The Summer Internship Project 2008

Designing the Industrial Safety Helmet

Company:
Udyogi Plastics Pvt. Ltd, Kolkata

Duration:
09th May 2008 to 06th July 2008

Submitted by:
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Industrial Design Centre
Indian Institute of Technology, Bombay

Certificate

Contents

Preface

This is a design journey of Industrial safety helmet, which is a part of the Summer Internship Project (2008). This project is done for India's largest manufacturer and exporter of personal protective equipment.

This industry represents the group industries which have their own well established manufacturing setup and are willing to launch innovative design, though they don’t have their own in house design studio. The organisations like this one are large in number, and their liberal attitude towards design will definitely benefit the society.

The experience gave me a brief look into the design process of a professional consultancy.

Acknowledgments

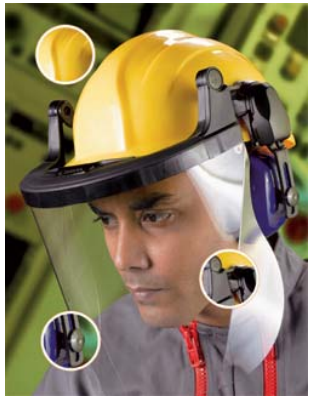
I would like to express my deepest gratitude to Mr. Manohar Bagri (Director-Technical), Mr. G K Mundhra, Mr. Natwar Bagri and the rest Directors of Udyogi Group, for making available the opportunity for me to work with them as a Summer Internship Project and for all their guidance and the support.

Furthermore, I wish to express my gratitude to thank Mr. Arup Chatterjee and Mr. D N Banerjee , for their valuable technical inputs. I would also like to take this opportunity to thank Mr. B K Neogy and all staff of Ugyogi Group for all their help, support and hospitality.

Further, I would also like to thank Mr. Dulal Paul and his group for assisting me in the clay modelling and who had helped in making the FRP models.

Most sincere thanks to Prof. B. K. Chakravarthy for his support and feedback at various stages in the project.



About the Udyogi Group of Industries

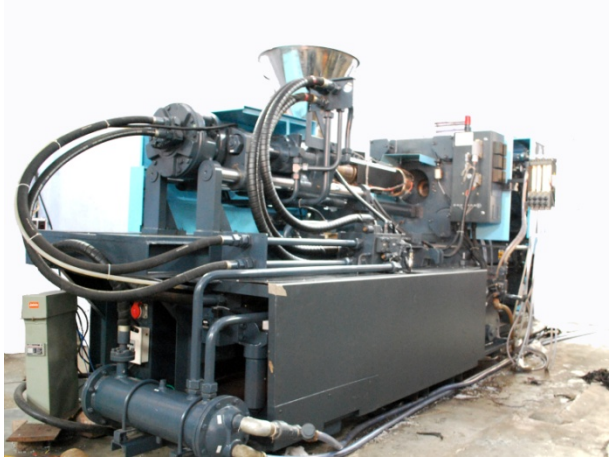
The Udyogi Group of Industries is India's largest manufacturer and exporter of personal protective equipment.

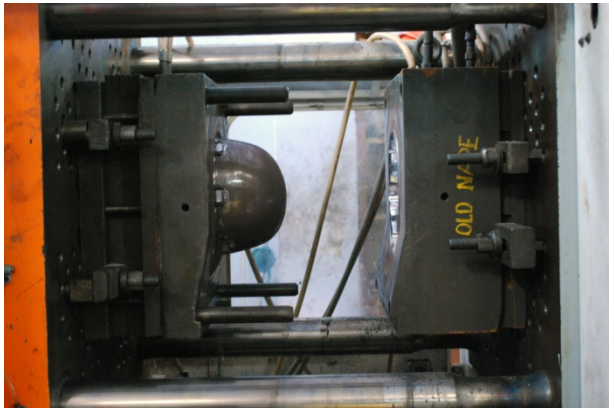
Udyogi (commissioned in 1962) derives its success from the longstanding exposure of entrepreneurs Mr.GK Mundhra and Mr. Manohar Bagri to the mining industry and insight into evolving safety standards.

Udyogi provides comprehensive solutions to industrial safety products. These solutions are provided across the construction, mining, oil rigs, power, refineries, petrochemicals, steel, transmission, aluminium, defence, telecommunication industries.

The comprehensive product assortment comprises safety helmets, started manufacturing fall protection systems 1972-1987 (full body harnesses, fall arrestors, connectors, retractable and lanyards), eye protection safety wears, ear protection as well as emergency showers and eyewash upgraded regularly in line with rising safety expectations.

The range of personal protective equipment is developed in consultation with users and professionals, designed to address specific needs within a range of activities involving the highest risk.





Udyogi group has three manufacturing units, which are located on the outskirts of Kolkata in West Bengal (India) across a consolidated area of 40,000 square feet. Udyogi possesses an internationally benchmarked laboratory at its facilities, qualified professionals applying the most stringent quality checks on products in line with domestic and international industry regulations.

Udyogi's distribution presence covers eight branches at Kolkata, Mumbai, Chennai, Delhi, Ahmedabad, Jamnagar, Bhubaneswar and Rayagada supported by more than 500 nationwide dealers. It has also consolidated its international footprint with a presence in the highly regulated markets of Eastern/ Central Europe, South East Asia and the Middle East.

Introduction

The industrial safety helmet, primarily intended to protect the upper part of the head against injury from the falling objects.

The effects of head injury can be classified generally into three categories:

Physical effects
The physical effects of head injuries include such symptoms as seizures, loss of motor speed or coordination and the presence of an abnormal movement such as tremors and spasticity

Cognitive changes
involve disorders of attention, concentration and memory, problems with understanding or producing speech, difficulties with initiating and planning daily activities, as well as poor reasoning and judgment

Behavioural effects
include agitation and irritability, verbal and physical aggressiveness, impulsivity, depression and suicidal thoughts, as well as an egocentric or self-centered orientation in interpersonal relationships

Safety helmets are designed to protect the head of a wearer against falling objects by resisting the penetration and reducing the shock absorption by the head and body even under the extreme local climatic conditions. According to Conformité Européenne standards,EN397, it has to withstand in following circumstances namely
Used in temperatures as low as -30oC and as high as +150oC,Electrical resistance up to 440 V, Resistance against molten metal, marked as MM, Resistance against side squeeze, marked LD and for lateral deformation.

The industrial safety helmet has a wide application in the industries viz.

- Construction projects
- Mining
- Tunneling
- Quarrying
- Ship building
- Oil and petrochemicals
- Transmission
- Defence
- Telecommunication
- Metal Industries

These helmets are required personal protective equipment where heavy labour is being performed. They were originally made from metal, then fiber-glass, but from the 1950s rigid plastic has been the most common material.

On construction sites hard hat colors can signify different roles. For instance: white for supervisors, blue for technical advisors, red for safety inspectors, and yellow for workmen.

The industrial safety helmet is properly inspected and cared for as per specified by the manufacturer's instruction, and it should be replaced after the specified life period.

The current product range

Fusion 6000L CE

Ultra 5000LRX
Ultra 5001LRX CE

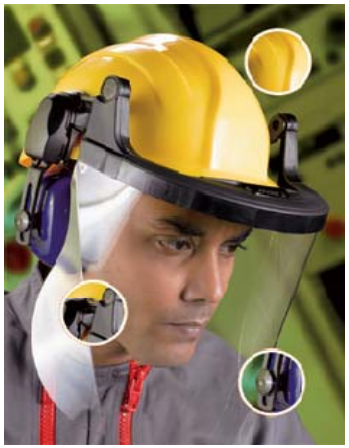
UI 1211

The Need of Designing…

- Targeting for foreign (European) market
- To create an brand identity
- To create a style statement
- To achieve more comfort for user
- Universal acceptance
- Looking for in house design for uniqueness of product

Project Brief

To design Industrial Safety Helmet,
which should be light-weight,
address the comfort of the user,
should have its own style statement,
and the target market is European as well as Asian countries.



Understanding the product

An industrial safety helmet often has that firm's name and/or logo and the manufacturing batch details on it. And the instructions for the user are provided with a sticker and/or a user's manual.

