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& Mukesh Bopalkar

Redesign of User Interaction for Air Defense System

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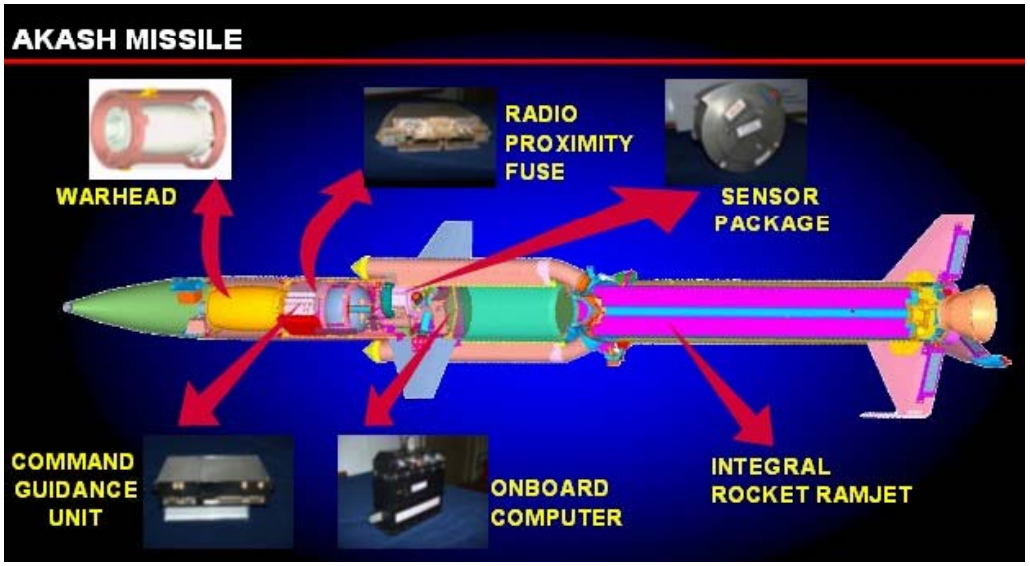
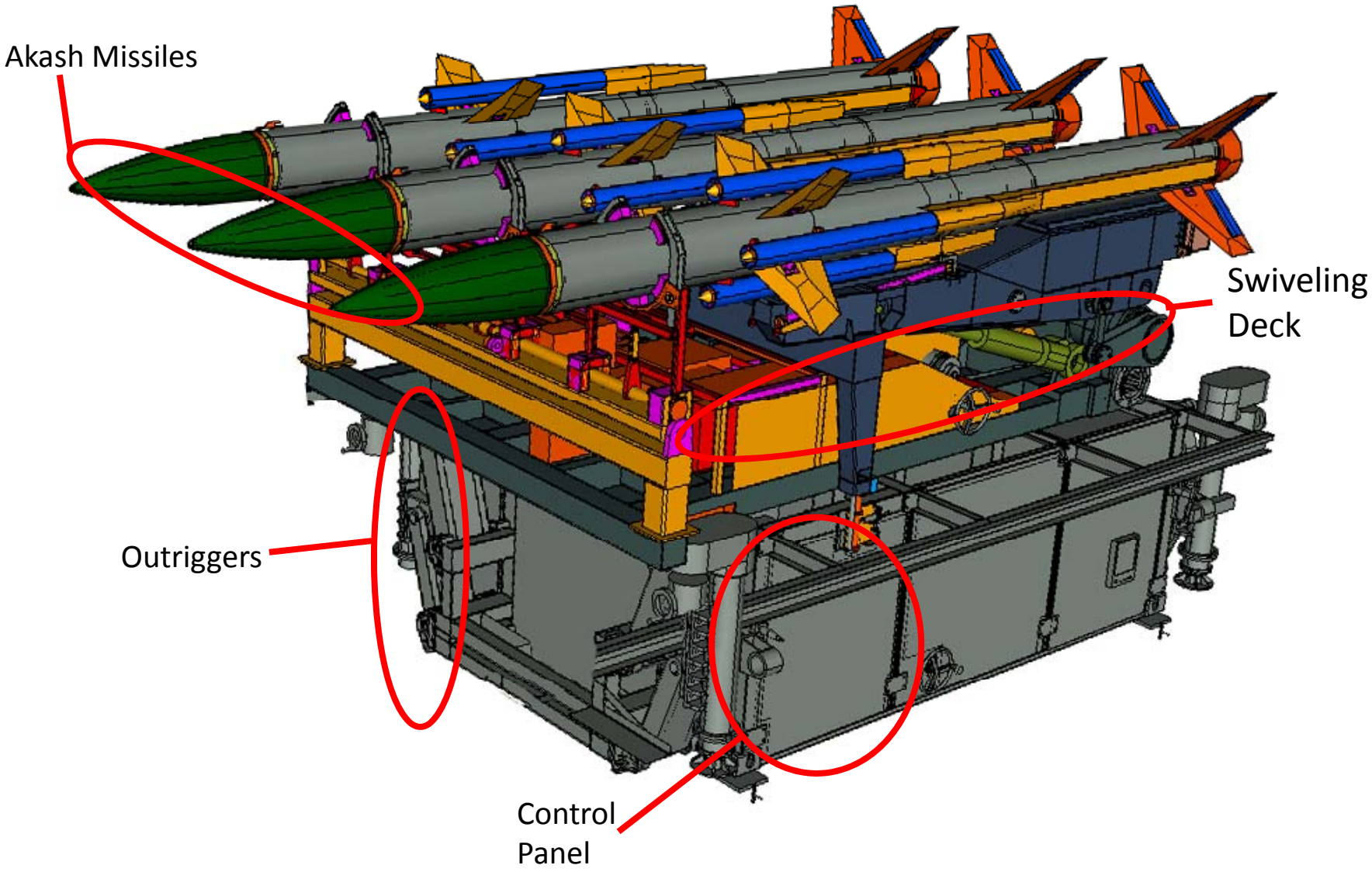
Project Akash Air Force Launcher

- AAFL is developed as a launch platform for surface to air missile for self defense purpose
- The launcher remains stationary once deployed
- It is to be deployed near an air-base and is never meant to enter the battlefield

About Akash Missile



- Akash (1990) : Supersonic Surface to Air Missile (SAM)
- Multi-target engagement
- Remote operated completely automated operation


