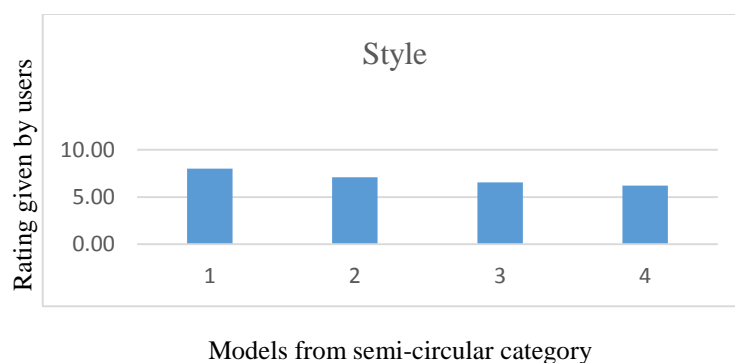


Fig. 4.6. Bar-graph analysis of semi-circular category pull handles for style/ looks (C)

4.1.3. Category circular:

A survey of 30 users was done by showing the pictures (*refer Appendix-VI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

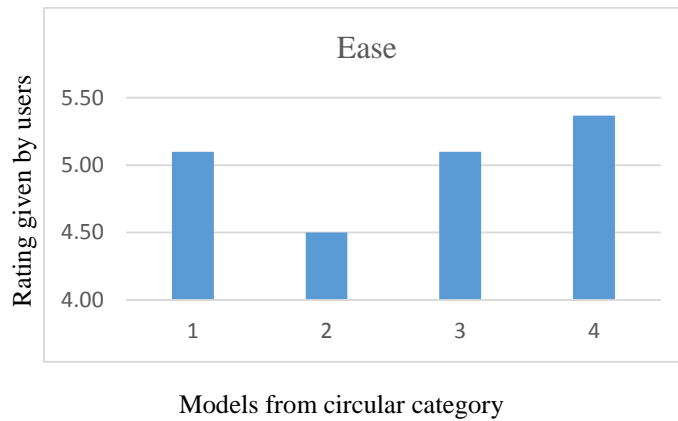


Fig. 4.7. Bar-graph analysis of circular category pull handles for apparent ease of use (A)

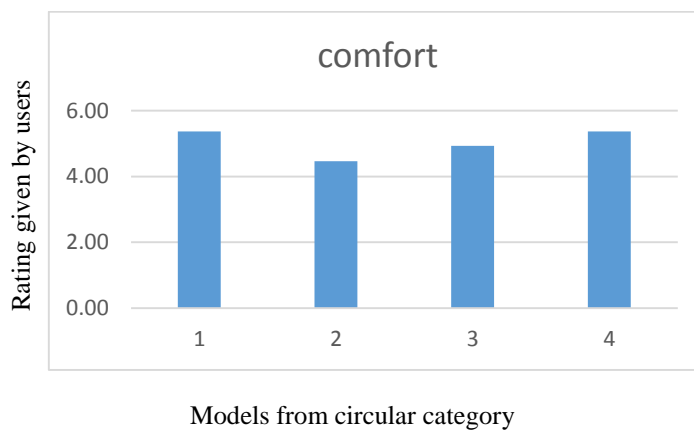


Fig. 4.8. Bar-graph analysis of circular category pull handles for apparent comfort (B)

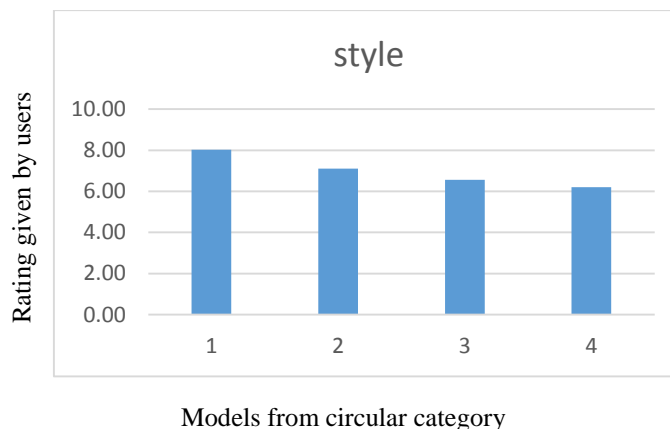


Fig. 4.9. Bar-graph analysis of circular category pull handles for style/ looks (C)

According to the survey the 4th design is best for ease of use and comfort voted by users but 1st design is voted for the best style category in circular pull handle category.

4.1.4. Category square:

A survey of 30 users was done by showing the pictures (*refer Appendix-VII*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

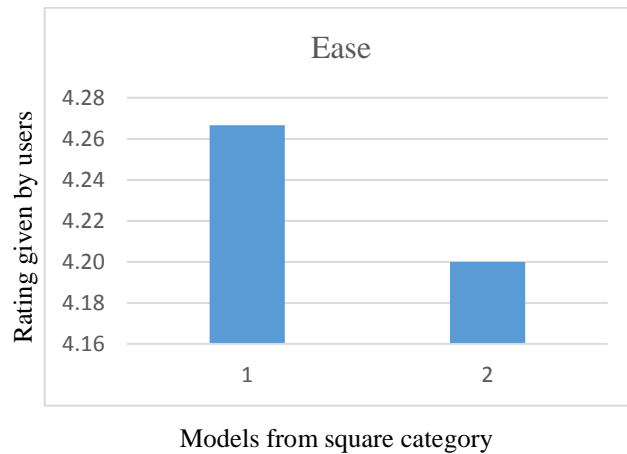


Fig. 4.10. Bar-graph analysis of square category pull handles for apparent ease of use (A)

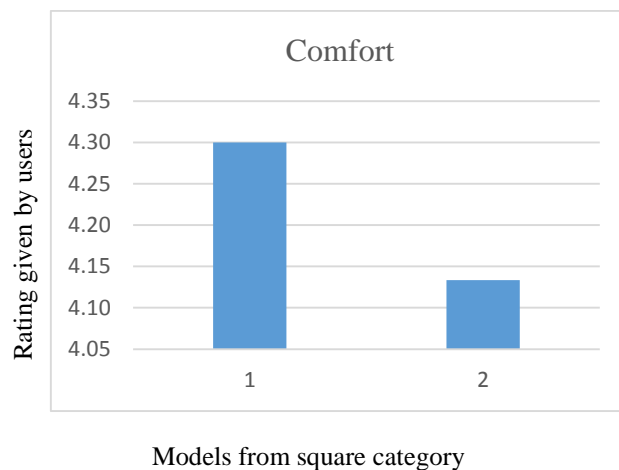


Fig. 4.11. Bar-graph analysis of square category pull handles for apparent comfort (B)

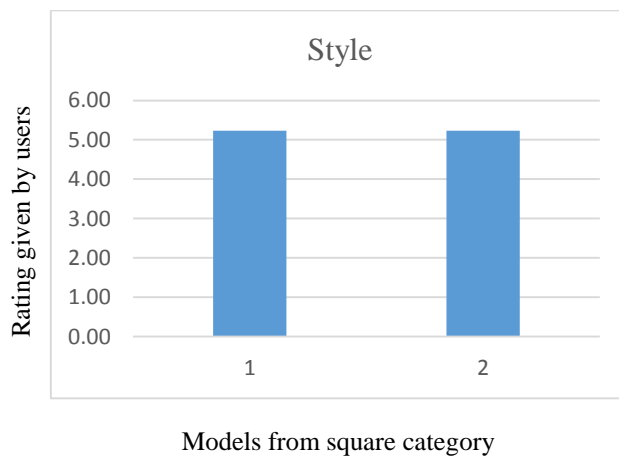


Fig. 4.12. Bar-graph analysis of square category pull handles for style/ looks (C)

4.1.5. Category spline:

A survey of 30 users was done by showing the pictures (*refer Appendix-VIII*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

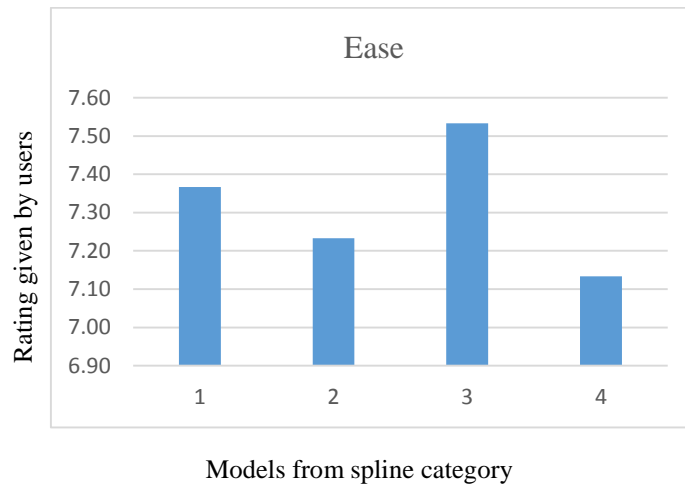


Fig. 4.13. Bar-graph analysis of spline category pull handles for apparent ease of use (A)

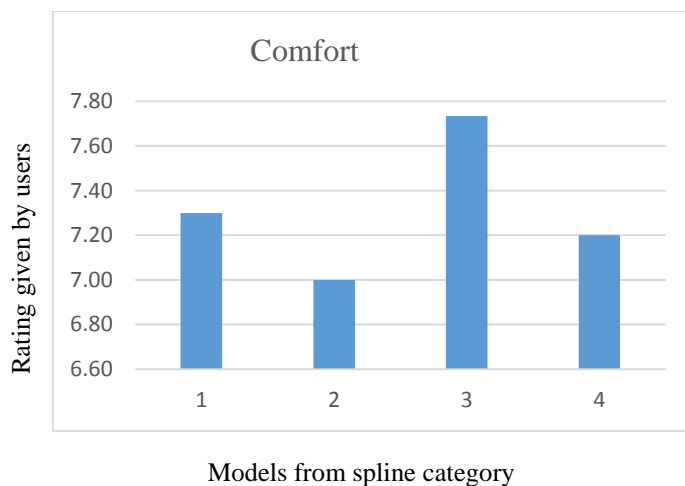


Fig. 4.14. Bar-graph analysis of spline category pull handles for apparent comfort (B)

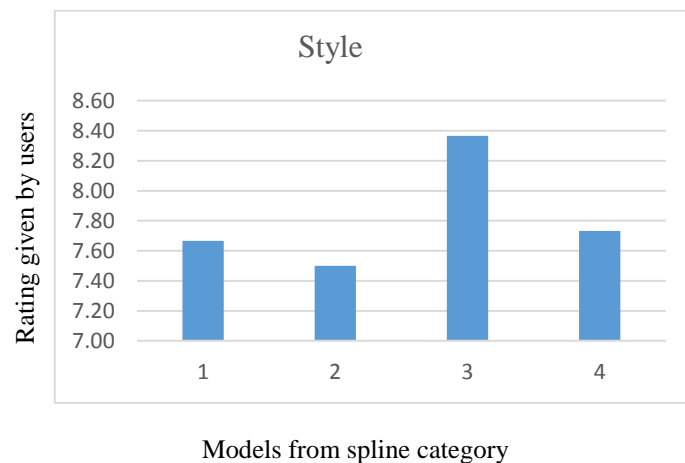


Fig. 4.15. Bar-graph analysis of Spline category pull handles for style/ looks (C)

4.1.6. Category curvy:

A survey of 30 users was done by showing the pictures (*refer Appendix-IX*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

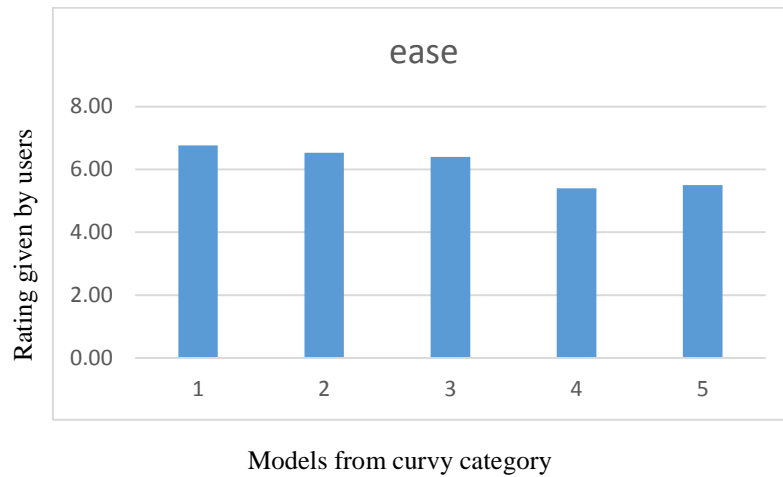


Fig. 4.16. Bar-graph analysis of curvy category pull handles for apparent ease of use (A)