The industrial helmet may also be fitted with the add-ons like :

- Visor
  - A welding visor, or
  - A thinner version of a riotsquad helmet visor
- Ear protectors
- Mirrors for increased rear field-of-view
- A helmet light mount
- A chinstrap to avoid the helmet falling off if the workman bends far forwards.

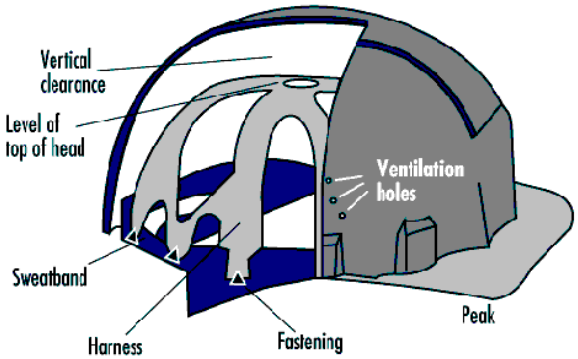
The lower edge of the brim of the helmet sometimes has a small gutter to catch rainwater and shed it off the front peak; but that needs the lower edge of the helmet to be horizontal instead of coming further down the back of the head.

Technical specifications

The industrial safety helmet has to be according to the standards accepted by the market countries. These standards have been prepared by the Technical Committees, formed by the experts in the concern field.
The standards includes the specifies physical and performance requirements, methods of test and marking for helmets in general use and Head-forms for use in the testing of protective helmets.

The following standards are followed for Industrial Safety Helmet.

CЄ	Conformité Européenne EN 397, 390
ANSI	American National Standards Institute ANSI 289.1 2003 Helmets American National Standard for Industrial Head Protection
BIS	Bureau of Indian Standards IS: 2925
OSHA	Occupational Safety and Health Administration
ILO	International Labour Organization (UN)



The sub-components

Elements of industrial helmet

Shell
: The hard smoothly finished material that provides the general outer form of the helmet

Peak
: The extension of the shell above the eyes

Brim
: A rim surround the shell

Harness
: The complete assembly that provides a mean of maintaining the helmet in position on the head and/or of absorbing kinetic energy during the impact

Head band
: The part of the harness completely or partly surrounding the head above the eyes at approximately the largest horizontal circumference of the head

Nape Strap
: The adjustable strap that fits behind the head below the planes of the headband

Cradle
: The assembly of the parts of the harness in contact with the head, excluding the headband and nape strap, and it may be either fixed or adjustable

Cushioning
Material to improve wearing comfort

Anti-concussions tapes
Supporting straps which absorbs kinetic energy during impact

Comfort band or Sweat bands
An accessory to cover at least the inner front surface of the headband to improve wearer comfort

Ventilation holes
Holes are provided in the shell which may allow circulation of the air

Chin Strap
A strap which fits under the chin to help secure the helmet on the head

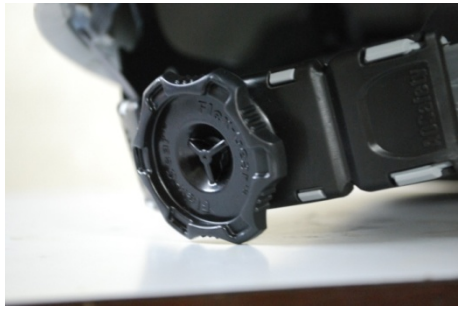
Helmet accessories
Any additional parts for special purposes such as chin strap, neck protector, drawlace and attachment devices for lamp, cable, face protection and hearing protection

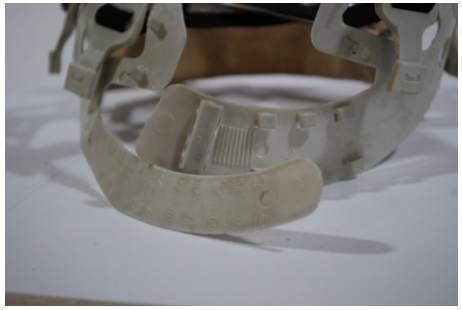
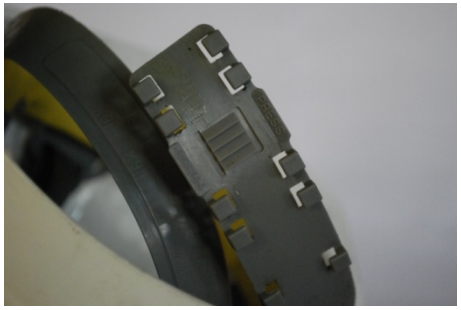
The synchronic analysis of the product

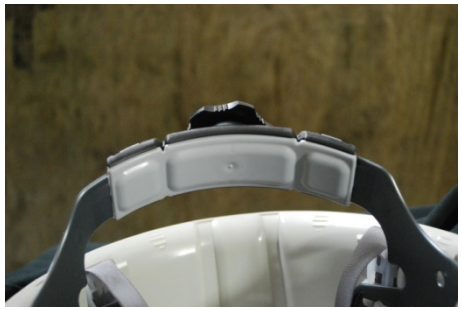
The current available various Industrial safety helmets are studied in details and a form of analysis drawn in which change over time is examined by comparing with other one.

The synchronic analysis gives us a brief overview of the current trends, styles and technological improvement of the product.