Akash Missiles
Swiveling Deck
Outriggers
Control Panel

Videos

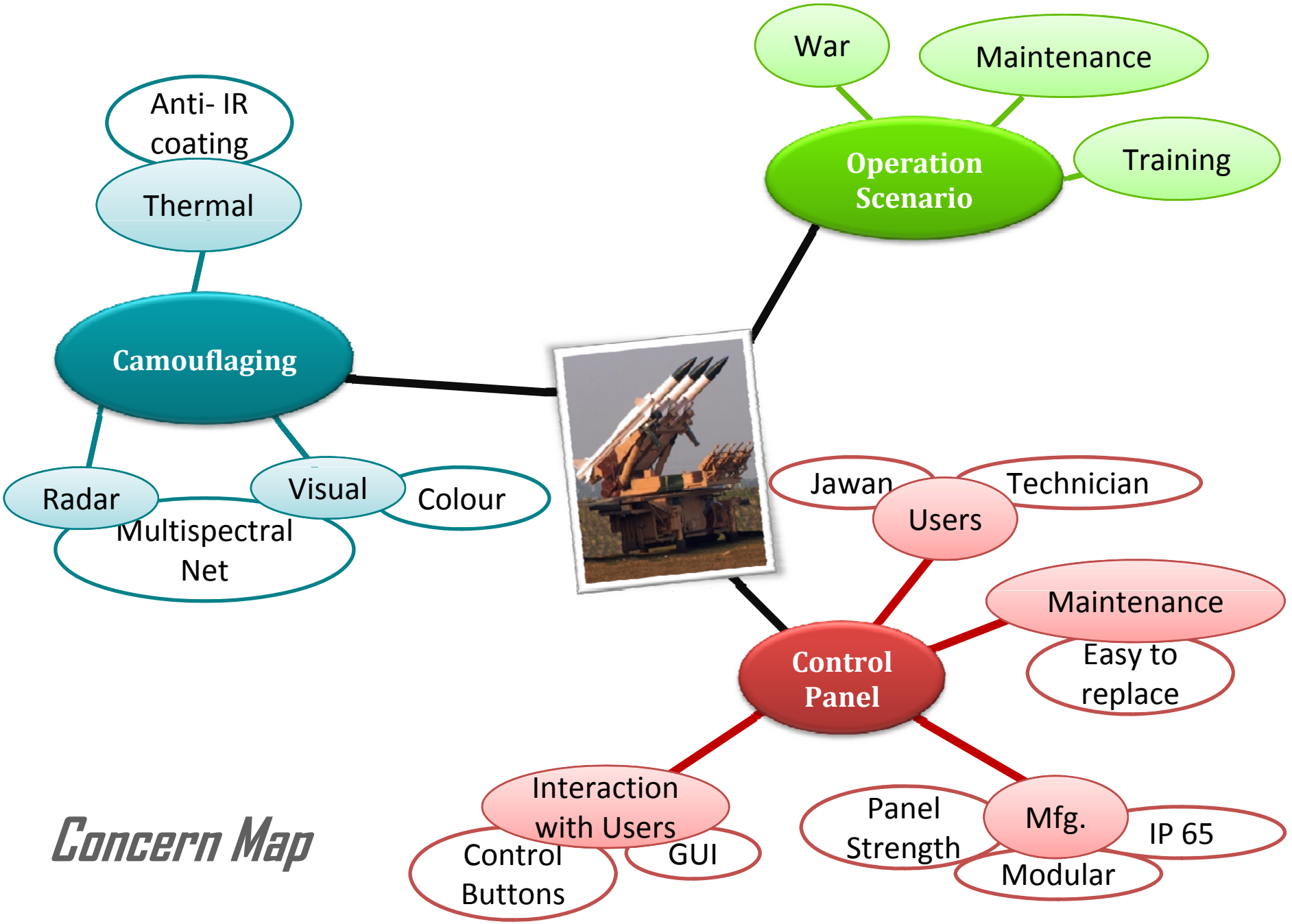
User Profile

Service Level Jawan:

- 10^{th} or 12^{th} pass
- low technical knowledge
- Trained to operate this specific system and few similar systems.
- Performs certain maintenance operations on regular basis and report the result to his superiors.

Engineers And Technicians:

- Involved in repair work from Indian Air Force (IAF) and L&T.
- Scientists from DRDO look after the update of the system.


War
Maintenance
Training
Operation Scenario
Anti- IR coating
Thermal
Camouflaging
Radar
Visual
Colour
Multispectral Net
Jawan
Technician
Users
Maintenance
Easy to replace
Control Panel
Interaction with Users
Control Buttons
GUI
Panel Strength
Mfg.
IP 65
Modular

Concern Map

Project Brief

- **User Interaction Panel (Control Panel):**
  - To refine the control panel GUI & layout for better user interaction.
  - To refine the control panel modules for ease of maintenance and assembly.
  - To study the operating procedure of the Launcher and identify the anomalies

- **Protection of the Launch system:**
  - To develop a camouflaging system for the Launcher to protect against all types of imaging methods like visual, radar and thermal.

War Preparedness

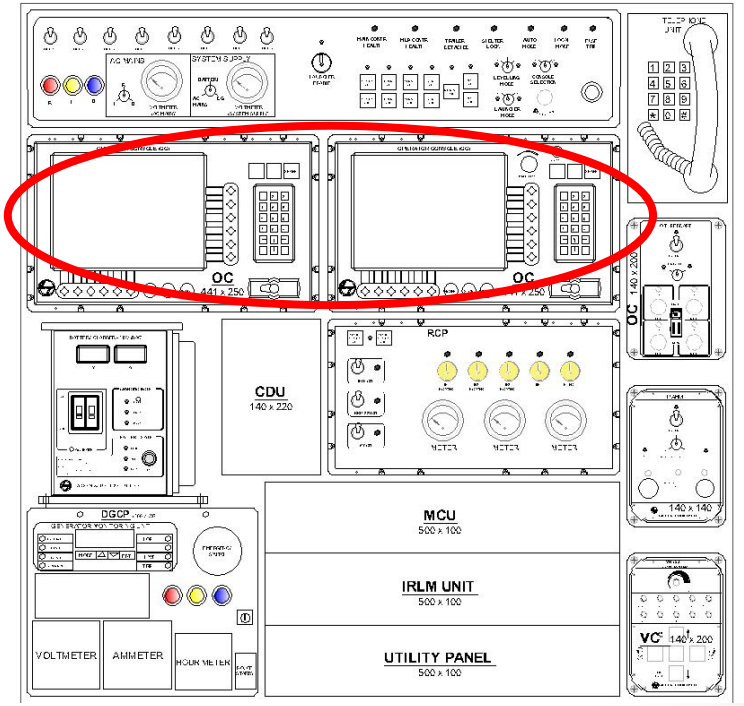
- Actual firing of the missiles happens via a Battery Level Radar (BLR) from a Battery Command Center (BCC).
- Control panel on the launcher is used for maintenance, training and repair purpose.
- System needs to be war ready all the time, for which regular maintenance is reqd.
- System efficiency and effectiveness depends on the ease with which it can be maintained.
- Very low reaction time.

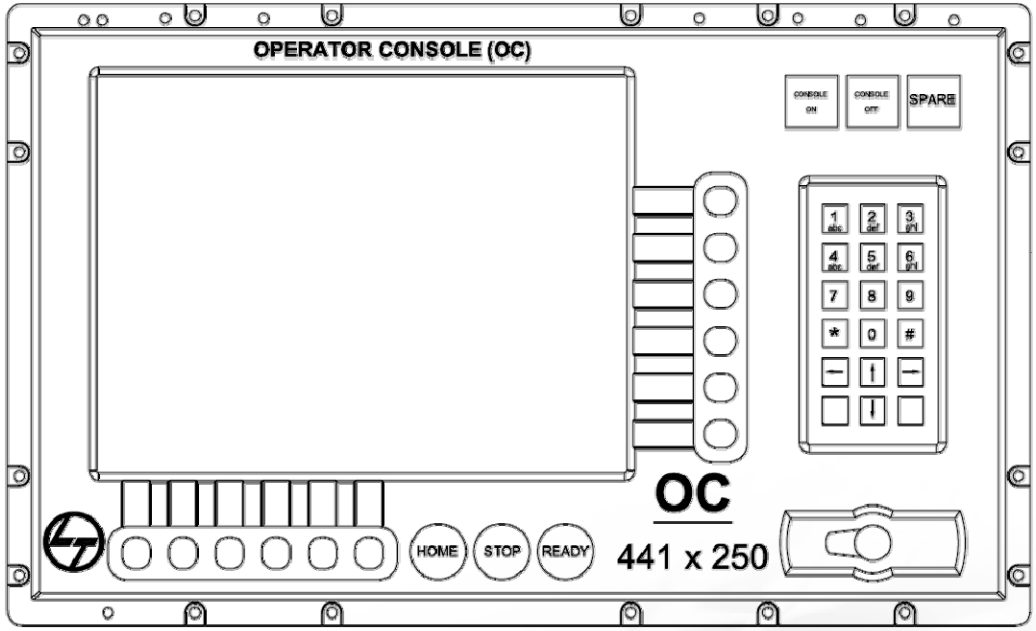
USER INTERACTION PANEL

Operator Console

User:

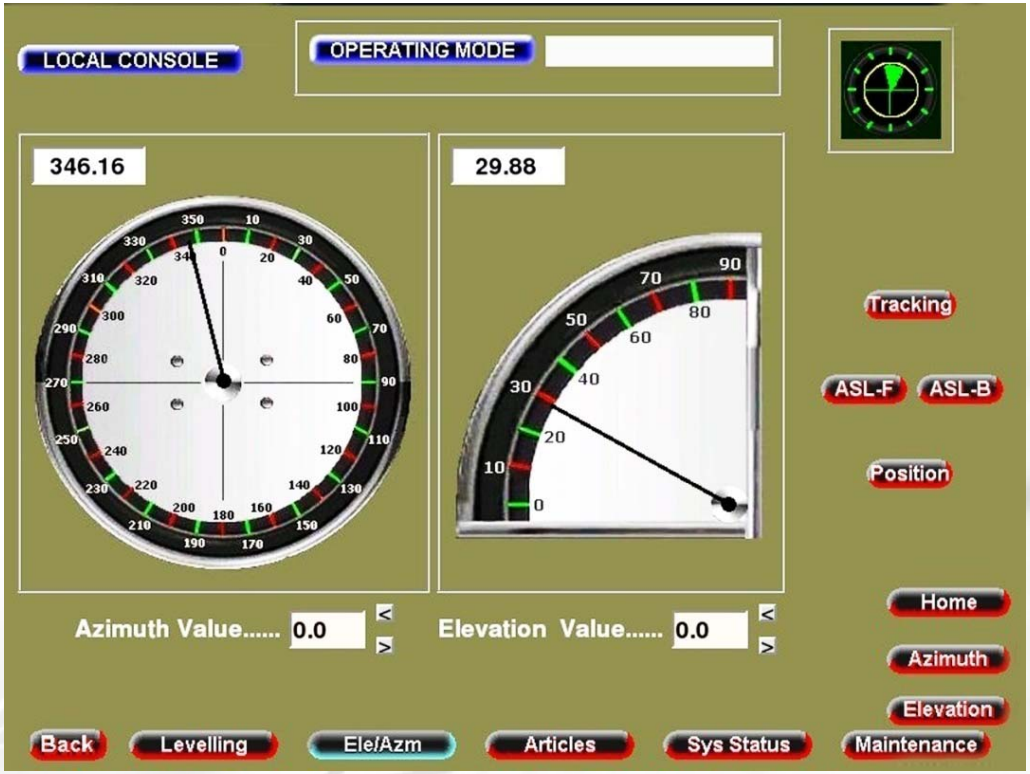
- Primary User: Service Level Jawan
- Secondary User: Technicians & Engineers @ Air Force and L&T



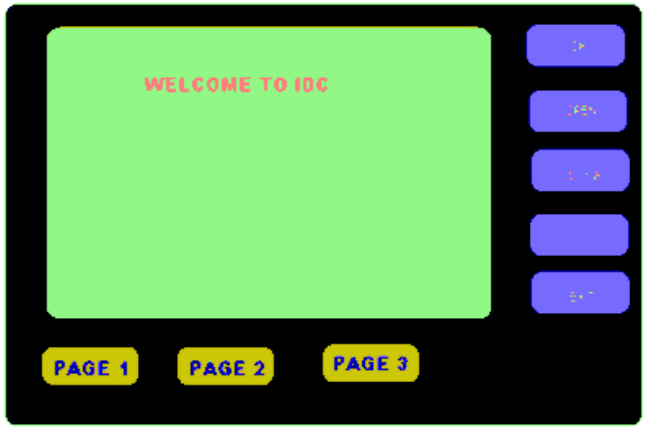
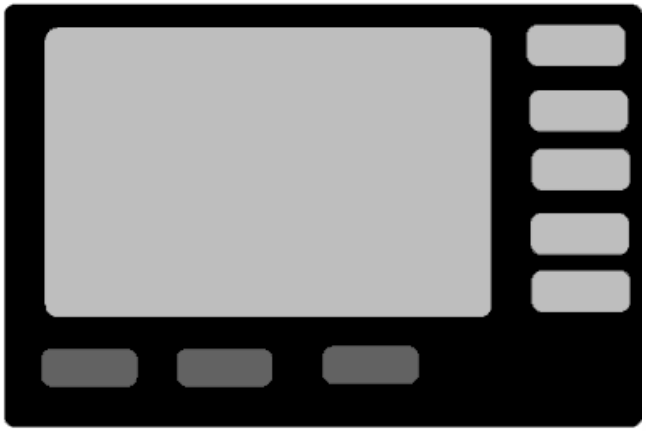
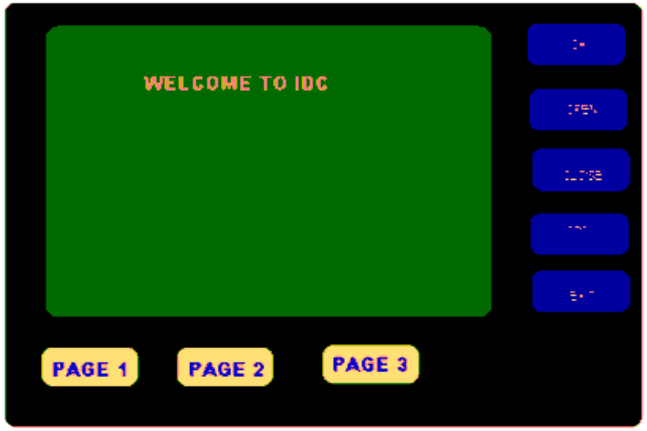


Operator Console

- Big OC with too many keys
- Screen barely visible in sunlight.
- GUI not flexible for further upgrades
- Multiple buttons
- Difficult to navigate through GUI
- GUI displayed excess information

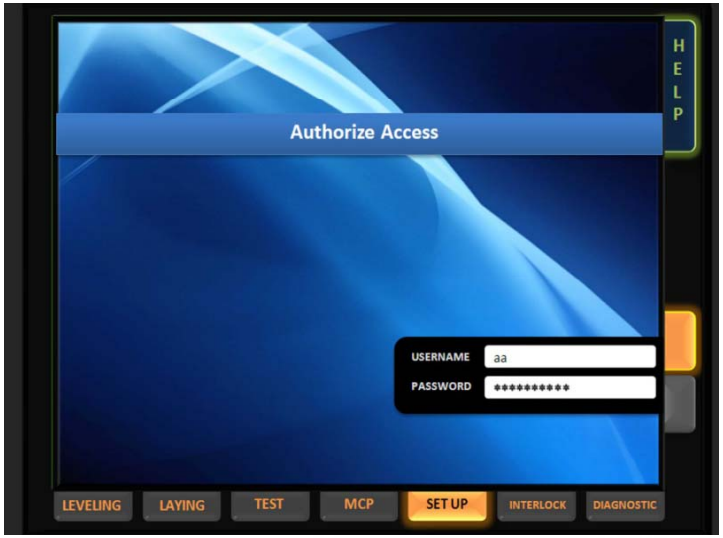


Effect of harsh sunlight on LCD screen

	Normal viewing	In harsh Sun-light
Using only contrast colour scheme		
Using Contrast colour scheme with contrasting grayscale value		

Operator Console- Layout & GUI

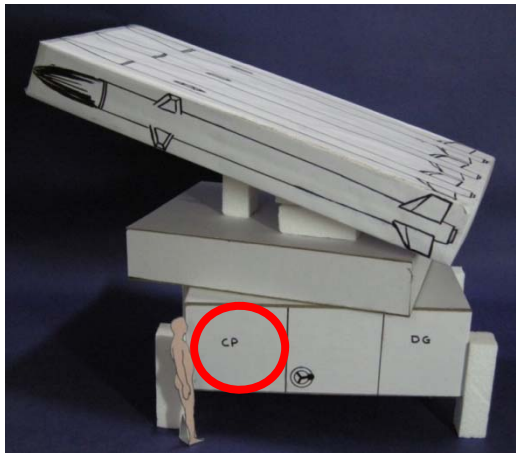
- Lesser number of buttons
- Easy to navigate
- Upgradable
- Sunlight visible