Fig. 4.17. Bar-graph analysis of curvy category pull handles for apparent comfort (B)

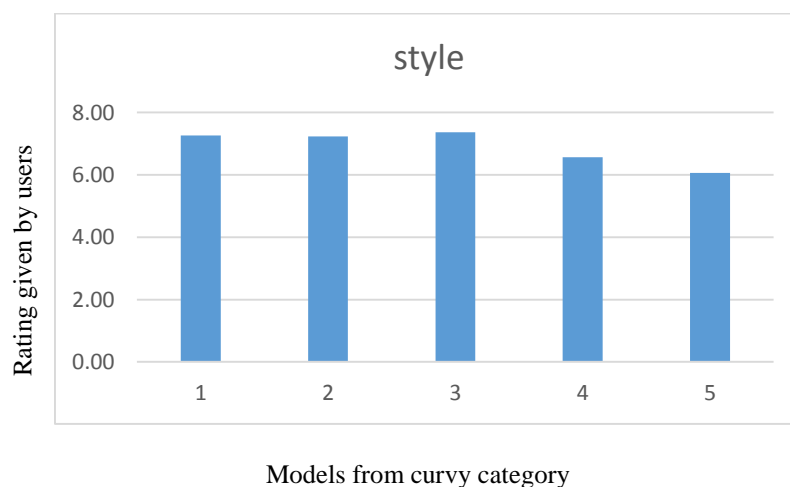


Fig. 4.18. Bar-graph analysis of curvy category pull handles for style/ looks (C)

4.1.7. Category Boomerang:

A survey of 30 users was done by showing the pictures (*refer Appendix-X*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

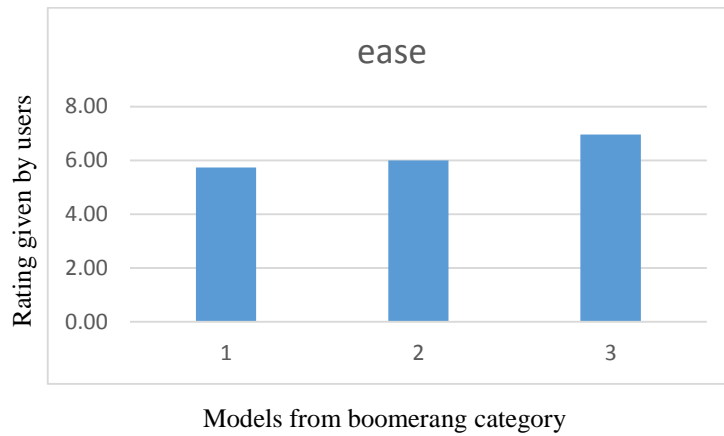


Fig. 4.19. Bar-graph analysis of boomerang category pull handles for apparent ease of use (A)

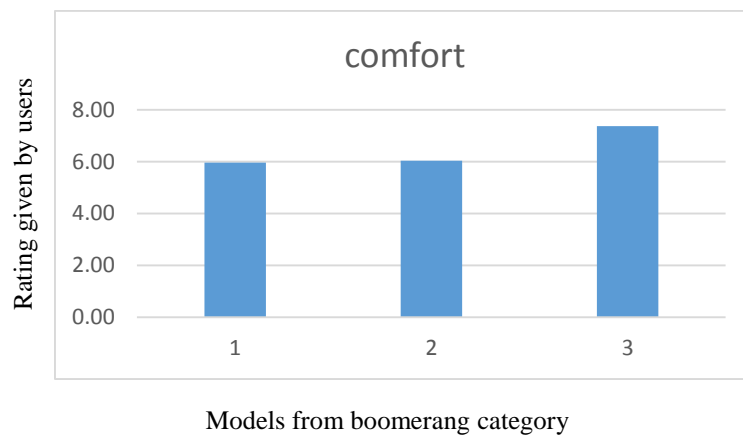


Fig. 4.20. Bar-graph analysis of boomerang category pull handles for apparent comfort (B)

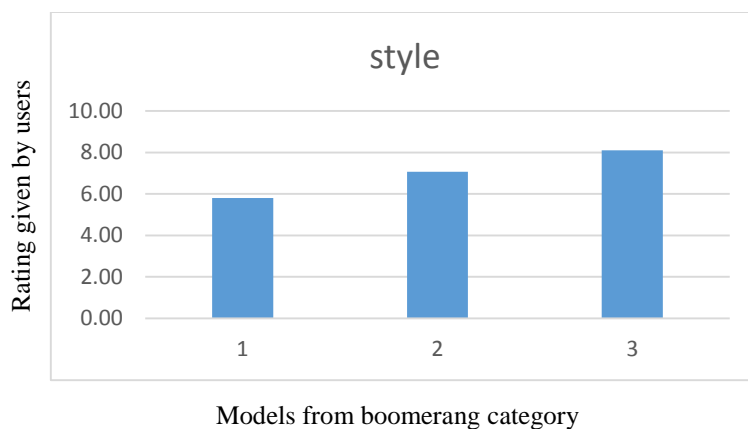


Fig. 4.21. Bar-graph analysis of boomerang category pull handles for style/ looks (C)

Door Knobs:

Its similar to the survey done for the pull handles. A total sample space of 30 was taken and the graphs for different attributes were plotted. Categorisation of the doorknobs includes the following.

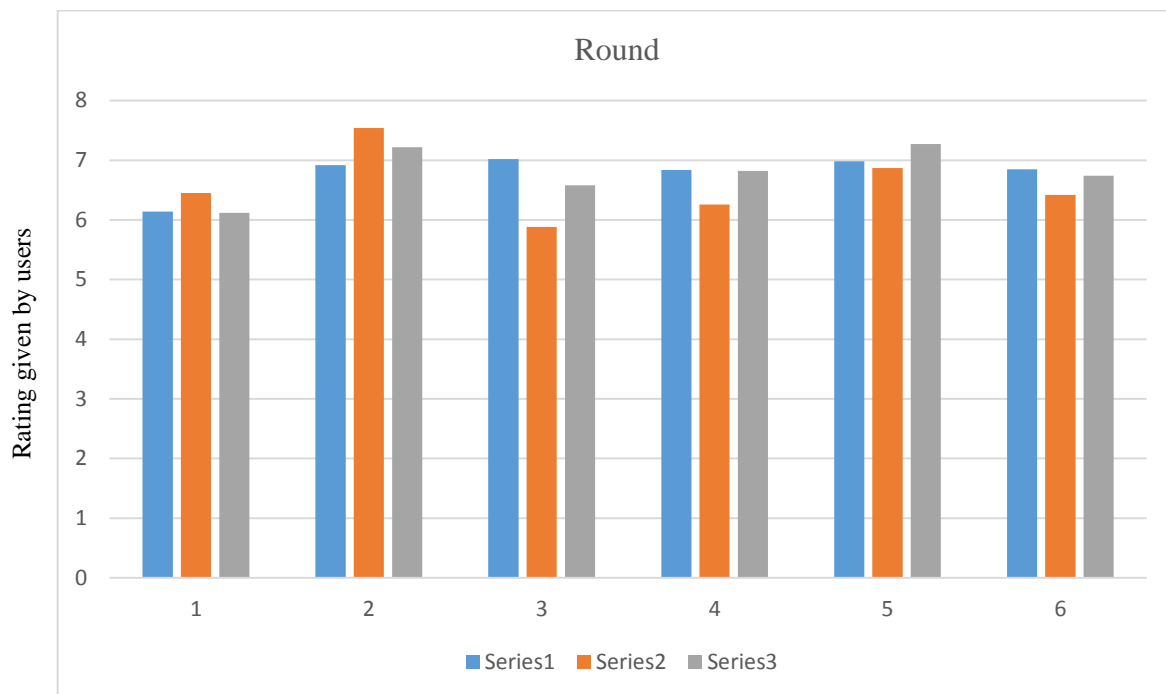
Series 1: apparent ease of use (A)

Series 2: apparent comfort (B)

Series 3: style or design (C)

4.1.8. Category Round:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.



Models from round category

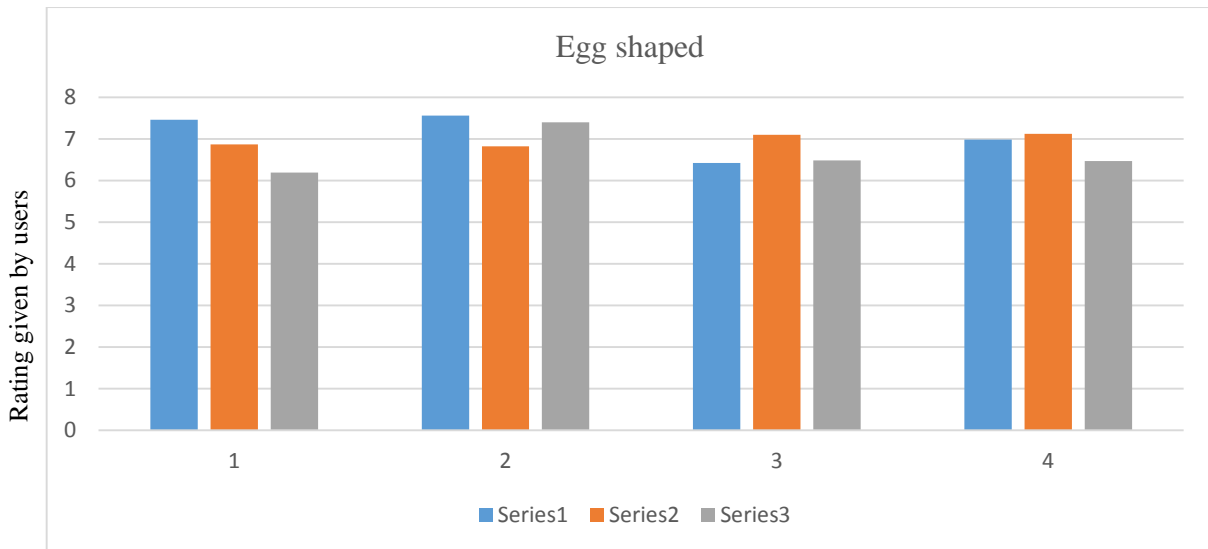
Fig. 4.22. Bar-graph analysis of round category pull handles