The head band and nape strap



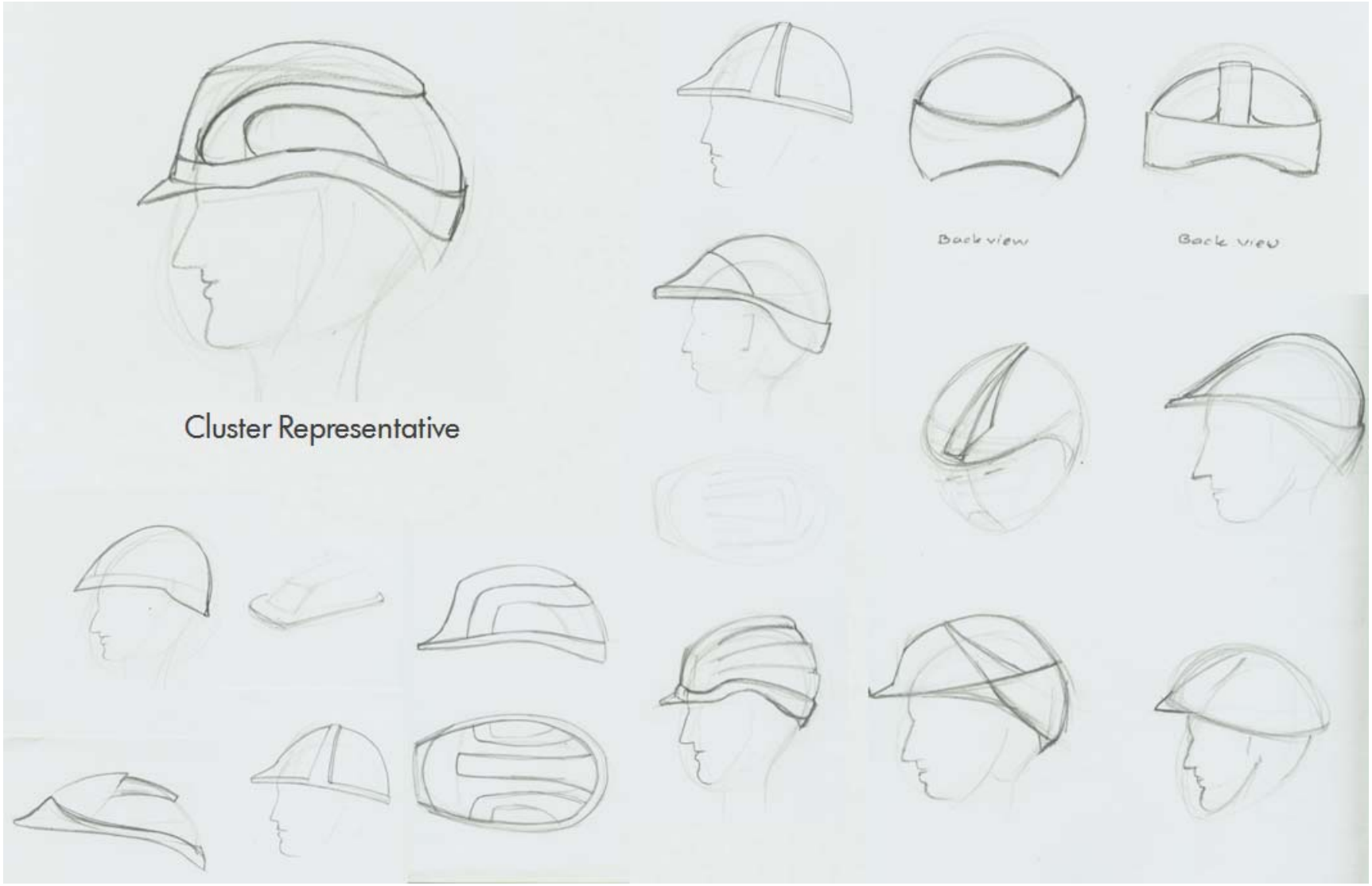


Idea Generation

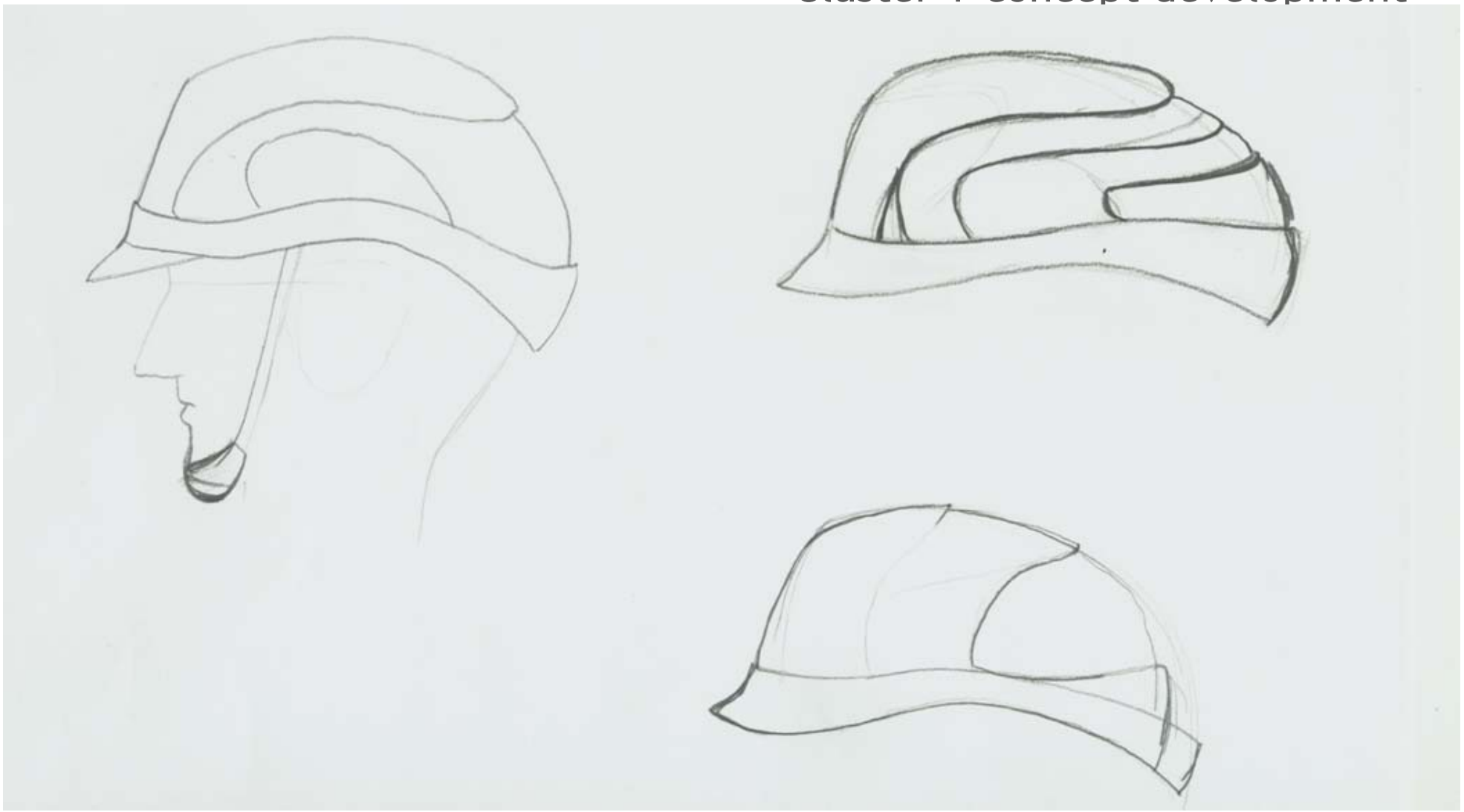
Some keywords

- Protection
- Stylish
  - The Attractive product
  - To grab attention
  - The desirable product
  - Customer should drawn towards product
- Comfort
  - Ventilation by circulation of fresh air
  - Adjustability for different size requirement
  - Cushion pads and Sweat pads
  - Hygiene
  - Light in weight
- The area for Graphics (Branding/ Instructions/ product data etc.)
- The personal helmet
- Name tag – user's info
- Arrangement to hold some accessories- pen, pencil, torch,
- Wearing a helmet
  - Grip for fingers
  - As hands on the field are covered with grease, oil, water…….and with different types of gloves also.
- The head band
- The adjustment should be quick and easy
  - Auto lock (?)
  - Velcro Fabric for replacement of sweat band (?)
- Heat seal
- Stitching
- Insert mold