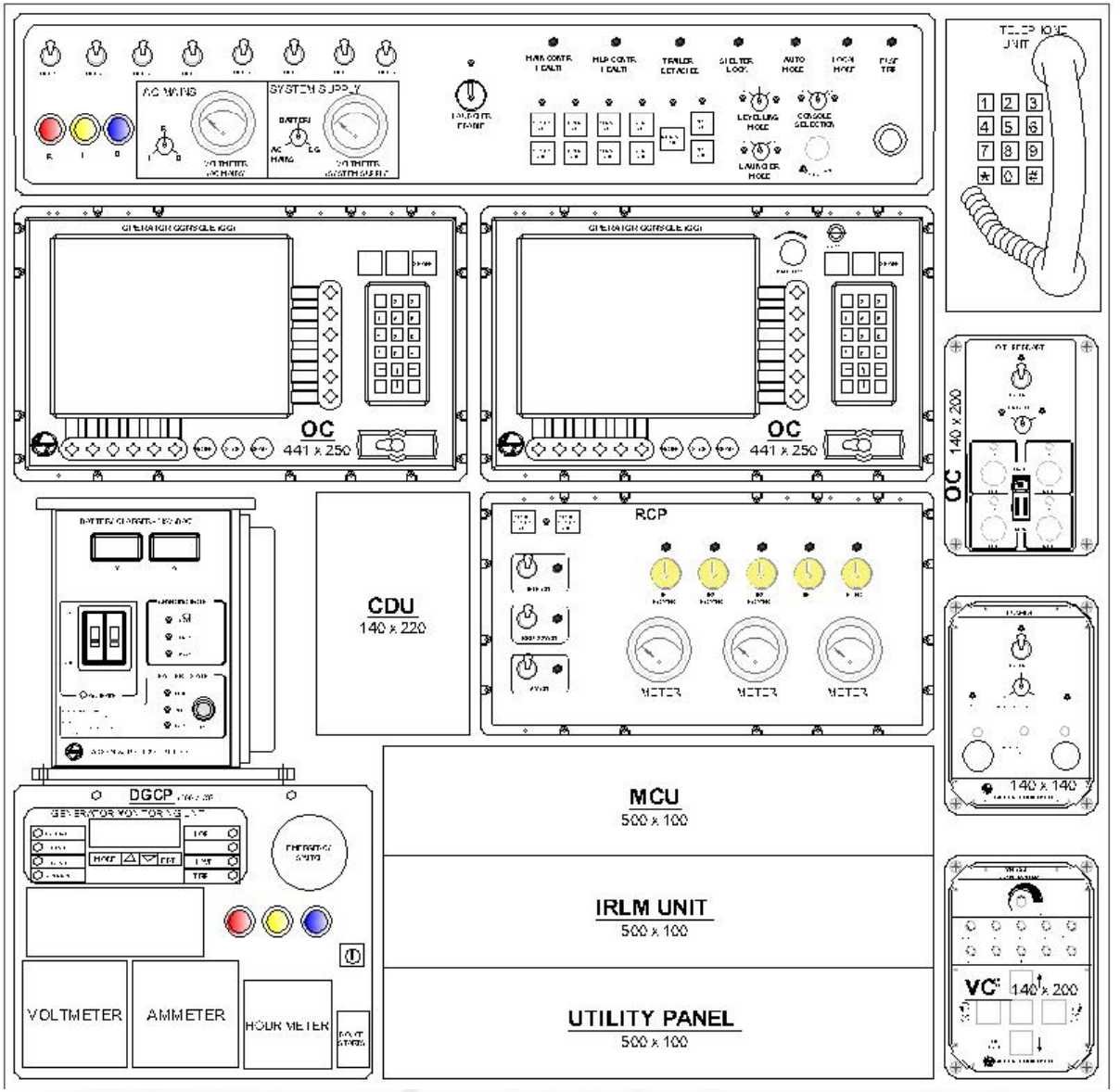


Control Panel Layout

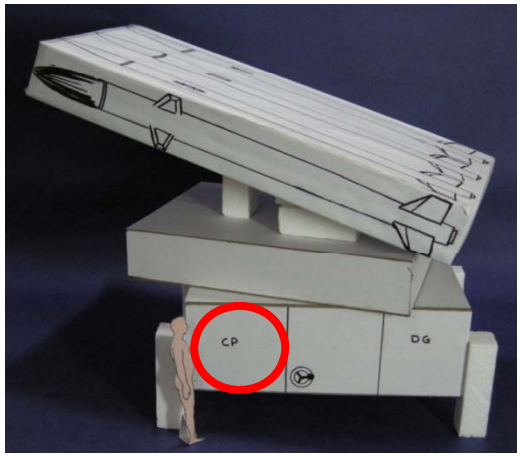
User:

- Primary User: Service Level Jawan
- Secondary User: Technicians & Engineers @ Air Force and L&T