4.1.9. Category Egg Shaped:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

Horizontal axis: model number in each category

Vertical axis: rating given by users 0-10

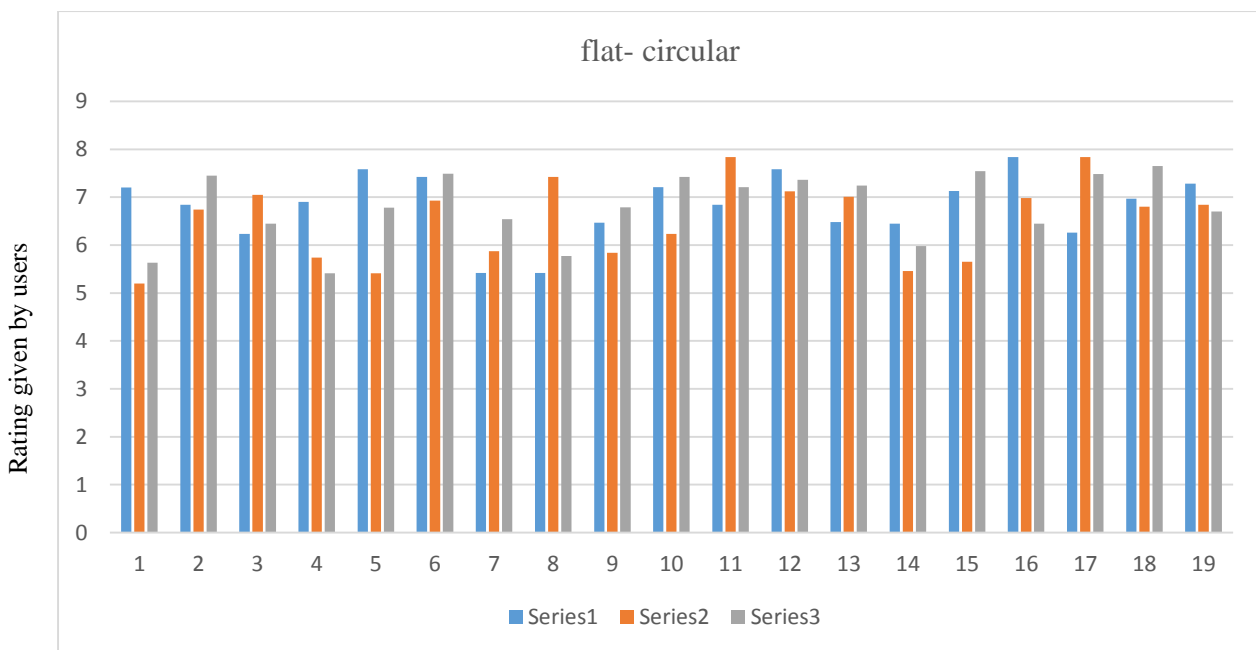


Models from egg shaped category

Fig. 4.23. Bar-graph analysis of egg shaped category pull handles

4.1.10. Category Flat Circular:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

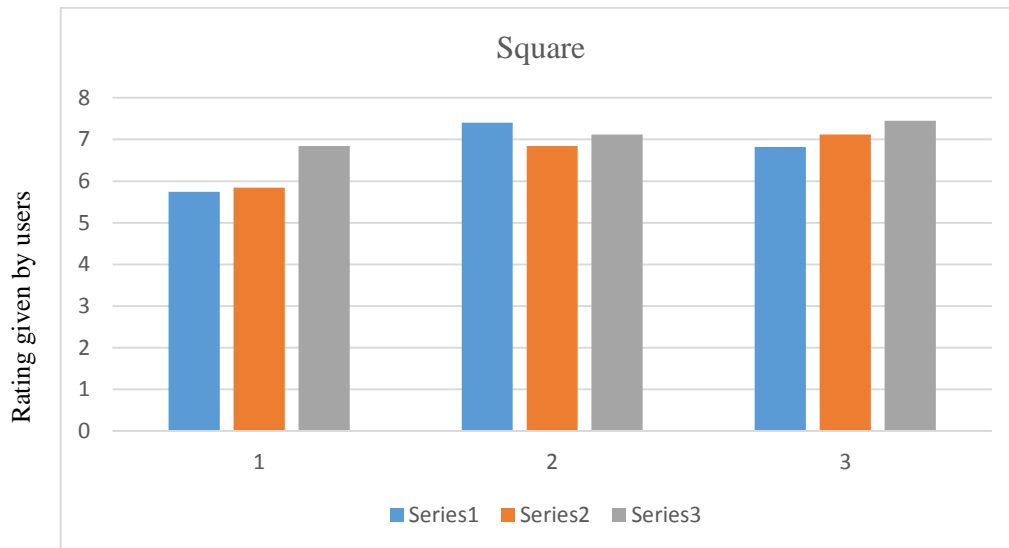


Models from flat-circular category

Fig. 4.24. Bar-graph analysis of flat circular category pull handles

4.1.11. Category Square:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

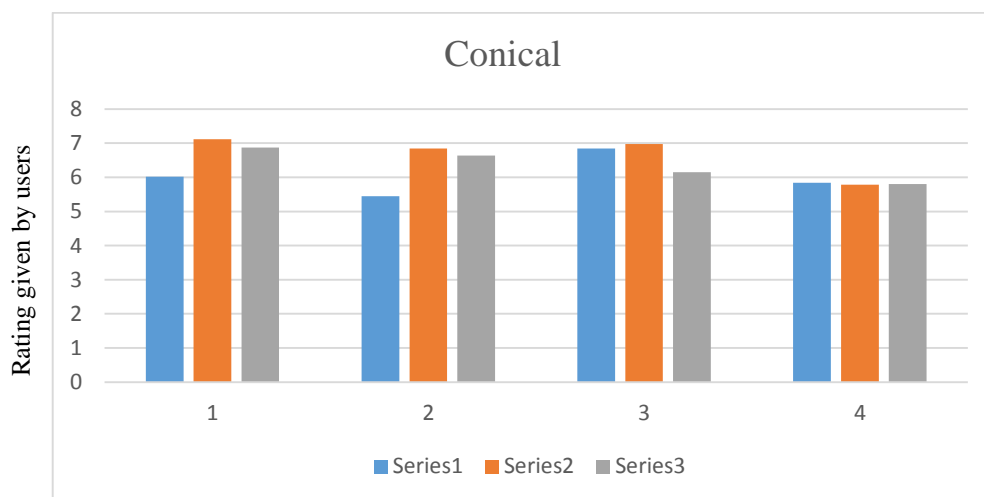


Models from square category

Fig. 4.25. Bar-graph analysis of square category pull handles

4.1.12. Category Conical:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

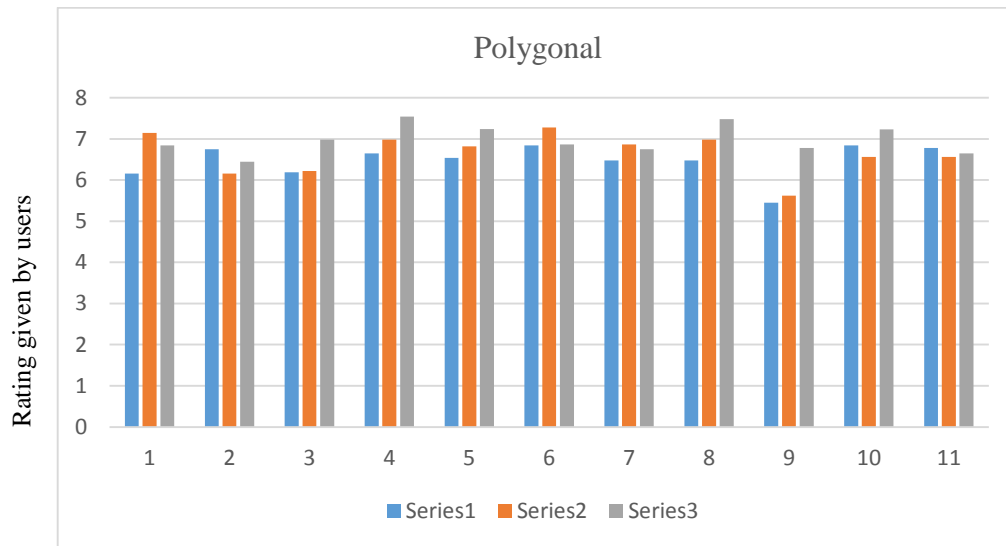


Models from conical category

Fig. 4.26. Bar-graph analysis of conical category pull handles

4.1.13. Category Polygonal:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 1-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.

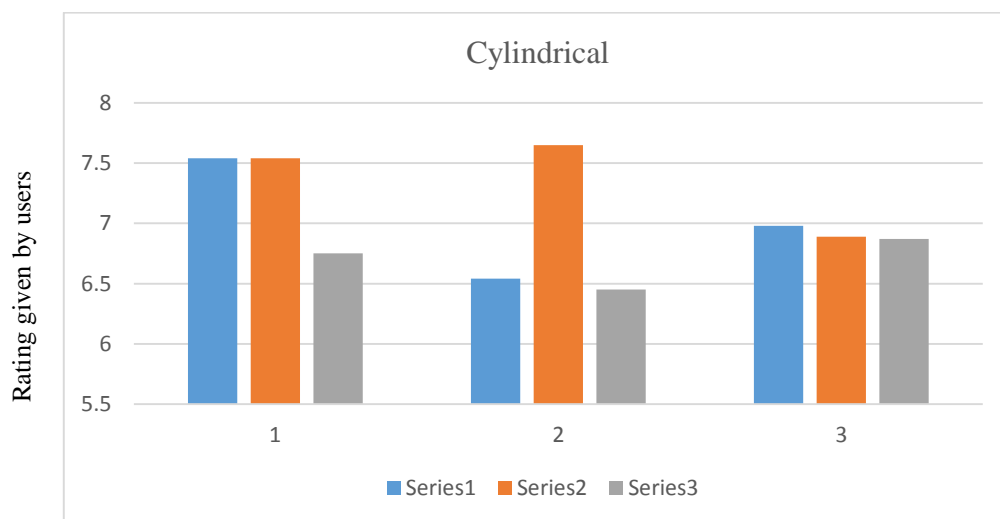


Models from polygonal category

Fig. 4.27. Bar-graph analysis of polygonal category pull handles

4.1.14. Category Cylindrical:

A survey of 30 users was done by showing the pictures (*refer Appendix-XI*) and rating was given from 0-10 scale. The parameters used for ratings were apparent ease of use, apparent comfort and style or design of the handle.



Models from cylindrical category

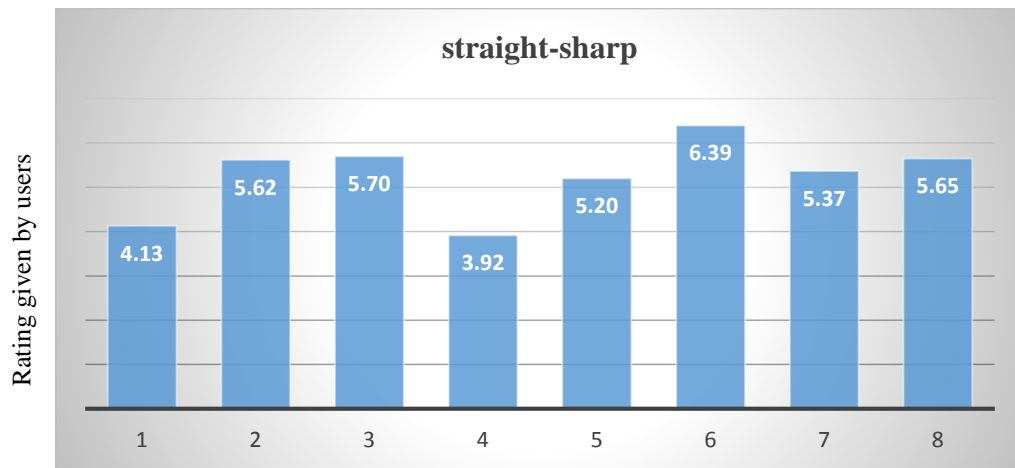
Fig. 4.28. Bar-graph analysis of cylindrical category pull handles

4.2. Results for Survey 3:

In 3rd survey we have categorised door handles on the basis of common shapes and feel for each shape and feel various models were taken and individual rating was done by the users. The rating of different users was plotted in excel sheet and arithmetic analysis was done and as result bar-graphs were obtained.