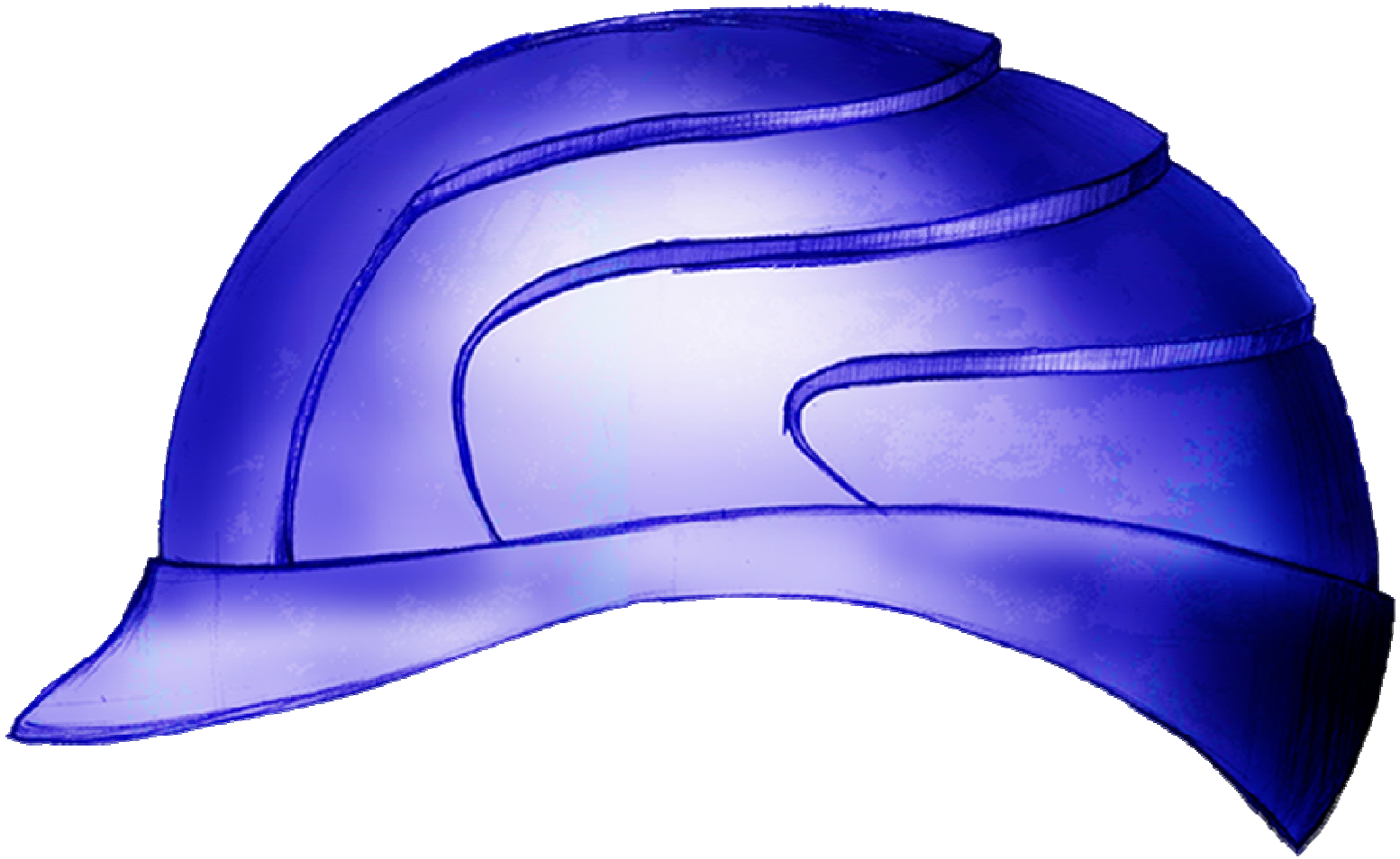
Cluster 1



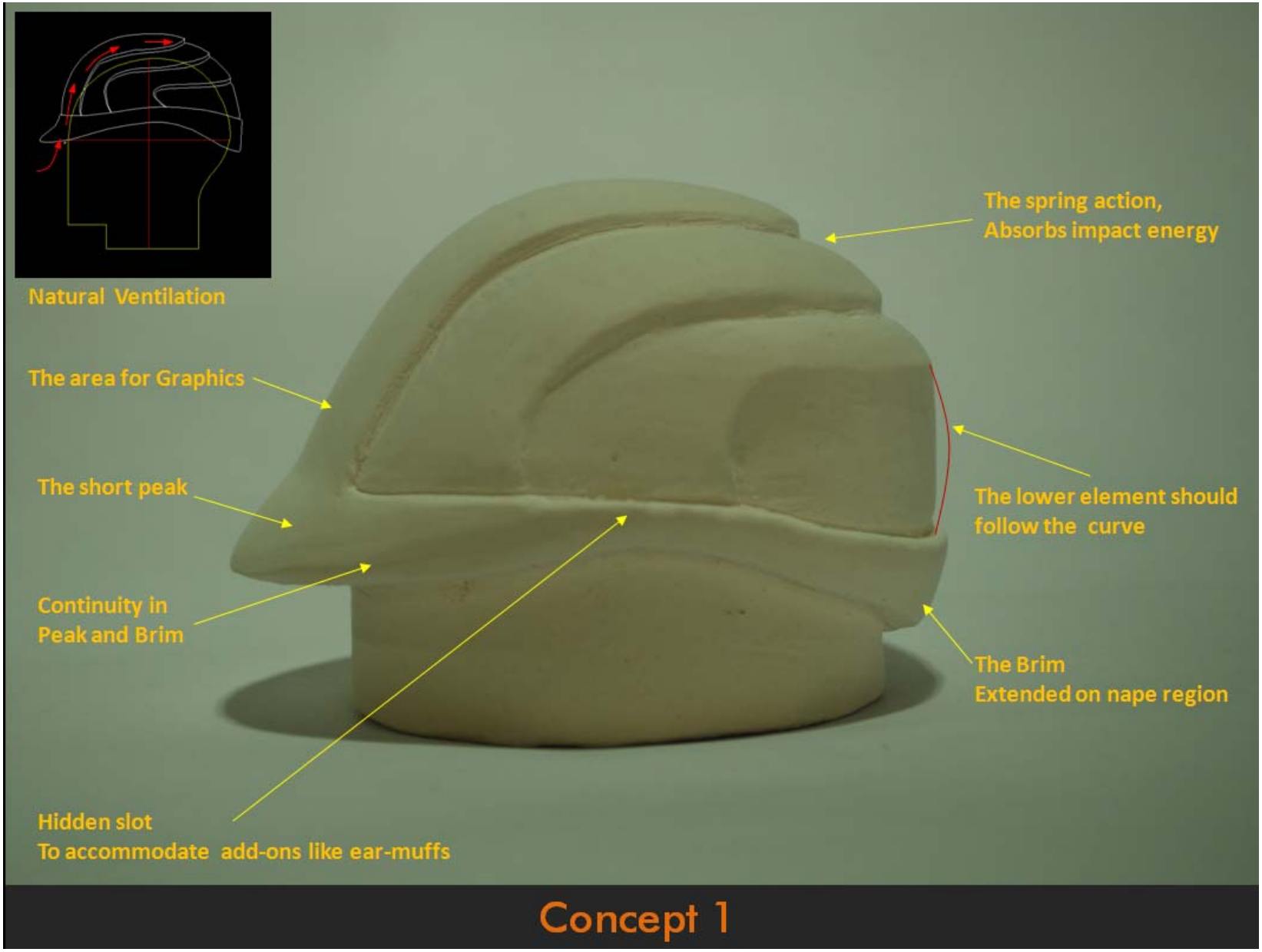
Cluster 1-concept development



Concept 1

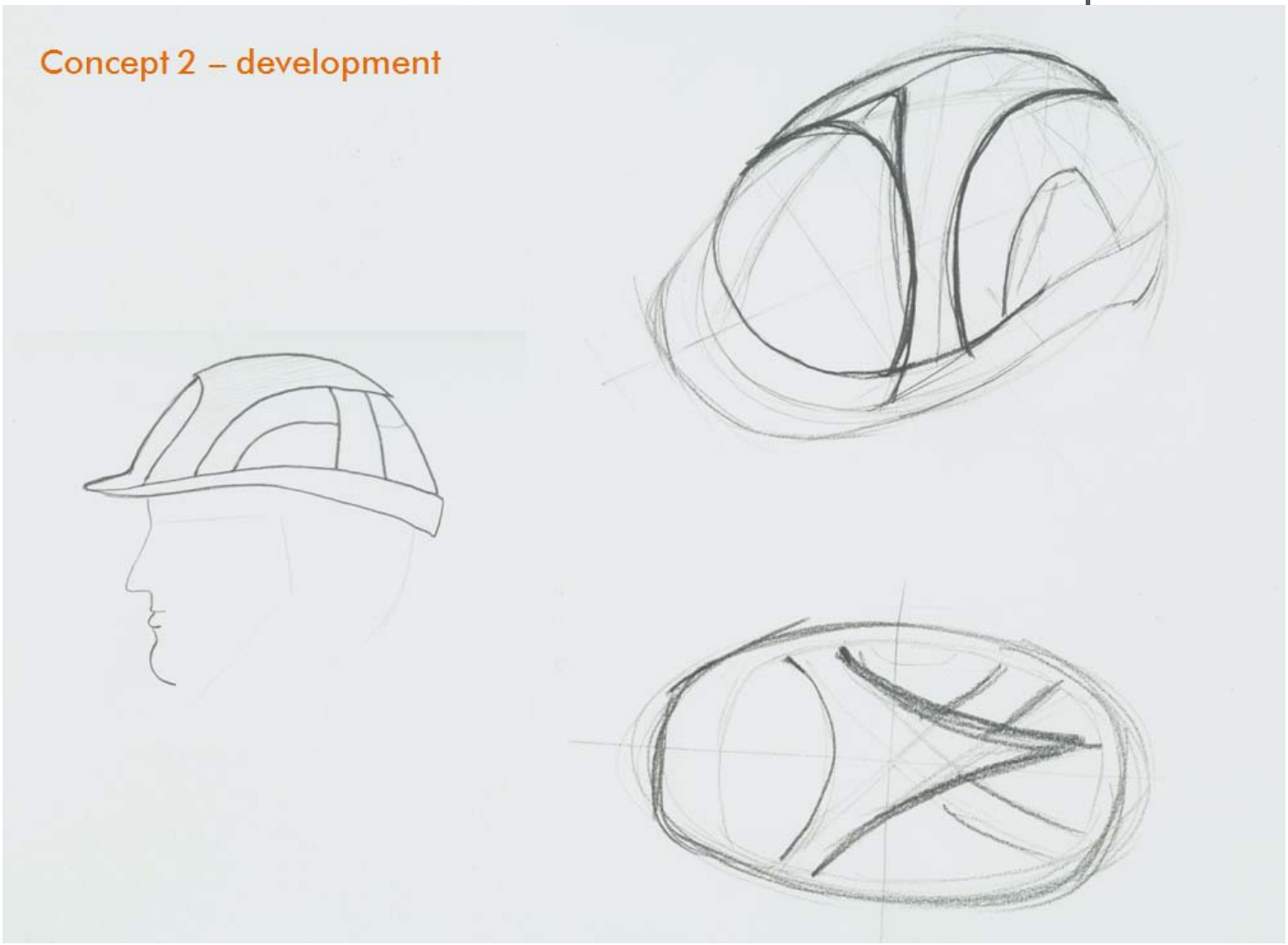


Concept 1- Mockup Model

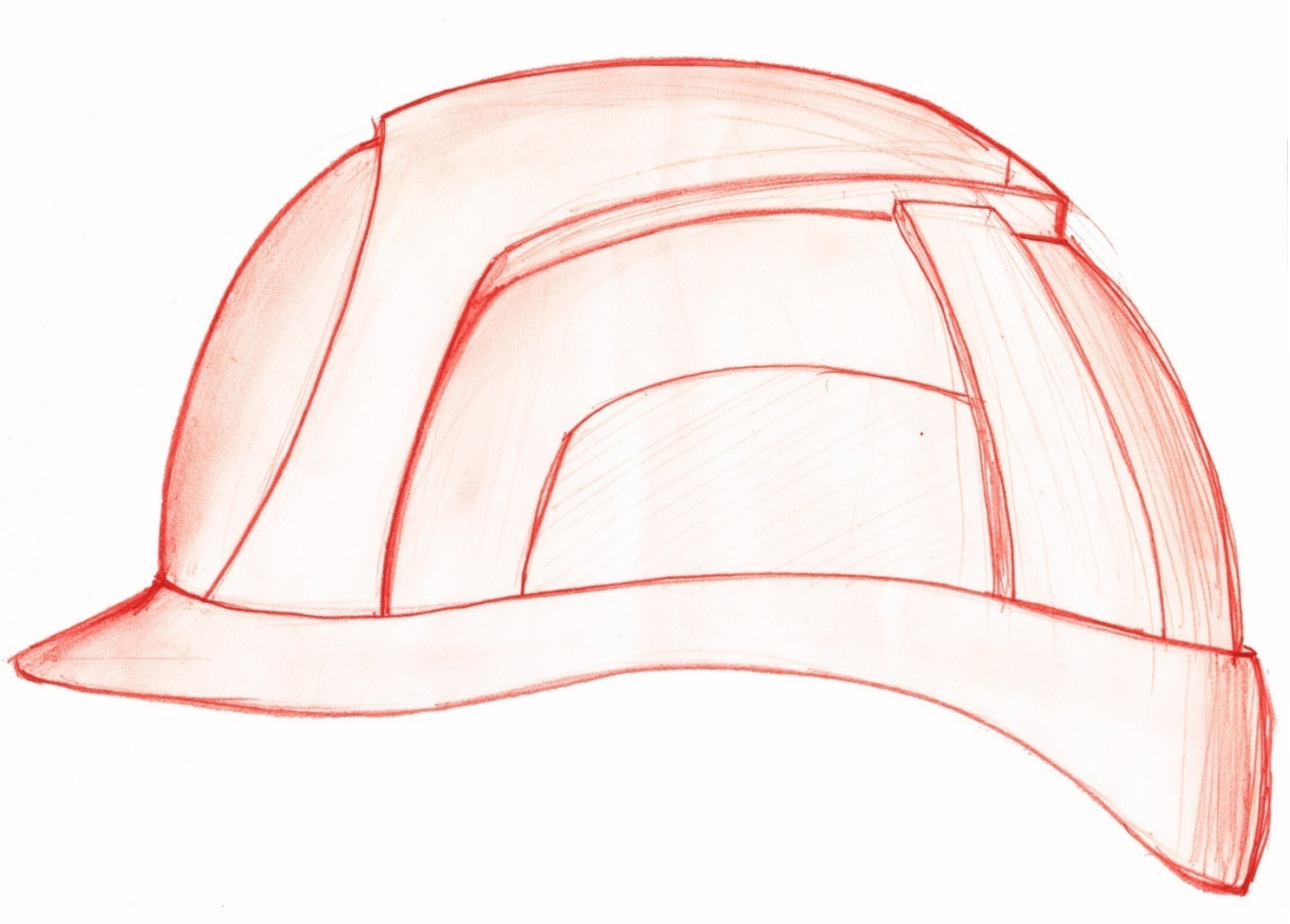

Natural Ventilation
The area for Graphics
The short peak
Continuity in
Peak and Brim
Hidden slot
To accommodate add-ons like ear-muffs
The spring action,
Absorbs impact energy
The lower element should
follow the curve
The Brim
Extended on nape region
Concept 1