Control Panel Layout- Ideation



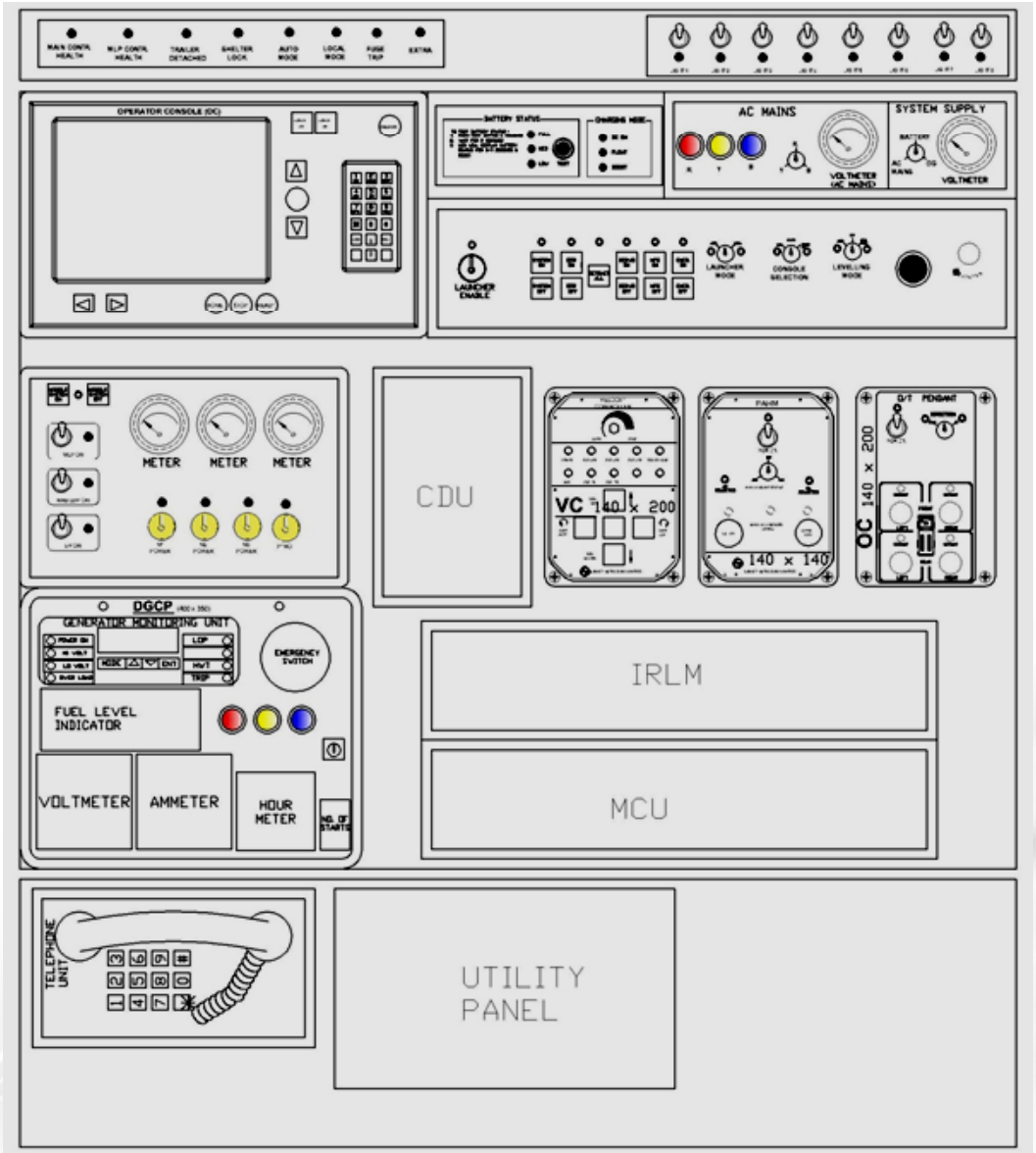
Control Panel Layout- Concepts

Concept #1:

- Here the second Operator Console (LCD screen) was completely hidden from the user to avoid any confusion, the other display being stored elsewhere in the system.

- Large Space was available on the horizontal panel for keeping the manual, resting the palm during prolonged usage.

- Most of the display units were placed at the top beside the operator console.



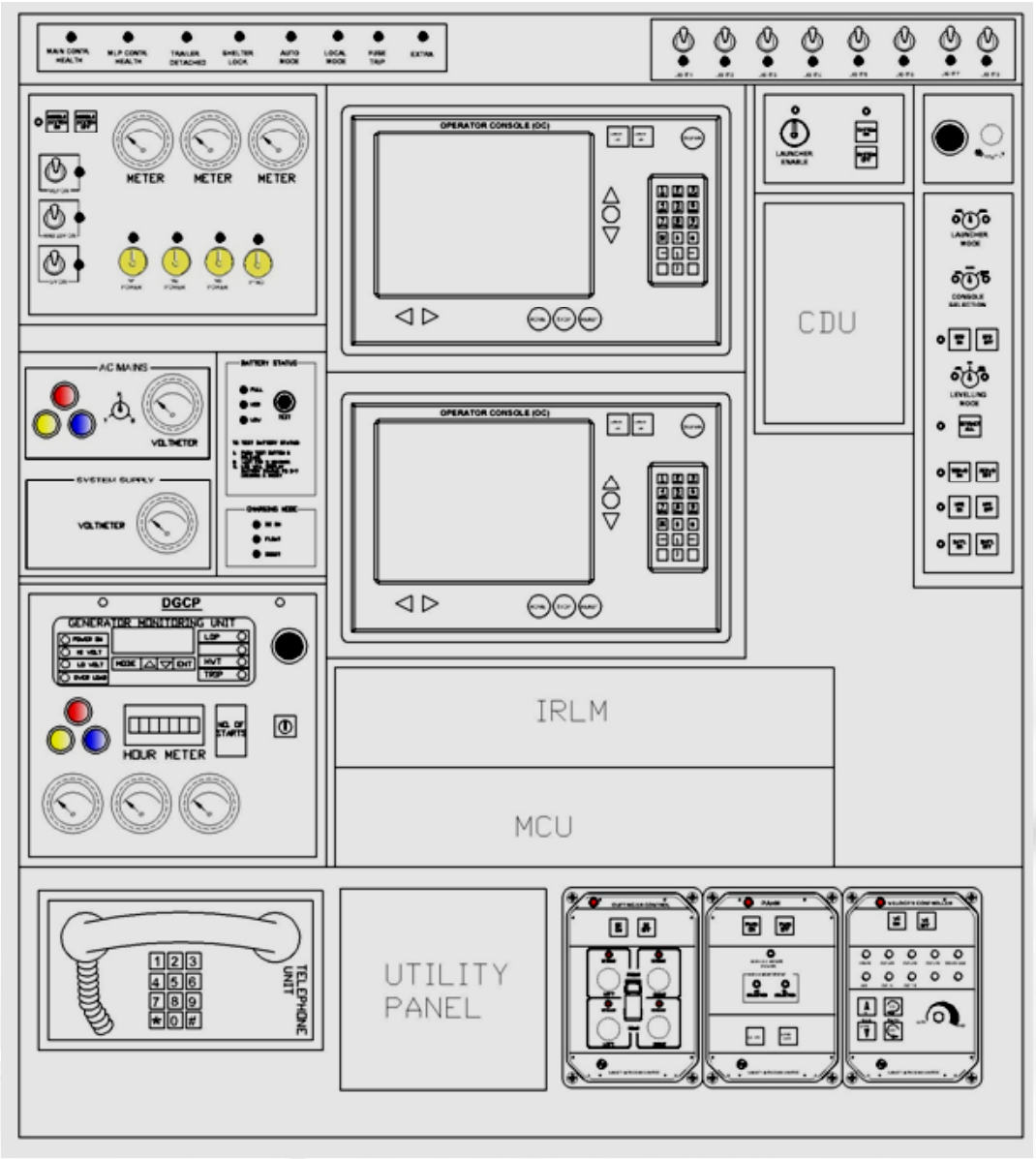
Control Panel Layout- Concepts

Concept #2:

- Here only one display was visible at a time other being covered by an open able lid but, both the displays were connected all the time.

- The dual display arrangement of one above another made for good use when the launcher had to be raised, as the lower display would still be in line of vision.

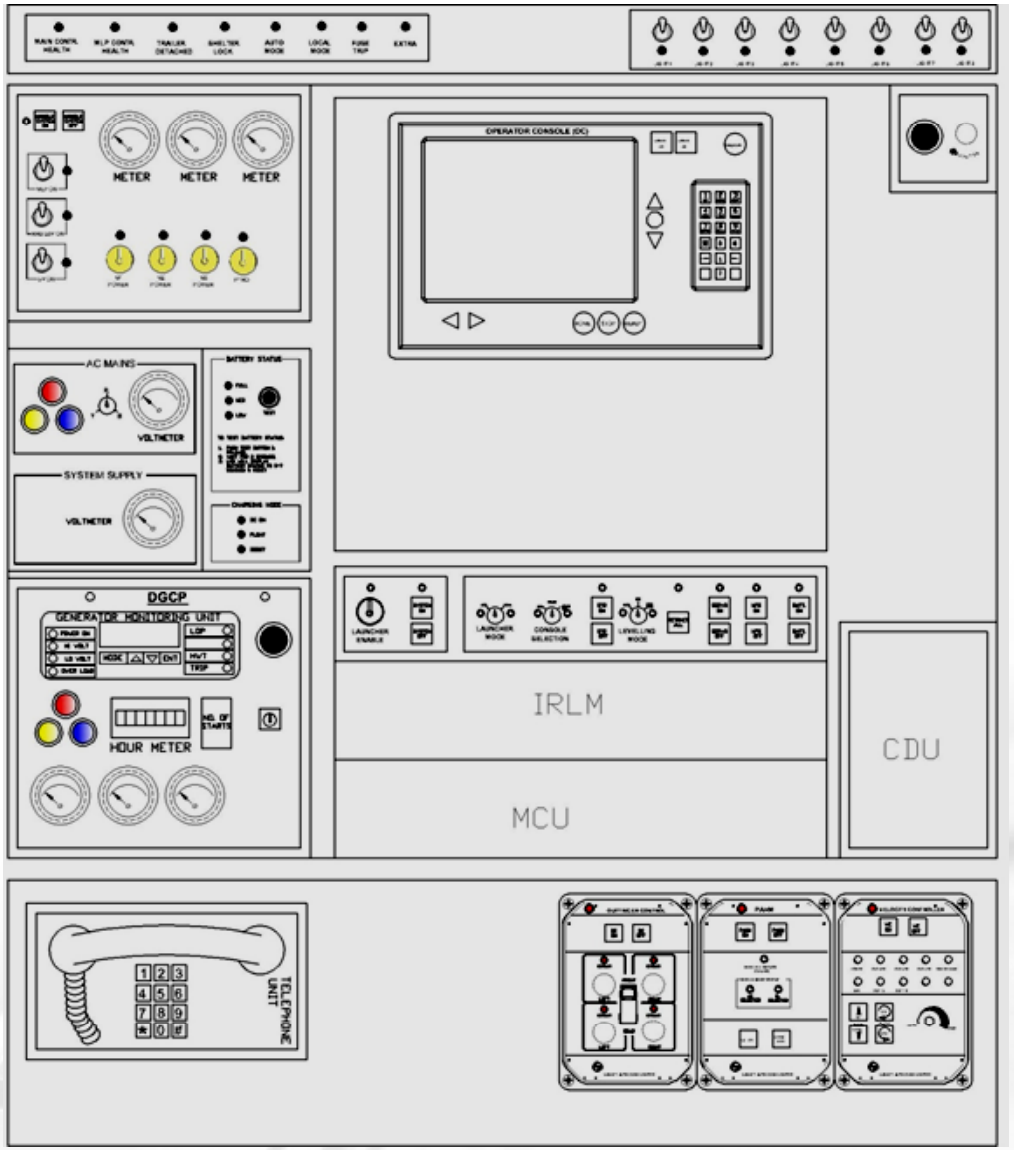
- Also the emergency button was shifted to rightmost top corner which is a general norm with such life critical systems.