Pull handles (refer Appendix-XII):

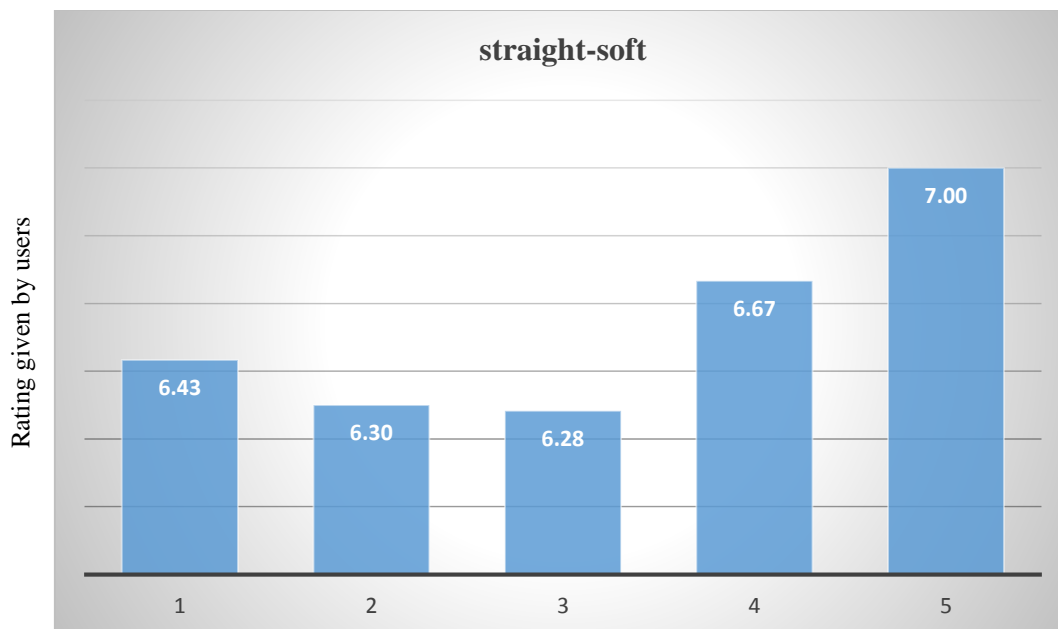
4.2.1. Straight-Sharp



Models from straight-sharp category

Fig. 4.29. Bar-graph analysis of Straight-Sharp category pull handles

4.2.2. Straight-Soft:



Models from straight-soft category

Fig. 4.30. Bar-graph analysis of Straight-Soft category pull handles

4.2.3. Straight-Semi:

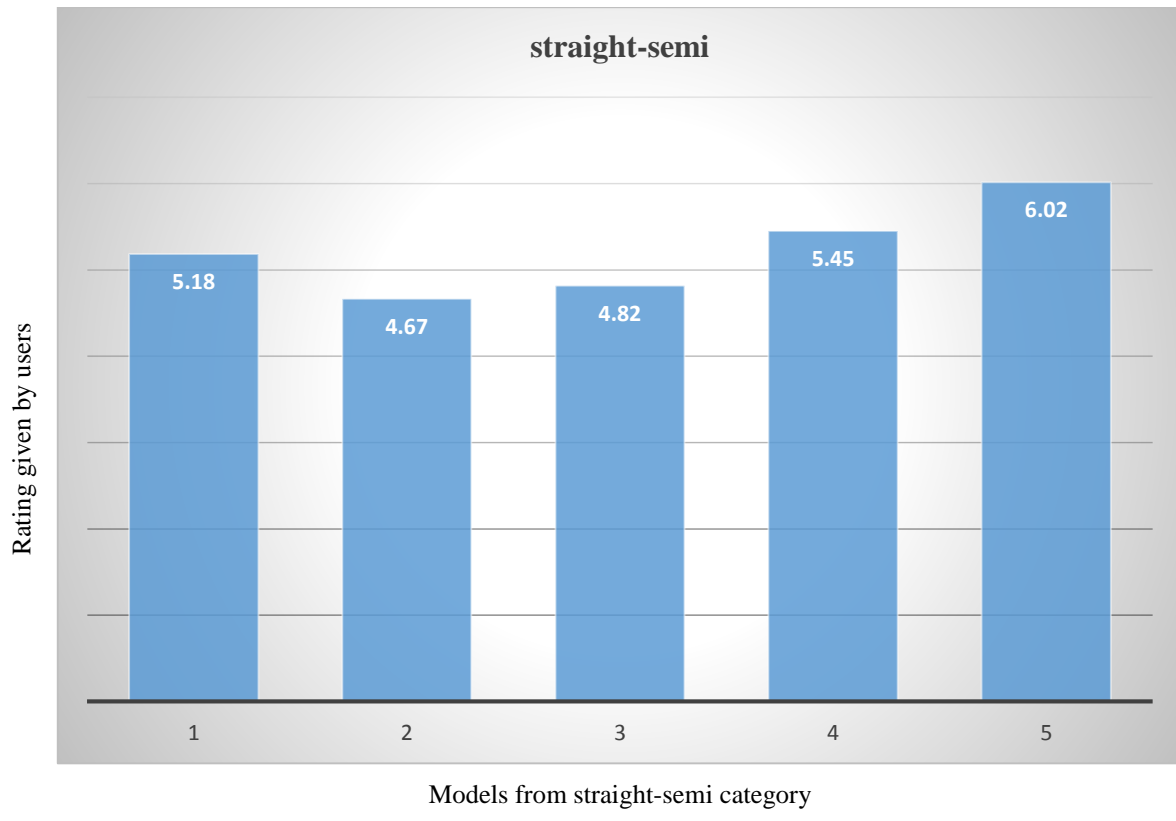


Fig. 3.31. Bar-graph analysis of Straight-Semi category pull handles

4.2.4. Curvy-Sharp:

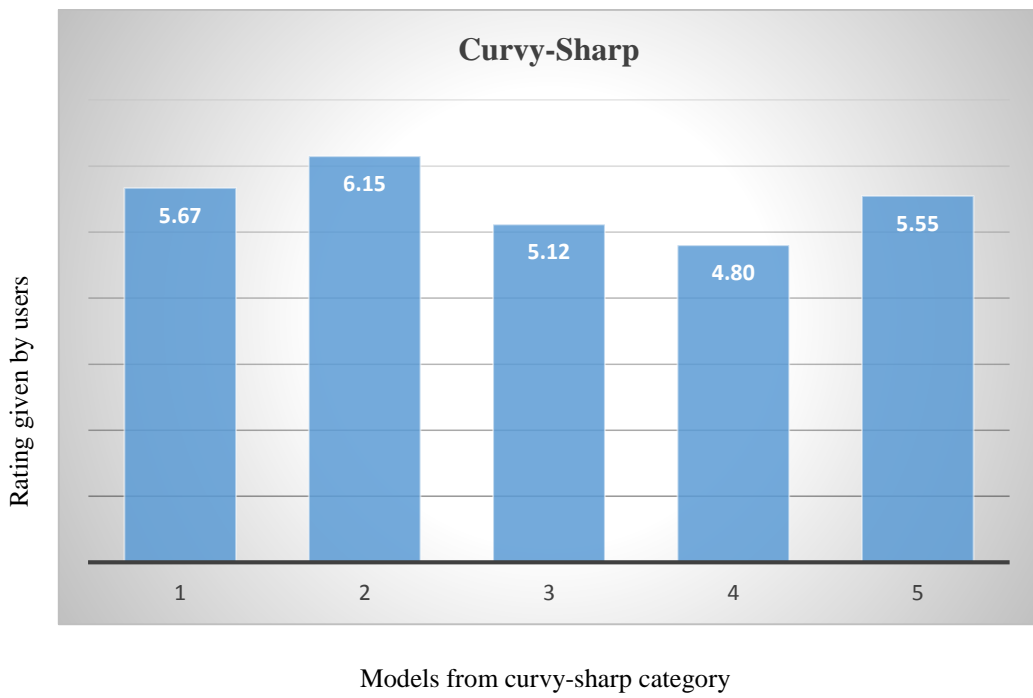


Fig. 4.32. Bar-graph analysis of Curvy-Sharp category pull handles

4.2.5. Curvy-Soft:

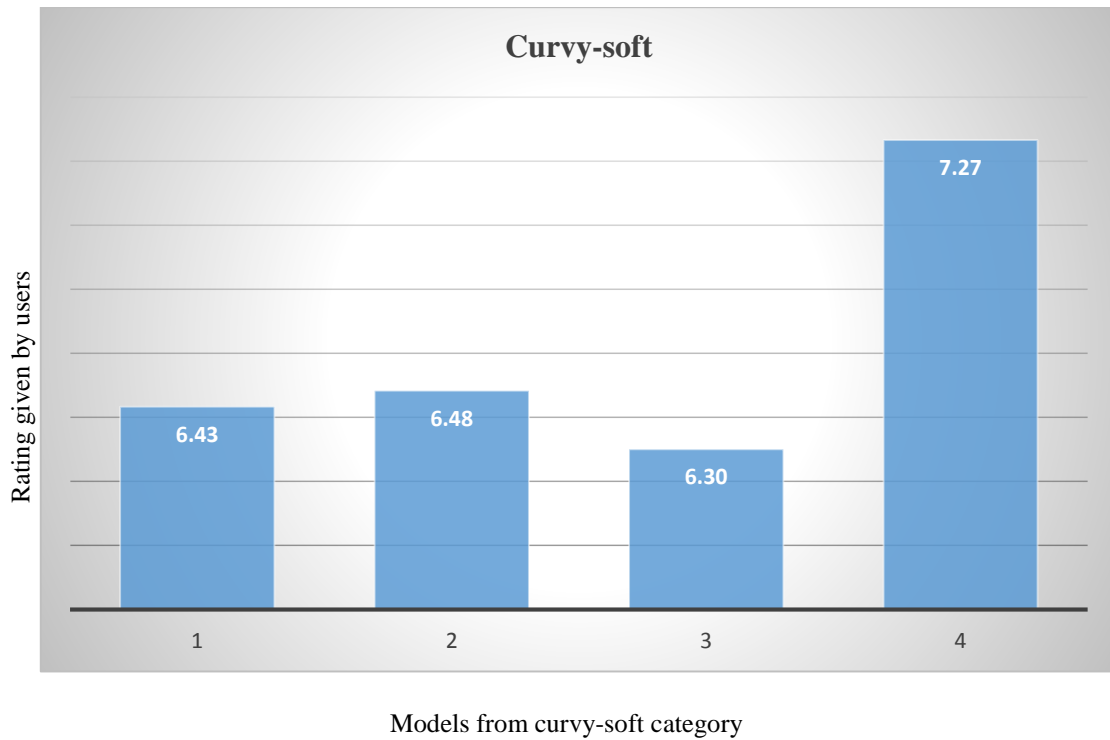


Fig. 4.33. Bar-graph analysis of Curvy-Soft category pull handles

4.2.6. Curvy-Semi:

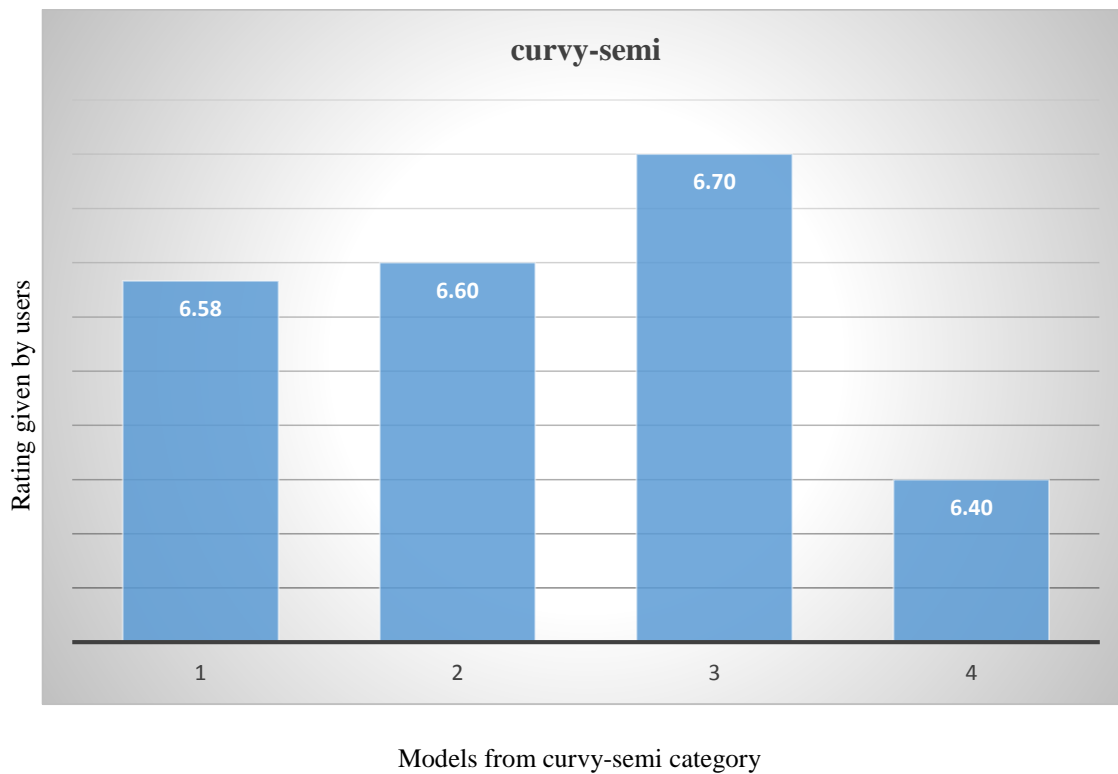
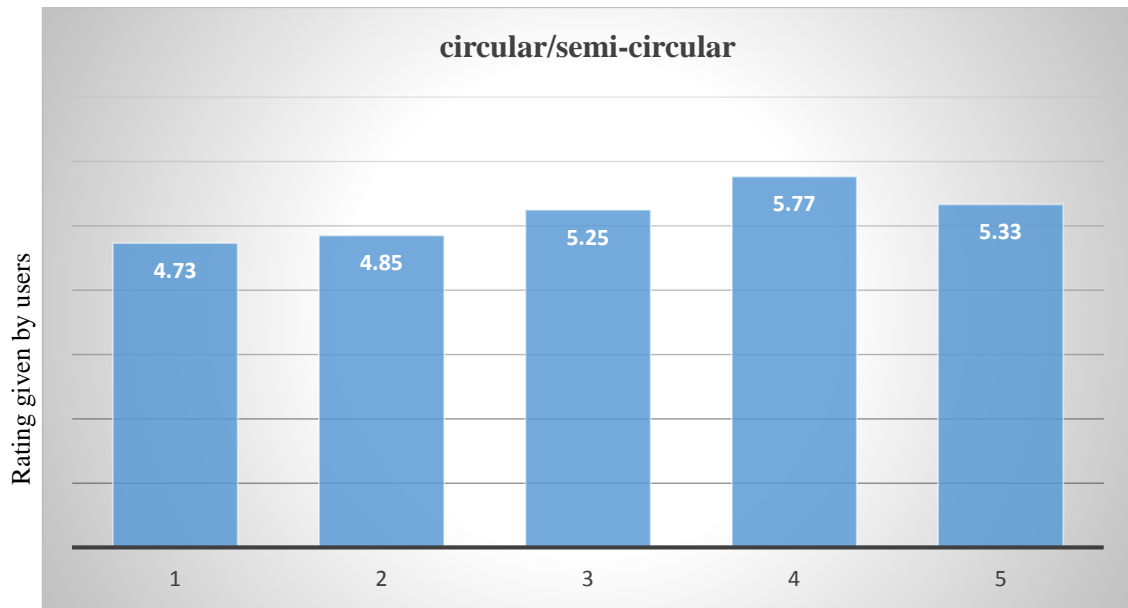


Fig. 4.34. Bar-graph analysis of Curvy-Semi category pull handles

4.2.7. Circular/Semi-Circular:

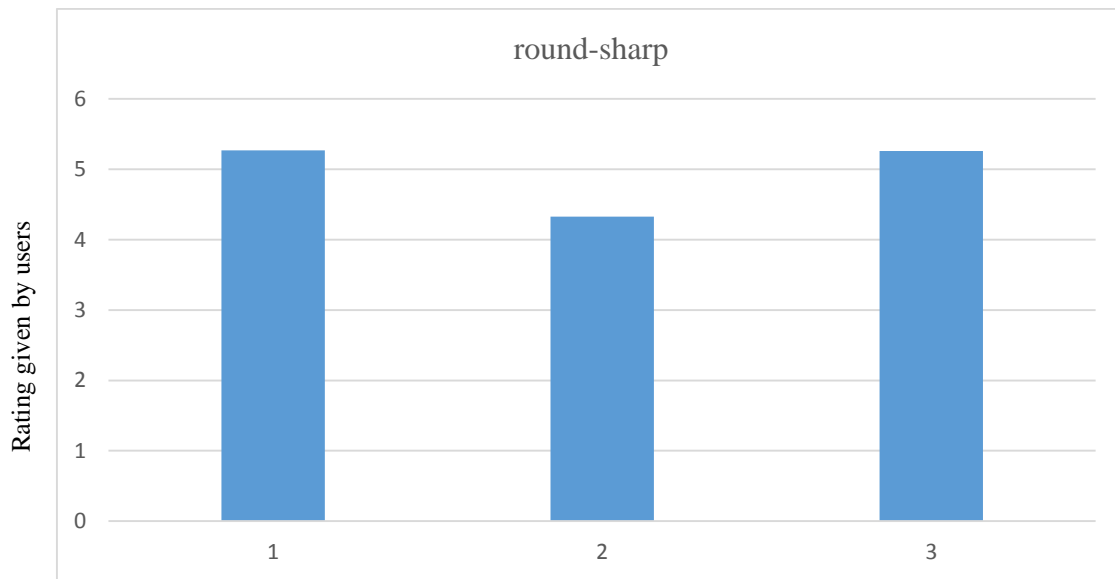


Models from circular/semi-circular category

Fig. 4.35. Bar-graph analysis of Circular/Semi-Circular category pull handles

Doorknobs (refer Appendix-XII):

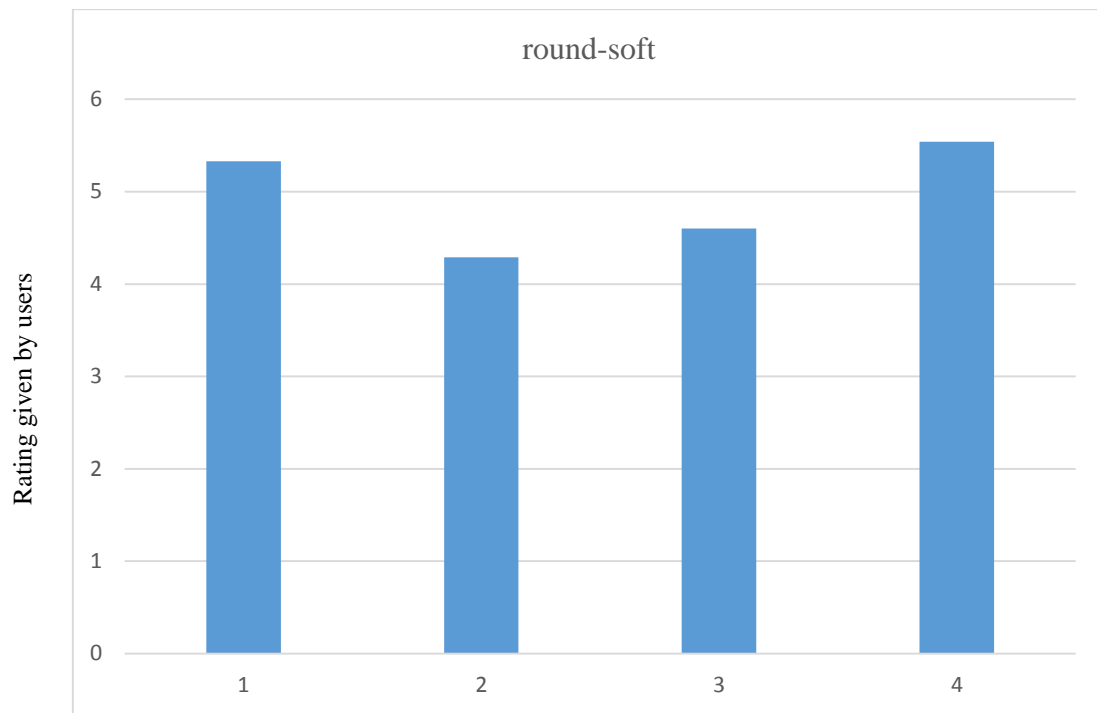
4.2.8. Round-Sharp:



Models from round-sharp category

Fig. 4.36. Bar-graph analysis of Round-Sharp category doorknob

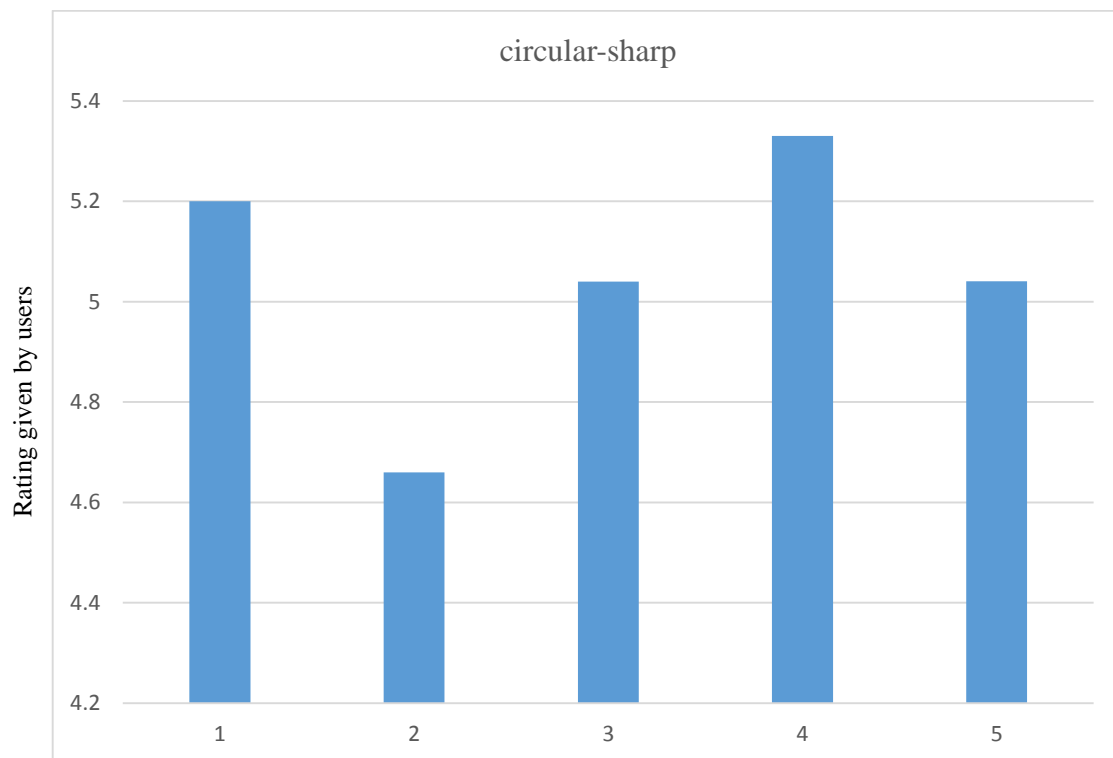
4.2.9. Round-Soft:



Models from round-soft category

Fig. 4.37. Bar-graph analysis of Round-Soft category doorknob

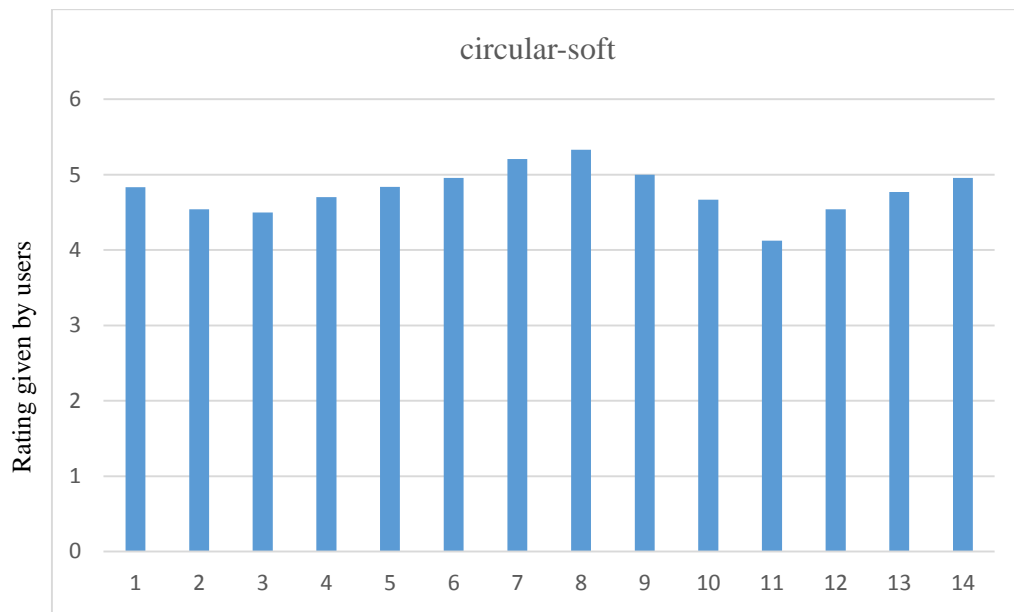
4.2.10. Circular-Sharp:



Models from circular-sharp category

Fig. 4.38. Bar-graph analysis of Circular-Sharp category doorknob

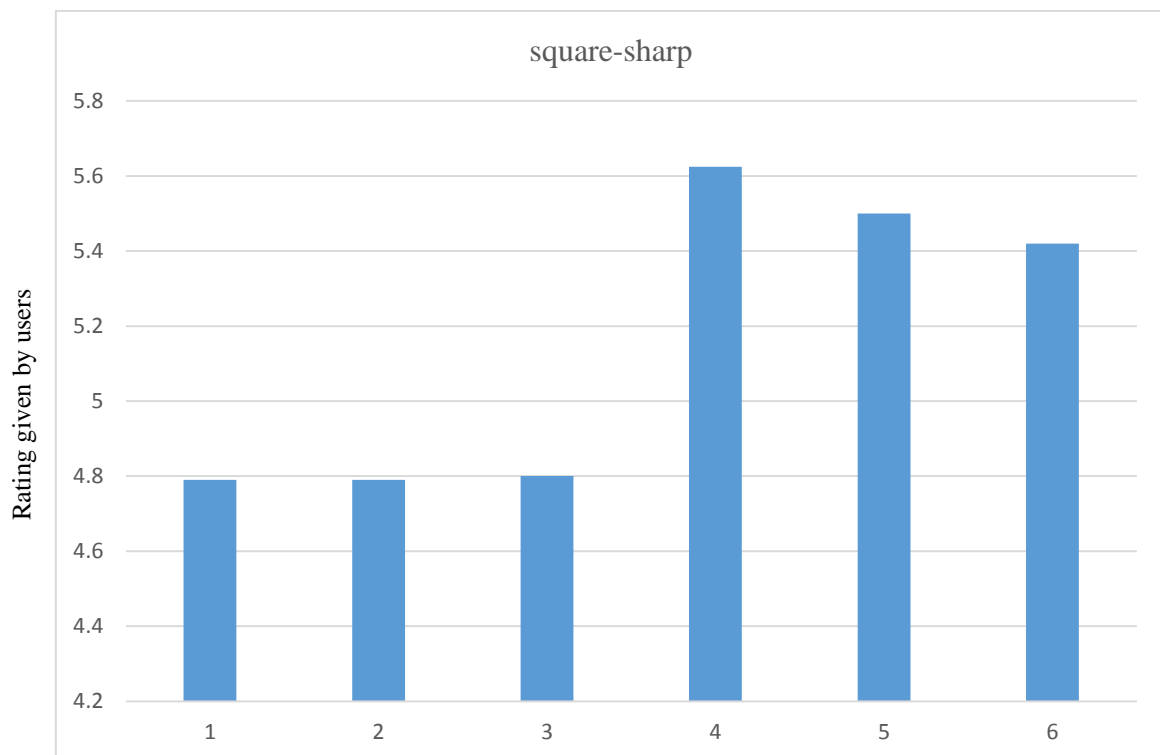
4.2.11. Circular-Soft:



Models from circular-soft category

Fig. 4.39. Bar-graph analysis of Circular-Soft category doorknob

4.2.12. Square-Sharp:



Models from square-sharp category

Fig. 4.40. Bar-graph analysis of Square-Sharp category doorknob

4.2.13. Square-Soft:

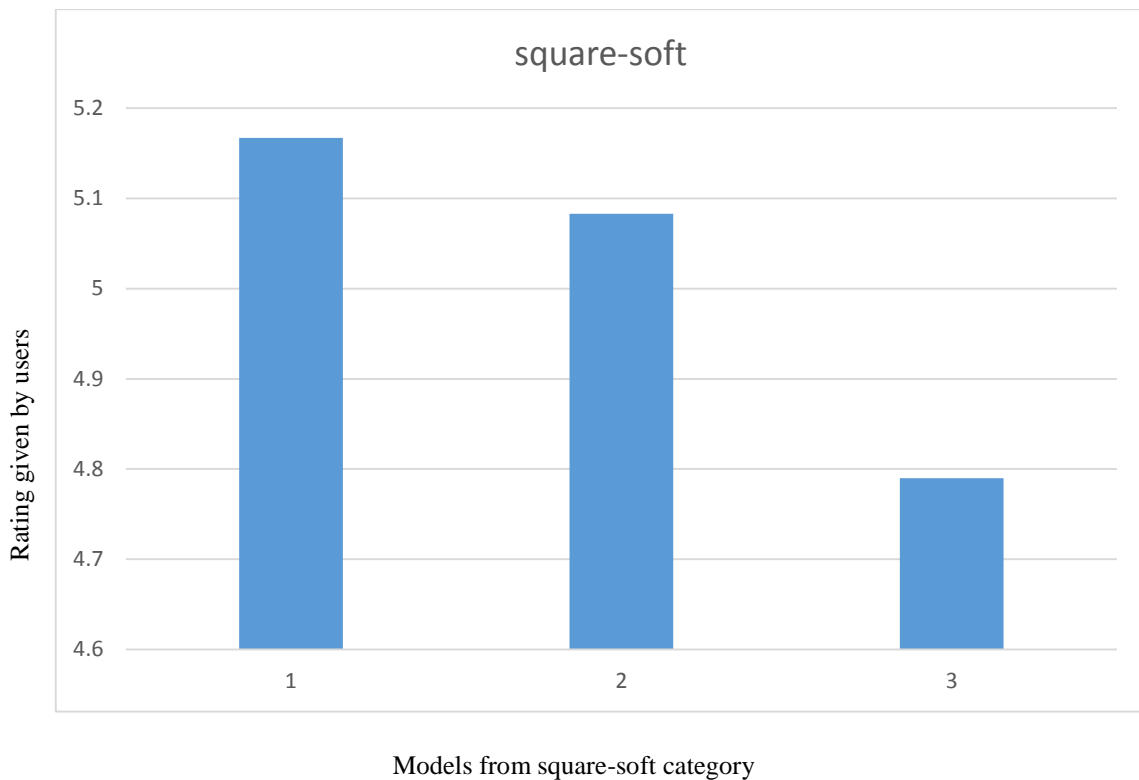


Fig. 4.41. Bar-graph analysis of Square-Soft category doorknob

4.3. Discussion:

In methodology total three surveys were taken. 1st survey results in defining parameters for the design of the door handle, in the 2nd survey we have interviewed 30 users and various door handles are rated according to three parameters. The 2nd survey was done find the winner design in each category for three attributes i.e. apparent ease of use(A), apparent comfort (B), style or looks (C). The bar graphs shown in methodology section depicts the winner design in each category.

The 3rd survey results in obtaining the winner in each category of shape and texture/ feel. The bar graphs shows a clear picture on the overall designs rated by users. So implication of these design attributes that we have obtained from the three surveys will result in the formation of unique set of design which will be user oriented and satisfactory.

CHAPTER 5

CONCEPTUALISATION AND DESIGN

Based on the results obtained from the three surveys that has been conducted by us for pull handles as well as doorknobs a few concept for door handles has been generated. In these design concepts we implemented some of the existing features of the top rated model shown in survey to the users. CAD model for each category of door handles has been done using Catia.

5.1. Doorknob Design Concept 01:

Design implications:

It's a design for circular- sharp doorknob. In form based classification of doorknobs the winner in style for circular doorknob has some flower pattern on the doorknob which is implemented in this design. For easy grasp or grip the proposed designs thickness was reduced.

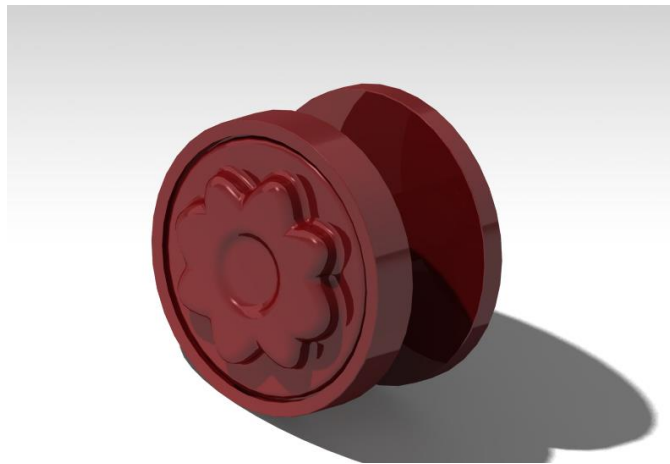


Fig.5.1. Rendered image of CAD model (circular-sharp)

5.2. Doorknob Design Concept 02:

Design implications:

It's a circular-soft design. In circular doorknob the winner in apparent ease of use didn't have sharp edges. The user will feel good for the finish and for the comfort.



Fig.5.2. Rendered image of CAD model (circular-soft)

5.3. Doorknob Design Concept 03:

Design implications:

In this concept the attributes of winner model in round category doorknob has been used. From the surveys it's known that tapered shape is the most favourable shape which is handy. For that reason we have combined the round shape with a flat surface to give a tapering feel to users which will be good for grip.

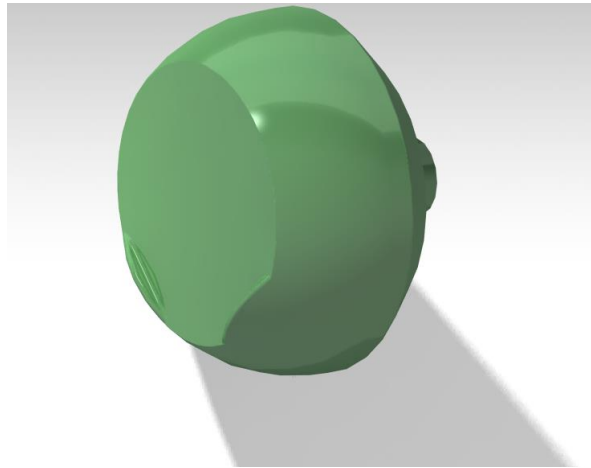


Fig.5.3. Rendered image of CAD model (round-sharp)

5.4. Doorknob Design Concept 04:

Design implications:

For doorknobs round shape is the most favourable shape for users as per the 2nd survey. So in this concept we simply put a round shape including some striations on the surface for a little rough feel.



Fig.5.4. Rendered image of CAD model (round-soft)

5.5. Doorknob Design Concept 05:

Design implications:

In this concept the pattern on the surface was taken from the doorknob model which is the top rated model for style in square doorknob category. The sharp edges may cause a little effect in ease of use but for style purpose it's the proposed model.

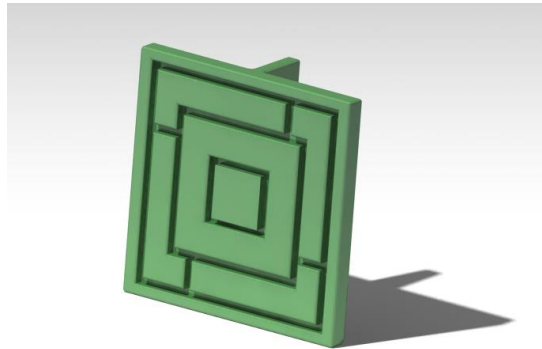


Fig.5.5. Rendered image of CAD model (square-sharp)

5.6. Doorknob Design Concept 06:

Design implication:

The design was taken from the soap. Generally the soap that we use in our daily life is of this shape. So we put on this shape to form a doorknob. It will be handy as the sharp edges were removed.