Cluster 2
Cluster Representative

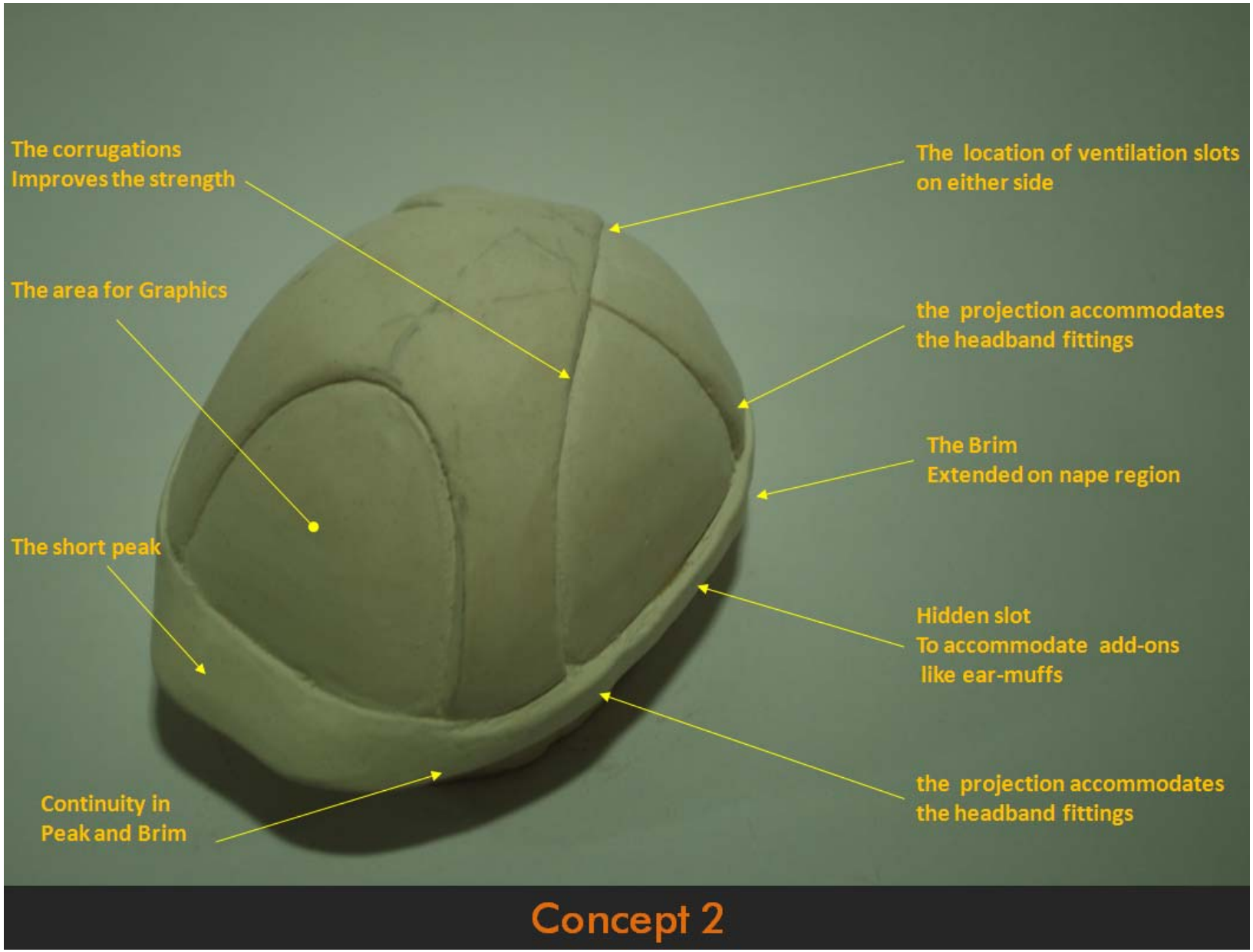
Cluster 2-concept development



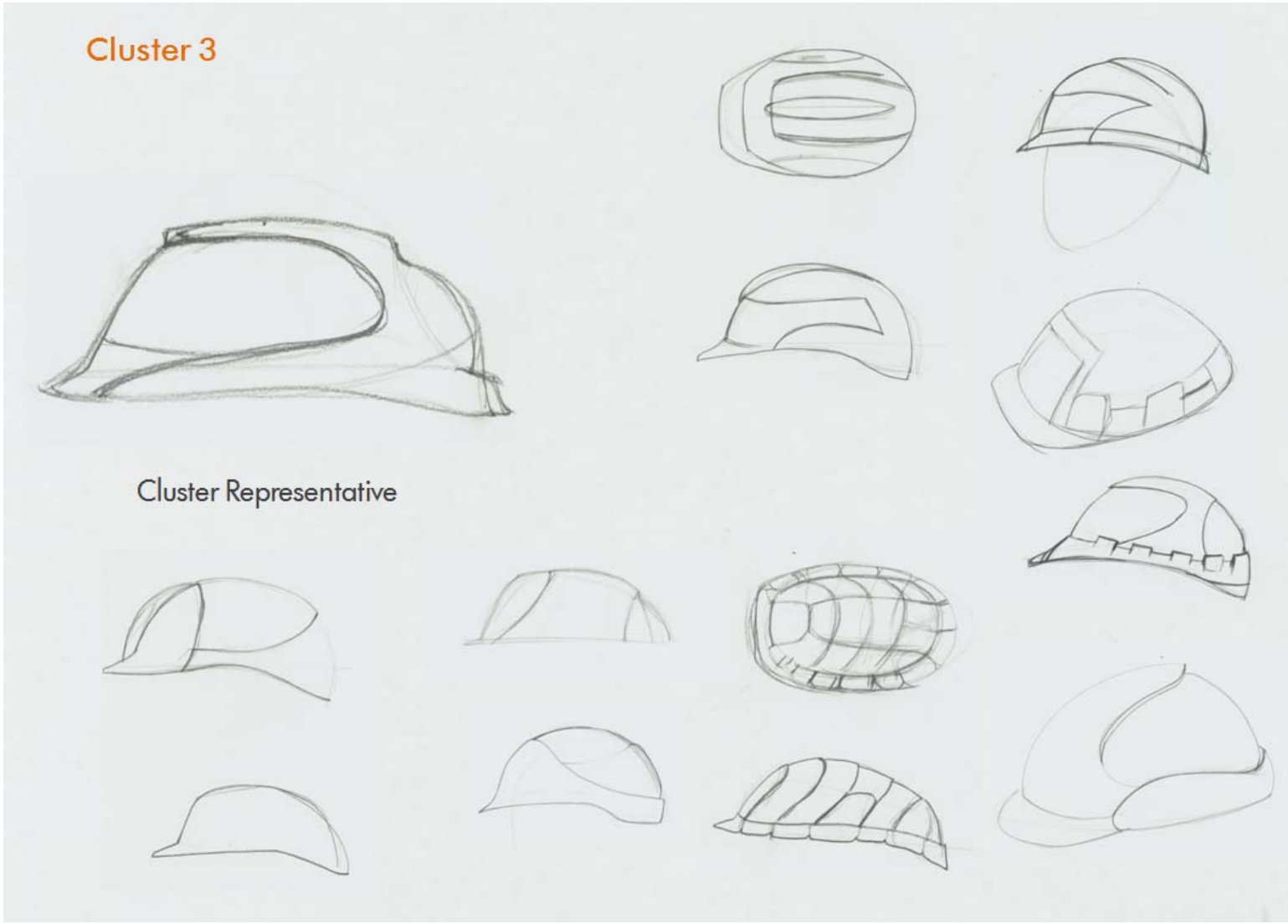
Concept 2



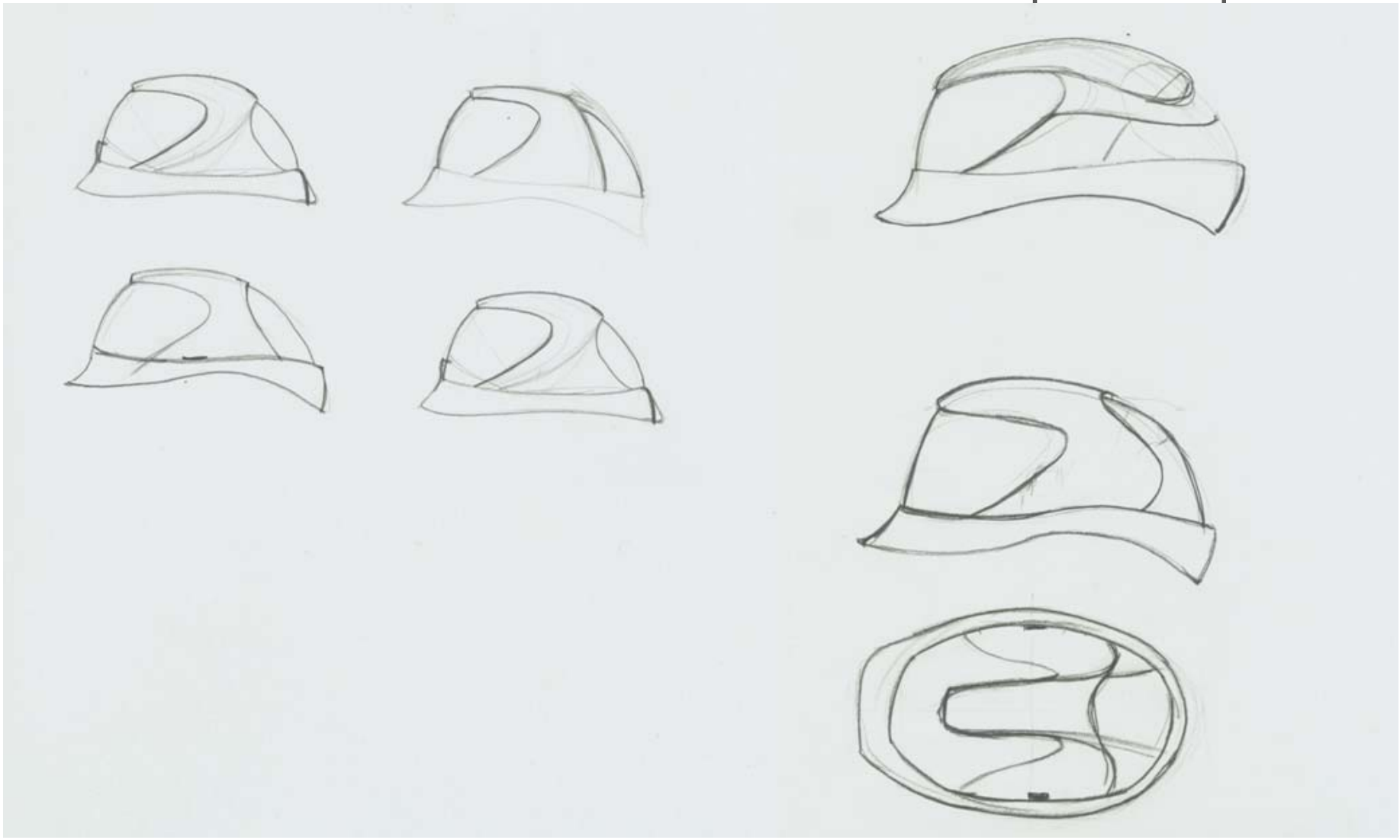
Concept 2- Mockup Model


The corrugations
Improves the strength
The area for Graphics
The short peak
Continuity in
Peak and Brim
The location of ventilation slots
on either side
the projection accommodates
the headband fittings
The Brim
Extended on nape region
Hidden slot
To accommodate add-ons
like ear-muffs
the projection accommodates
the headband fittings
Concept 2