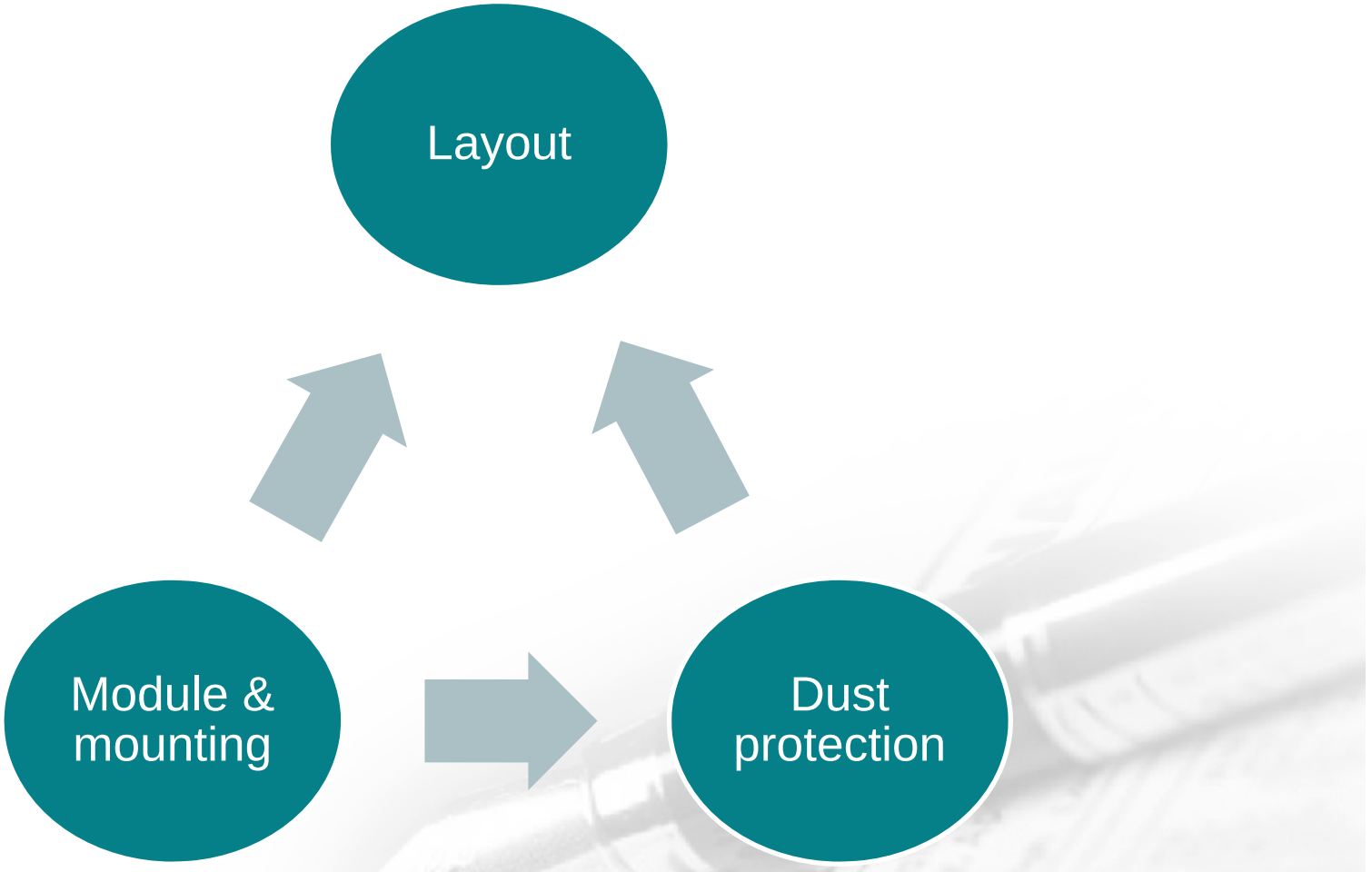
Control Panel Layout- Concepts

Concept #3:

- Here at any given time only one display would be visible with the other being completely out of sight.
- This would avoid any confusion that may arise due to two displays.
- Also both the displays are hardwire connected and boot with the system simultaneously.