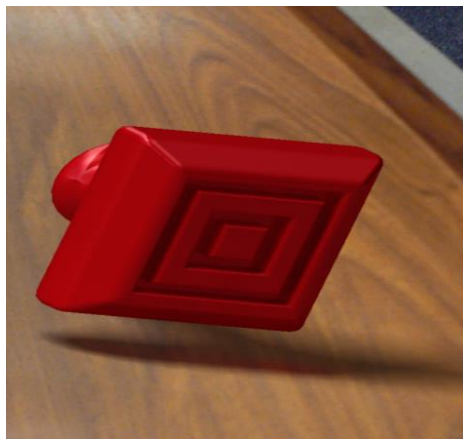


Fig.5.6. Rendered image of CAD model (square-soft)

5.7. Pull handle Design Concept 07:

Design implications:

The best chosen model in curvy category of pull handles contain this shape of bow. So we decided to add something to the bow shape and the result is as follows. The handles will be good for ease of use as the spacing given in this model is good enough.

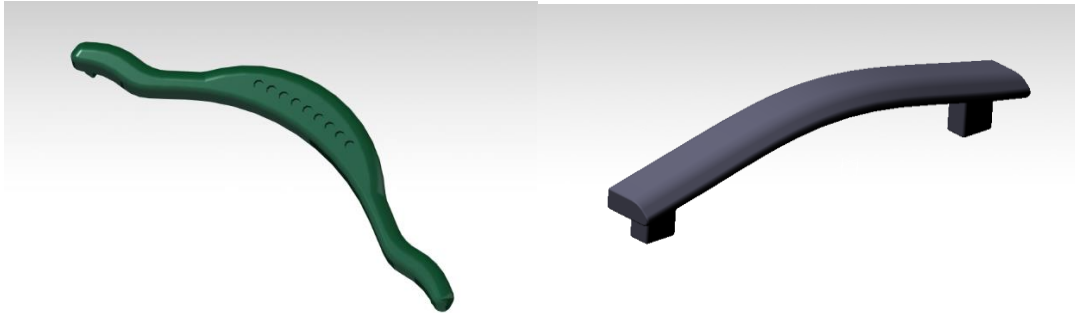


Fig.5.7. Rendered image of CAD model (curvy-soft)

5.8. Pull handle Design Concept 08:

Design implication:

This model came under straight category though it's not completely straight. The little curvy shape was taken from the curvy category model for style.

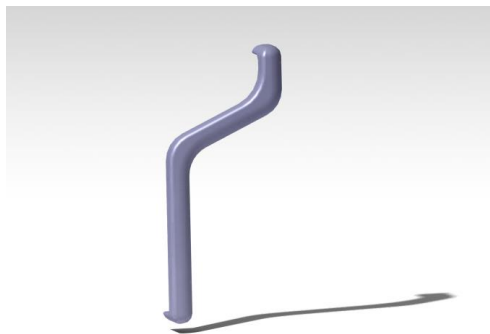


Fig.5.8. Rendered image of CAD model (straight-sharp)

5.9. Pull handle Design Concept 09:

Design implication:

It's an angular shape taken from the boomerang shaped pull handle. In this concept the rough edges may be a problem for the ease of use but for style the shape is very good.



Fig.5.9. Rendered image of CAD model (curvy-sharp)

5.10. Pull handle Design Concept 10:

Design implication:

In general we use a thin shaped straight category pull handles in our household. So we decided to bulge the middle portion a little bit for the ease of use and for the texture which will feel soft to our hands. The bulging shape was taken from 3rd topper of pull handle in straight category.

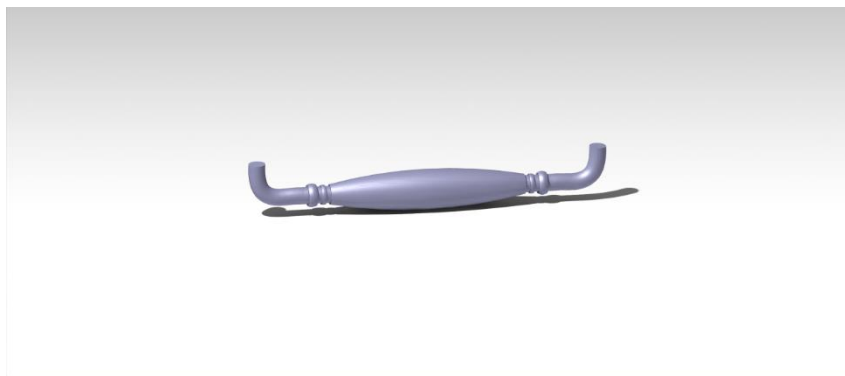


Fig.5.10. Rendered image of CAD model (curvy-sharp)

CHAPTER 6

CONCLUSIONS

Design of any product require market research. For designing a door handle it's required to know how many different types of door are available and their functions. From this project we have come to know different kinds of doors and door handles and their functions. Hierarchy of task while operating a door is understood. Different kinds of grips used in holding or operating a door handle is understood. Product personality is a highly essential element in design field. Defining product personality will increase design parameters.

More than 500 samples of door handles including lever handle, doorknobs and pull handles were collected. Categorisation of these door handles are done based on their shapes and finishes initially. Later on a few models of door handles were used for survey to define design parameters using adjective list and all.

Finally shape based categorisation of pull handles and doorknobs were taken into account. Pull handles were categorised into straight, curvy, circular etc. and doorknobs were categorised into round, egg shaped and circular. Survey on these models result in winner in each category of door handles. Later shape as well as texture based categorisation was done and the winner in those categories were implied in CAD models using Catia.

6.1. Scope for future work:

In this research project we have categorised door handles on the basis of shape and designed them according to shape and feel. Our research include sample collection of different brands including Indian brands and their available finishes. In future the project can be done in different angle such as






























































- Finish wise classification of door handles and survey.
- Collection of anthropometric data of users for proper handling of tools.
- Naked eye ball test analysis using eye ball tracking software for better result in defining parameters for design of door handle.
- Use of proper dimensions for design.

REFERENCES

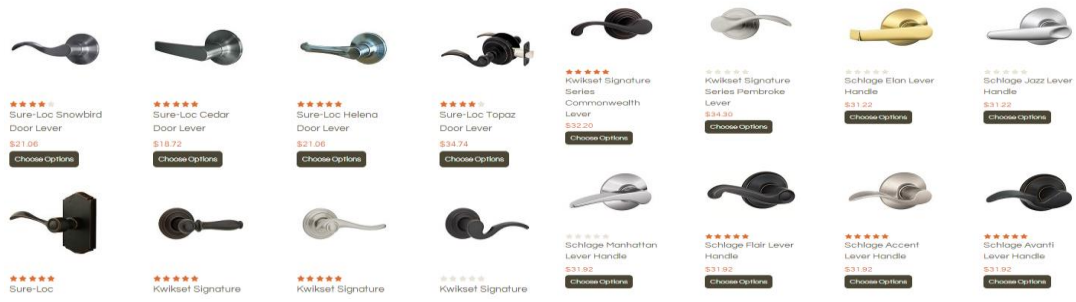
- [1] OSBOURN DORSEY, Improvement in door holding devices Patent no. US 210764 A, dated December 10, 1878.
- [2] www.directdoorhardware.com/baldwin as seen on August 25, 2013.
- [3] www.doorsetindia.com as seen on August 27, 2013.
- [4] www.directdoorhardware.com/baldwin/doorknobs as seen on August 25, 2013.
- [5] Applied Ergonomics 38 (2007), Task demands and human capabilities in door use, by Shih-Kai Chang, Collin G. Drury, Department of Industrial Engineering, University of Buffalo, New York.
- [6] Assessment of grip force and subjective hand force exertion under handedness and postural conditions, by Kai Way Li, Ruifeng Yu, Department of Industrial Management, Chung Hua University. www.sciencedirect.com/science/article/ as seen on October 16, 2013.
- [7] www.mccc.edu as seen on September 8, 2013.
- [8] Product personality in physical interaction, by Pieter M.A Desmet, Juan Carlos Ortiz Nicolas and Jan P. Schooramans, Department of Industrial Design, Delft University of Technology, Landbergstraat 15, CE Delft, The Netherlands. www.sciencedirect.com as seen on November 15, 2013.