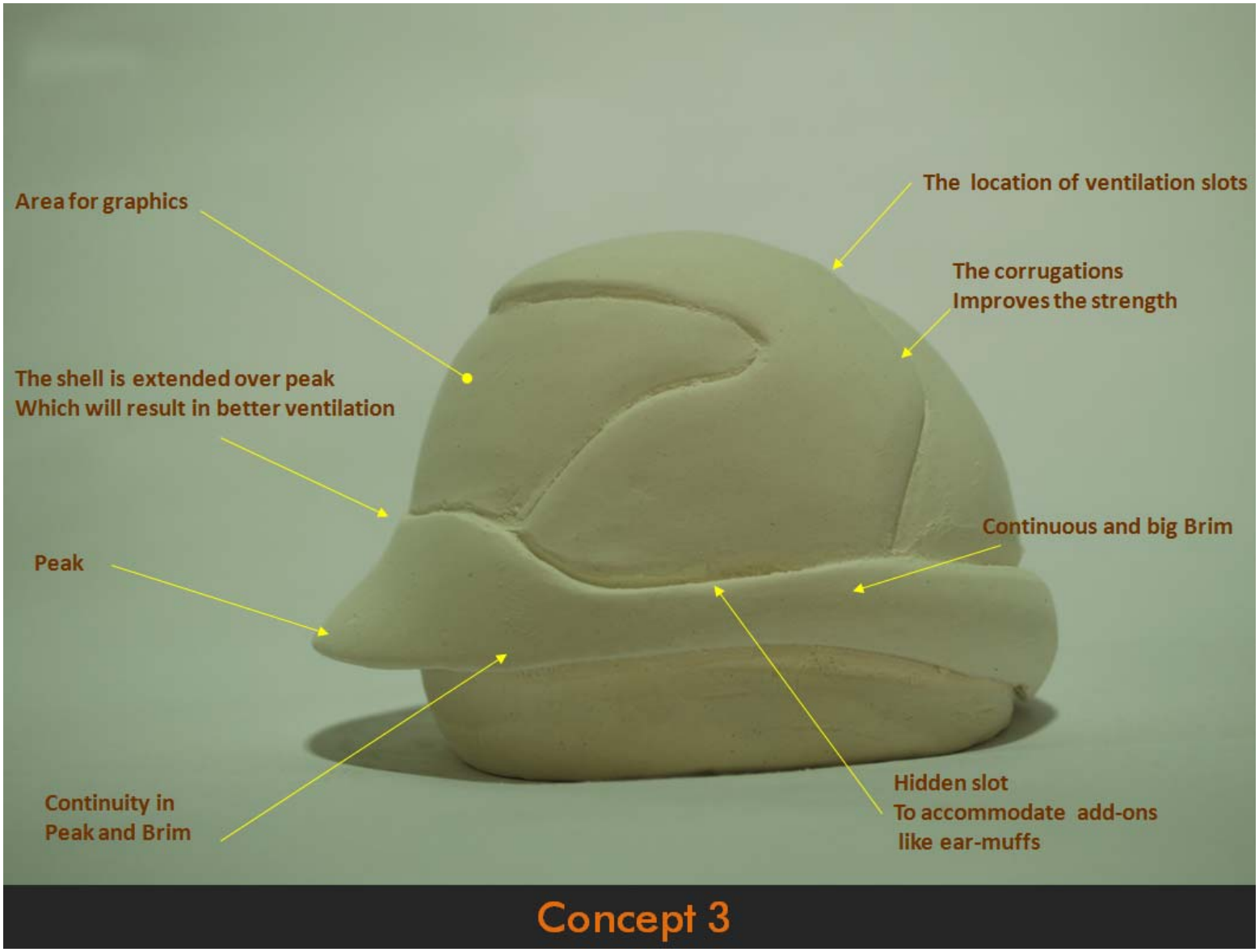
Cluster 3



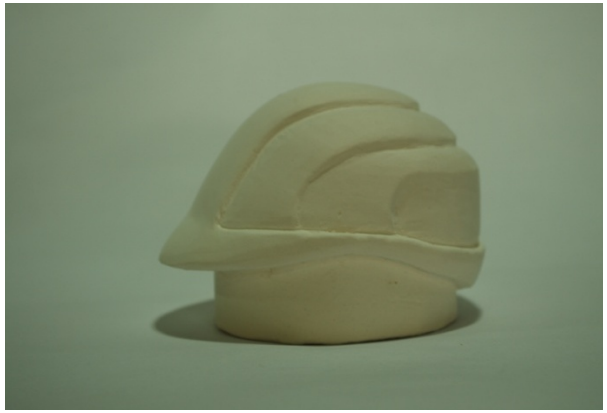
Cluster 3- concept development



Concept 3- Mockup Model


Area for graphics
The location of ventilation slots
The corrugations
Improves the strength
The shell is extended over peak
Which will result in better ventilation
Peak
Continuous and big Brim
Continuity in
Peak and Brim
Hidden slot
To accommodate add-ons
like ear-muffs
Concept 3

Concepts



Concept 1

Concept 2

Concept 3

Out of the three concepts, concept 1 and concept 2 are selected .

Refinement in Concept

For the better perception the diagrams are drawn at the 1:1 scale.

Following the standards, defined the basic major dimensions and also freeze the various details.

The concepts are checked with the standard head-forms for the better fitment of the helmet

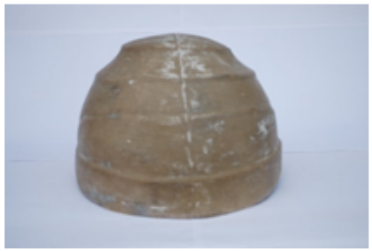
Dimension detailing is done.

Checked the feasibility of the concepts with the existing manufacturing setup.