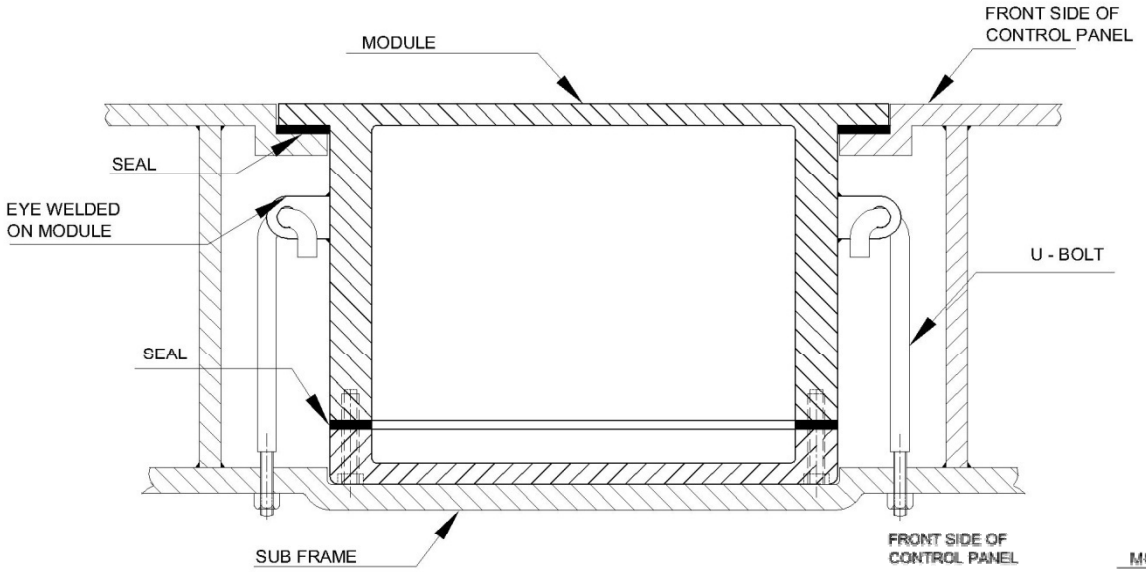
Control Panel



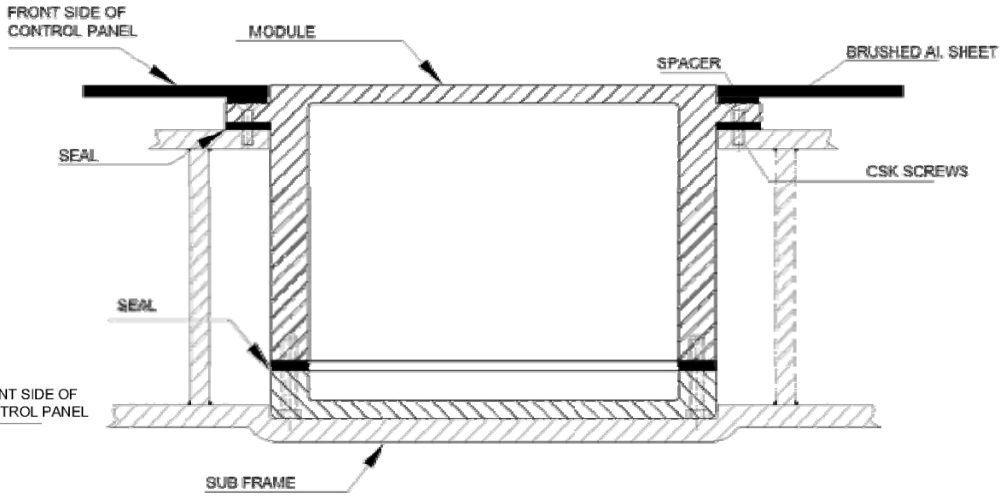
Control Panel- Module

- **Control Panel:**
  - Ease of maintenance and assembly of modules
  - Dust protection for modules

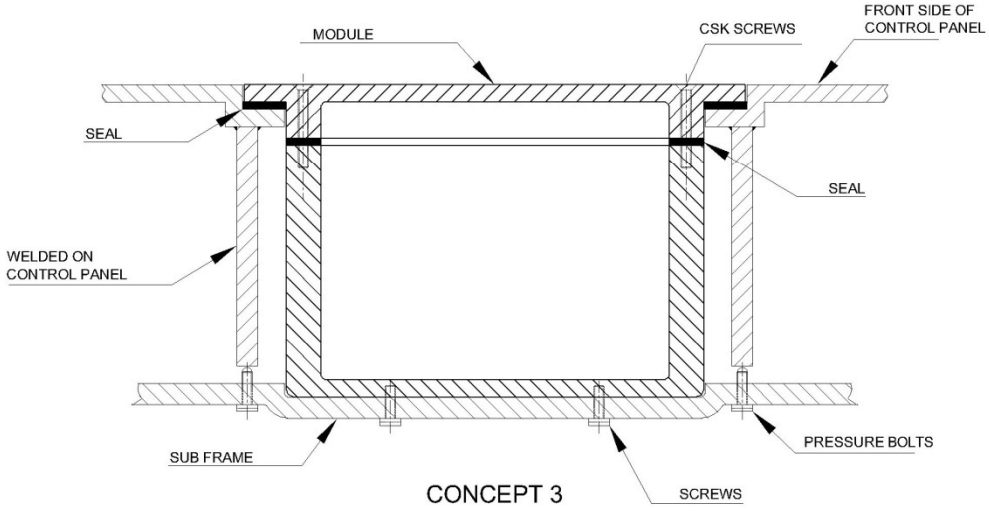
- **User:**
  - Primary User: Technicians & Engineers @ Air Force and L&T