Appendix-I

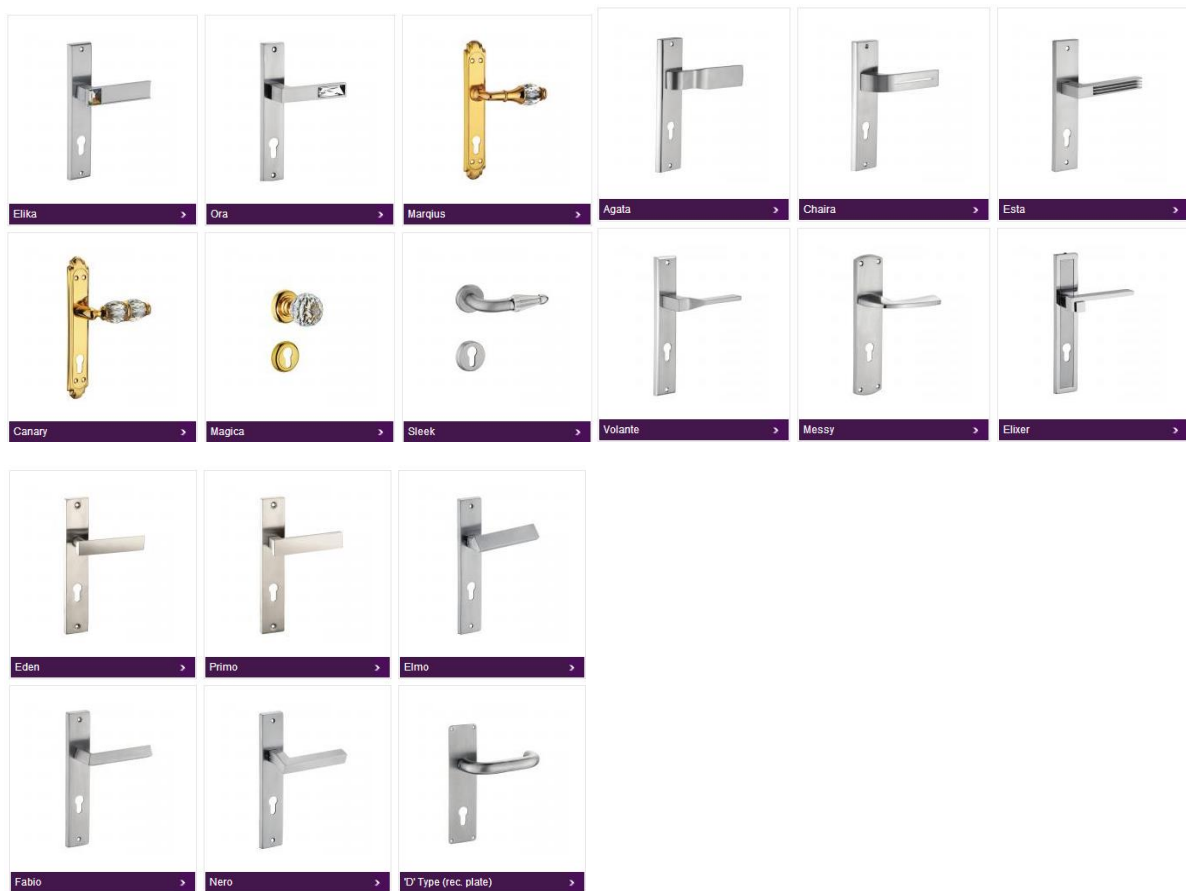
DOOR KNOBS

 ★★★★ Baldwin Reserve Series Elipse Knob \$73.50 Choose Options	 ★★★★ Baldwin Reserve Series Round Knob \$73.50 Choose Options	 ★★★★ Baldwin Reserve Series Traditional \$73.50 Choose Options	 ★★★★ Baldwin Reserve Series Rustic Knob \$94.50 Choose Options	 ★★★★ Baldwin Estate Series 5013 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5020 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5023 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5024 Knob \$208.80 Choose Options	 ★★★★ Schlage Plymouth Knob with \$139.99 Choose Options	 ★★★★ Schlage Orbit \$22.96 Choose Options	 ★★★★ Schlage Siena \$39.55 Choose Options	 ★★★★ Schlage Siena FS1- SE \$49.80 Choose Options
 ★★★★ Baldwin Estate Series 5002 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5005 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5011 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5013 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5025 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5030 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5031 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5041 Knob \$208.80 Choose Options	 ★★★★ Schlage Georgian Knob with \$32.79 Choose Options	 ★★★★ Schlage Georgian Knob with \$32.79 Choose Options	 ★★★★ Schlage Plymouth Knob with \$32.85 Choose Options	 ★★★★ Schlage Georgian Knob with \$34.02 Choose Options
 ★★★★ Omnia Door Knob Style 425 \$142.80 Choose Options	 ★★★★ Omnia Door Knob Style 415 \$144.00 Choose Options	 ★★★★ Omnia Door Knob Style 417 \$130.00 Choose Options	 ★★★★ Omnia Door Knob Style 428 \$149.75 Choose Options	 ★★★★ Omnia Max Steel Knob Style 432 \$166.40 Choose Options	 ★★★★ Omnia Max Steel Knob Style 442 \$166.40 Choose Options	 ★★★★ Omnia Door Knob Style 59 \$168.00 Choose Options	 ★★★★ Omnia Door Knob Style 137 \$177.90 Choose Options	 ★★★★ Kwikset Abbey Knob \$29.95 Choose Options	 ★★★★ Kwikset Circa Door Knob \$29.95 Choose Options	 ★★★★ Kwikset Signature Series Hancock \$17.90 Choose Options	 ★★★★ Kwikset Signature Series Laurel Door \$29.00 Choose Options
 ★★★★ Omnia Door Knob Style 430 \$169.00 Choose Options	 ★★★★ Omnia Door Knob Style 433 \$169.00 Choose Options	 ★★★★ Omnia Door Knob Style 440 \$169.00 Choose Options	 ★★★★ Omnia Door Knob Style 441 \$169.00 Choose Options	 ★★★★ Omnia Door Knob Style 198/90 \$132.80 Choose Options	 ★★★★ Omnia Door Knob Style 232 \$173.70 Choose Options	 ★★★★ Omnia Door Knob Style 260 \$168.00 Choose Options	 ★★★★ Omnia Door Knob Style 294 \$224.00 Choose Options	 ★★★★ Kwikset Signature Series Juno Door \$18.80 Choose Options	 ★★★★ Kwikset Signature Series Phoenix \$18.90 Choose Options	 ★★★★ Kwikset Signature Series Copo Door \$18.90 Choose Options	 ★★★★ Kwikset Signature Series Laurel Door \$15.75 Choose Options
 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Newport Rosette with Eden \$200.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$198.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$198.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$198.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$155.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$158.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$128.00 Choose Options	 ★★★★ Grandeur Newport Rosette with Fifth \$130.00 Choose Options
 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$184.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$184.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$169.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$169.00 Choose Options	 ★★★★ Grandeur Fifth Avenue Plate with \$169.00 Choose Options	 ★★★★ Grandeur Parthanon Plate \$198.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$133.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$133.00 Choose Options	 ★★★★ Grandeur Newport Rosette with \$133.00 Choose Options	 ★★★★ Grandeur Newport Rosette with Fifth \$130.00 Choose Options
 ★★★★ Baldwin Estate Series X003 Knob \$199.80 Choose Options	 ★★★★ Baldwin Estate Series X004 Knob \$199.80 Choose Options	 ★★★★ Baldwin Estate Series X005 Knob \$199.80 Choose Options	 ★★★★ Baldwin Estate Series X006 Knob \$199.80 Choose Options	 ★★★★ Baldwin Estate Series 5085 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5086 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5087 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series X002 Knob \$228.00 Choose Options	 ★★★★ Baldwin Estate Series 5045 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5050 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5055 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5055a Knob \$208.80 Choose Options
 ★★★★ Baldwin Estate Series 5007a Knob \$228.00 Choose Options	 ★★★★ Baldwin Prestige Series Alcott Door \$41.25 Choose Options	 ★★★★ Baldwin Prestige Coraby Door Knob \$22.80 Choose Options	 ★★★★ Baldwin Prestige Series Alcott Door \$22.80 Choose Options	 ★★★★ Baldwin Estate Series 5089 knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5073 knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series X001 Knob \$268.80 Choose Options	 ★★★★ Baldwin Estate Series X002 Knob \$268.80 Choose Options	 ★★★★ Baldwin Estate Series 5045 Knob \$208.80 Choose Options	 ★★★★ Baldwin Estate Series 5050 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5055 Knob \$216.00 Choose Options	 ★★★★ Baldwin Estate Series 5084 Knob \$216.00 Choose Options
 ★★★★ Grandeur Georgetown \$135.00 Choose Options	 ★★★★ Grandeur Georgetown \$135.00 Choose Options	 ★★★★ Grandeur Georgetown \$130.00 Choose Options	 ★★★★ Grandeur Georgetown \$135.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$189.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$189.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$189.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$189.00 Choose Options	 ★★★★ Schlage Indover F51-AND \$39.00 Choose Options	 ★★★★ Schlage Indover F51-AND \$39.00 Choose Options	 ★★★★ Schlage Bell F51- BEL \$39.00 Choose Options	 ★★★★ Schlage Bell \$39.00 Choose Options
 ★★★★ Grandeur Georgetown \$130.00 Choose Options	 ★★★★ Grandeur Georgetown \$130.00 Choose Options	 ★★★★ Grandeur Georgetown \$130.00 Choose Options	 ★★★★ Grandeur Georgetown \$130.00 Choose Options	 ★★★★ Grandeur Grande Victorian Plate with \$189.00 Choose Options	 ★★★★ Grandeur Windsor Plate with \$189.00 Choose Options	 ★★★★ Grandeur Windsor Plate with \$189.00 Choose Options	 ★★★★ Grandeur Windsor Plate with \$189.00 Choose Options	 ★★★★ Schlage Georgian F51-GE0 \$69.00 Choose Options	 ★★★★ Schlage Georgian \$130.00 Choose Options	 ★★★★ Schlage Plymouth F51-PLY \$130.00 Choose Options	 ★★★★ Schlage Orbit F51- ORB \$130.00 Choose Options

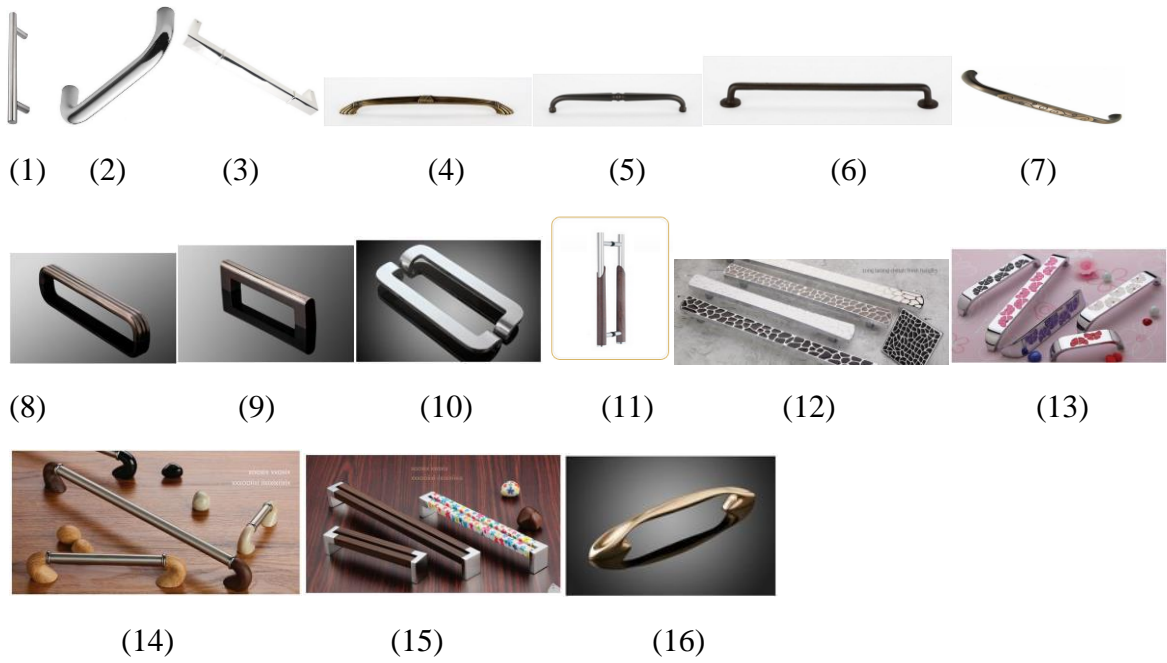
Appendix-II



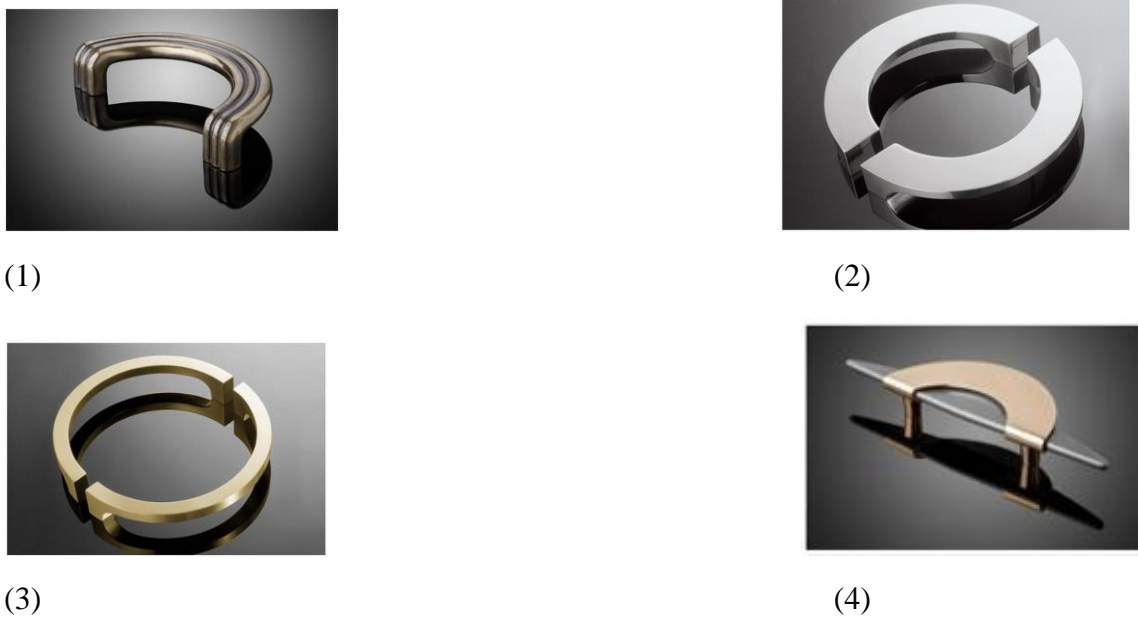
Appendix-III



Appendix-IV



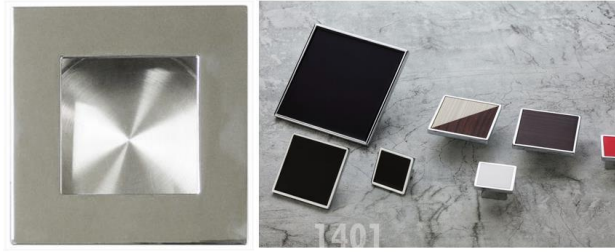
Appendix-V



Appendix-VI



Appendix-VII



(1)

(2)

Appendix-VIII



(1)

(2)

(3)

(4)

Appendix-IX



(1)

(2)

(3)

(4)

(5)

Appendix-X



(1)

(2)

(3)

Appendix-XII

Straight-sharp:



1.)



(2)



(3)



(4)



(5)



(6)



(7)



(8)

straight-soft:



(1)



(2)



(3)



(4)



(5)

Straight-semi:



(1)



(2)



(3)



(4)



(5)

Curvy-sharp:



(1)



(2)



(3)



(4)



(5)

Curvy-soft:



(1)



(2)



(3)



(4)

Curvy-semi:



(1)



(2)



(3)



(4)

Circular/semi-circular:



(1)



(2)



(3)



(4)



(5)