Concept 1: Clay Modeling

Concept 2: Clay Modeling

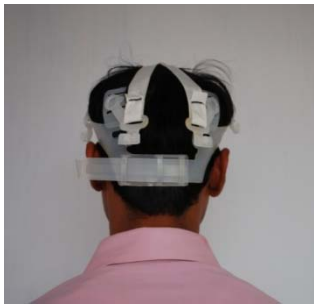
Concept 1: FRP Model



Concept 2: FRP Model

Final Concept 1

Final Concept 2



Inside the helmet

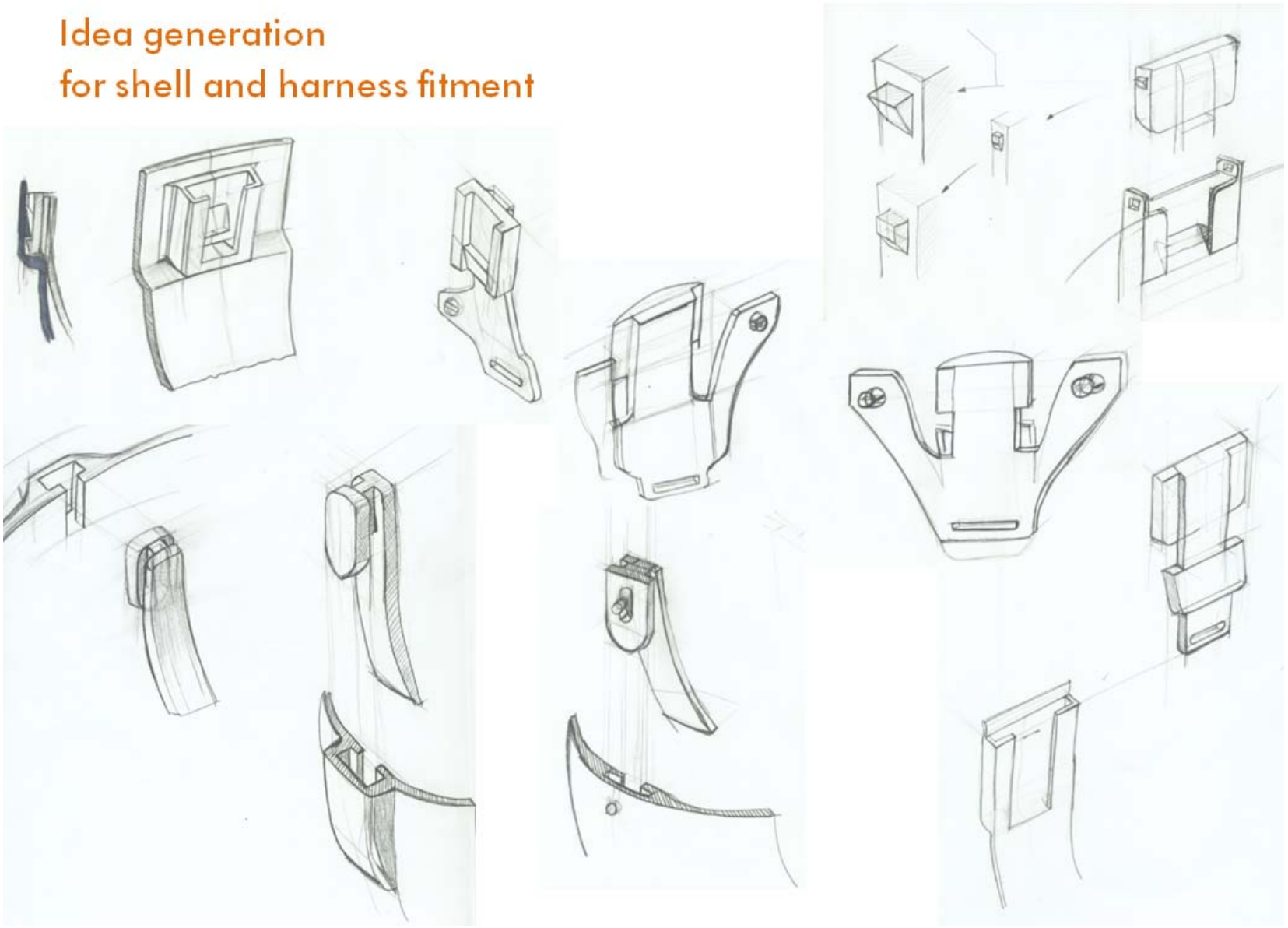
Harness

the complete assembly that provides a means of maintaining the helmet in position on the head and /or absorbing kinetic energy during the impact.

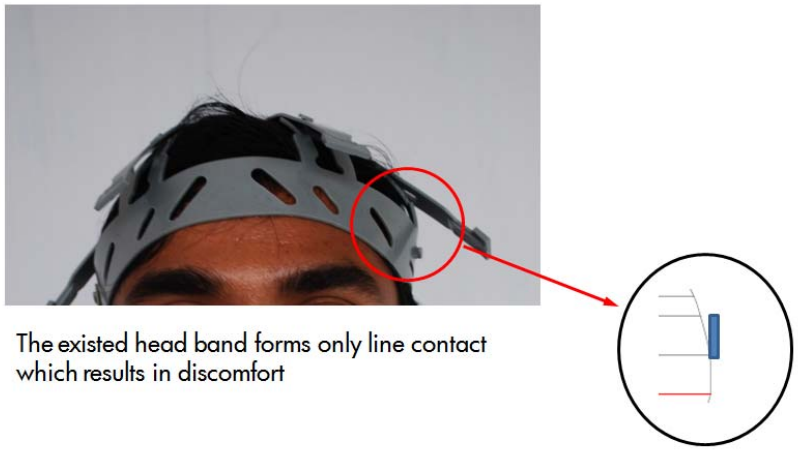
It includes

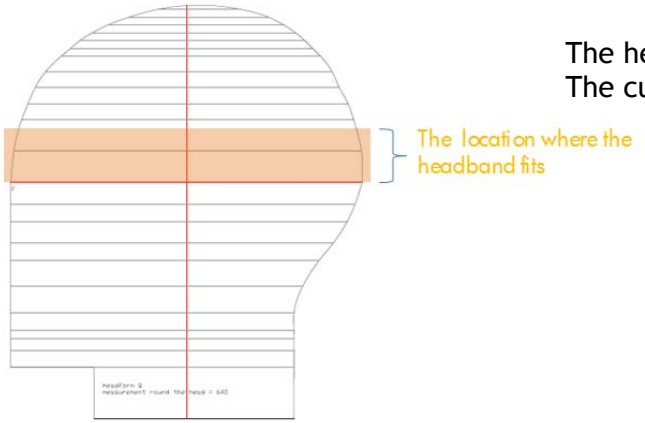
- Cradle
- Head band
- Nape strap
- Sweat band

Idea generation
for shell and harness fitment



Problems with current harness





...for the better comfort

The head curvature are studied with respect to the standard head-forms
The current band forms a part of cylinder, which results as a line contact with head

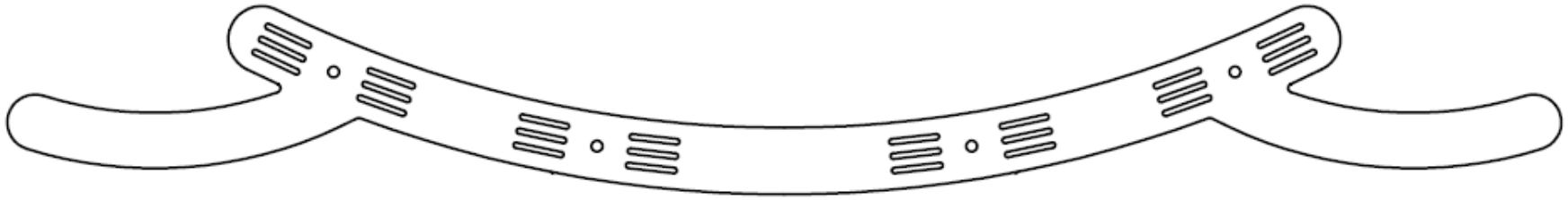
Redesigned headband

The improved comfort

The headband follows the curvature of head-forms

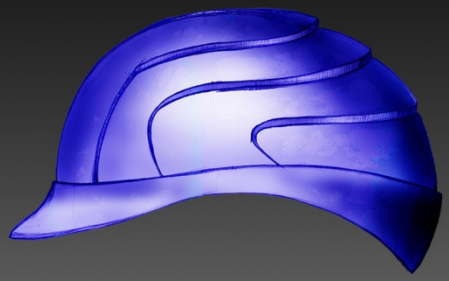
Manufacturing –
- Injection molding
- With two piece mould die

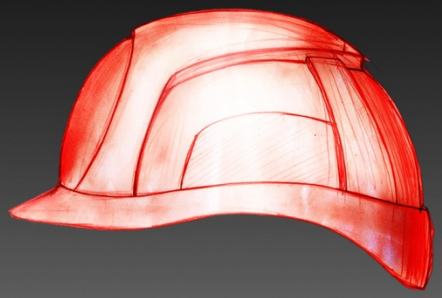
Compatible with current manufacturing setup



Industrial Safety Helmet

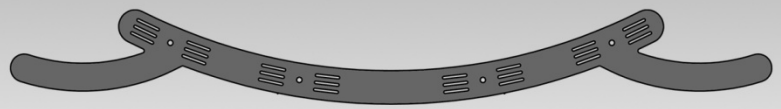
Concept sketches





FRP Prototype

Craddle
& support details



Learning

An enriching experience

Constraints drives the design and also decides the direction to the process

The design process is dependent upon the management

The open-mindedness results in liberal design

The design is always a teamwork

The team should include the representatives from all the departments

The experience was a brief look into the design process of a professional consultancy

References

Specification for industrial safety helmets, BS EN 397:1995, ISBN: 0 580 23432 0
(Specifies physical and performance requirements, methods of test and marking for helmets in general use)

Head-forms for use in the testing of protective helmets, BS EN 960:2006,
ISBN: 0 580 48908 6

Specification for industrial safety helmets, IS 2925, Bureau of Indian Standards

Product Design: A practical guide to systematic methods of new product development
Mike Baxter, 1995, Chapman & Hall, ISBN: 0 412 63230 6

A meeting had with Mr. Prashanta Malik, from B.T. Polymer, dated 28th May 2008.
He had given some valuable inputs in the material technology (Plastics).

www.udyogisafety.com
The authorised website of the Udyogi groups