CONCEPT 1

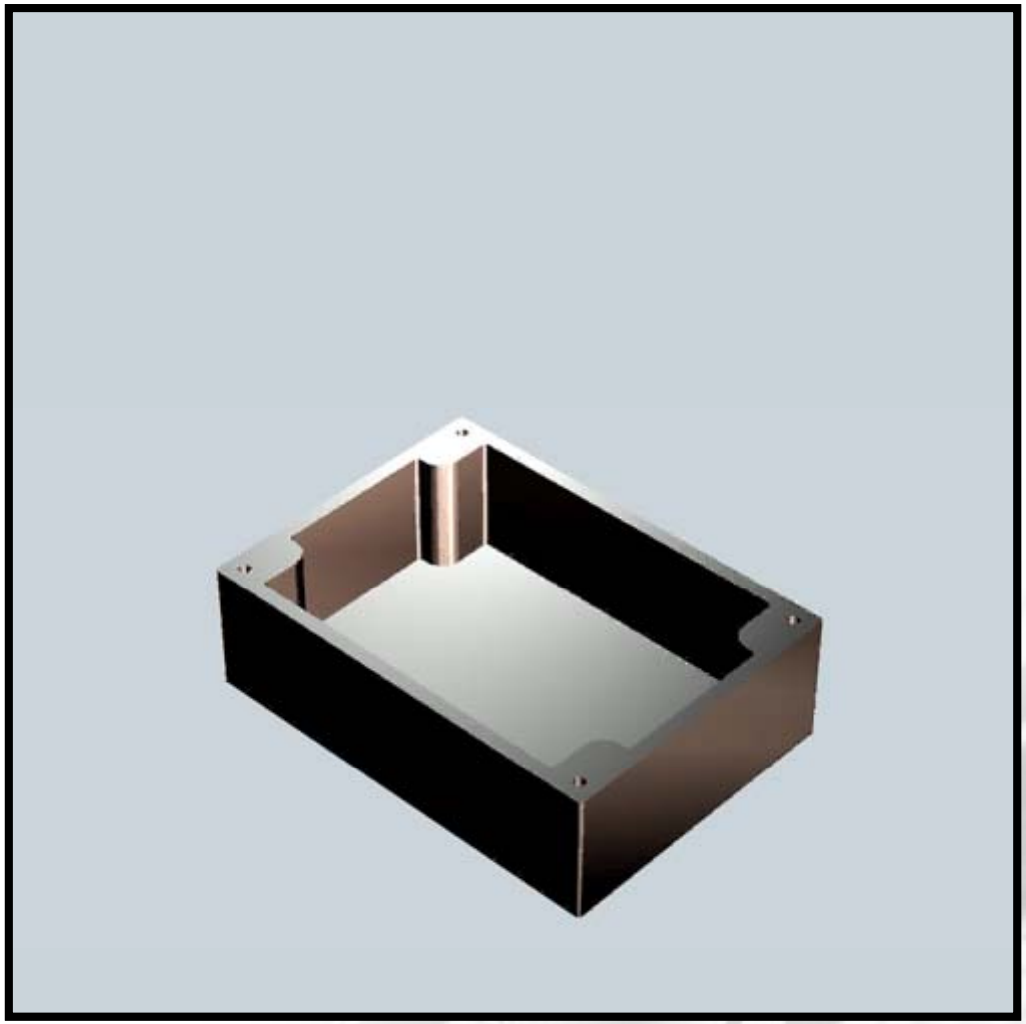


CONCEPT 2



CONCEPT 3

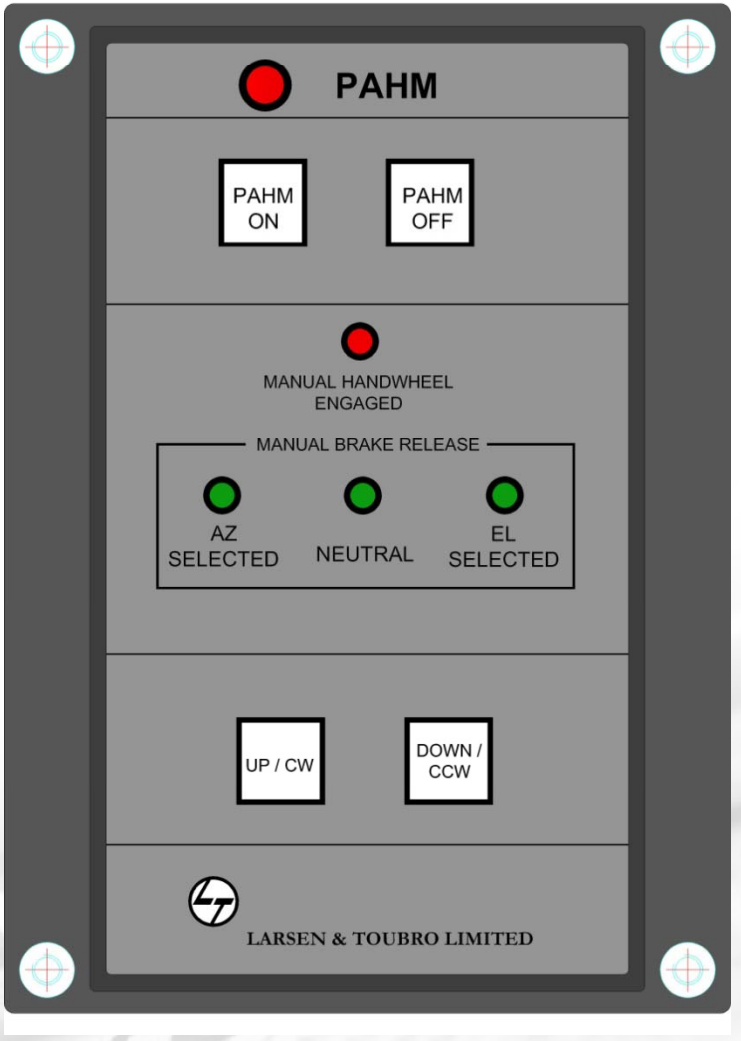
Final Concept – Assembly



Final Concept- Control Panel Module

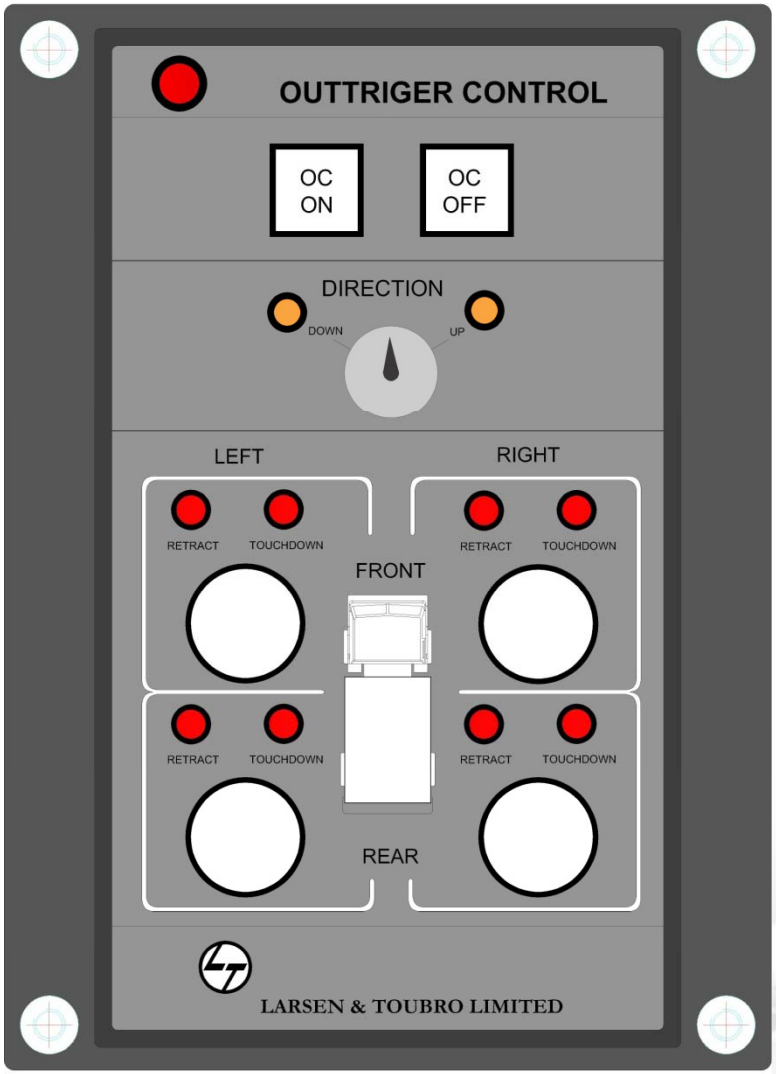
Control Panel- Module Interface

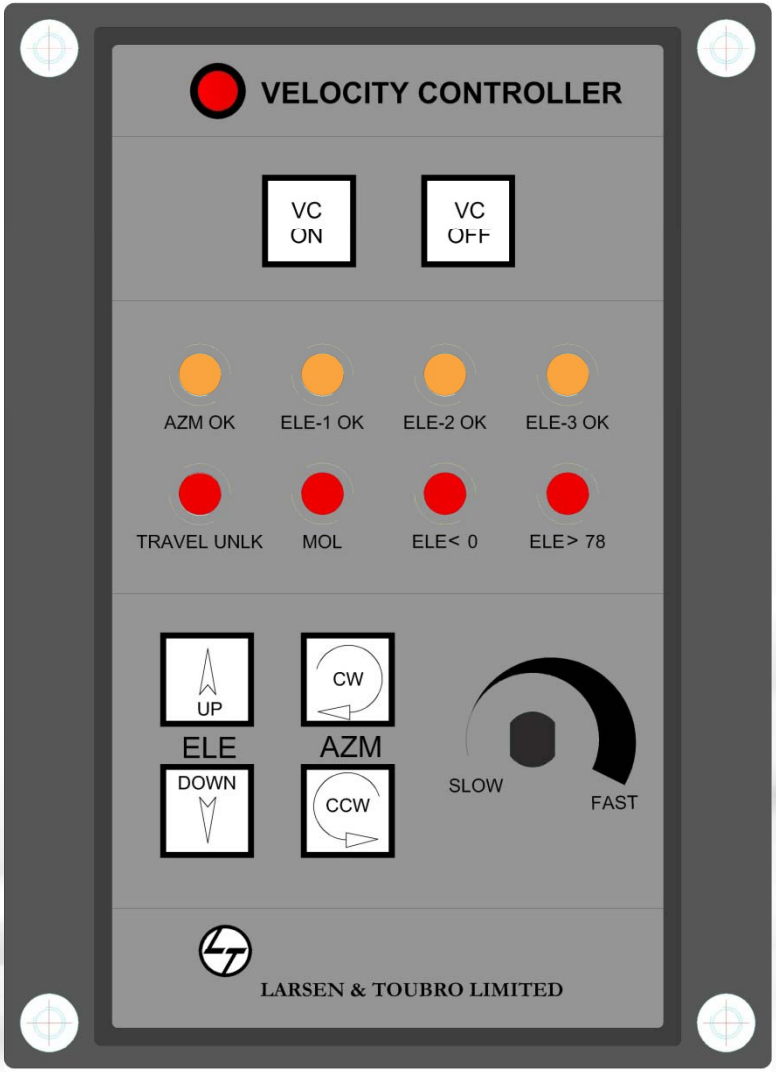
Old



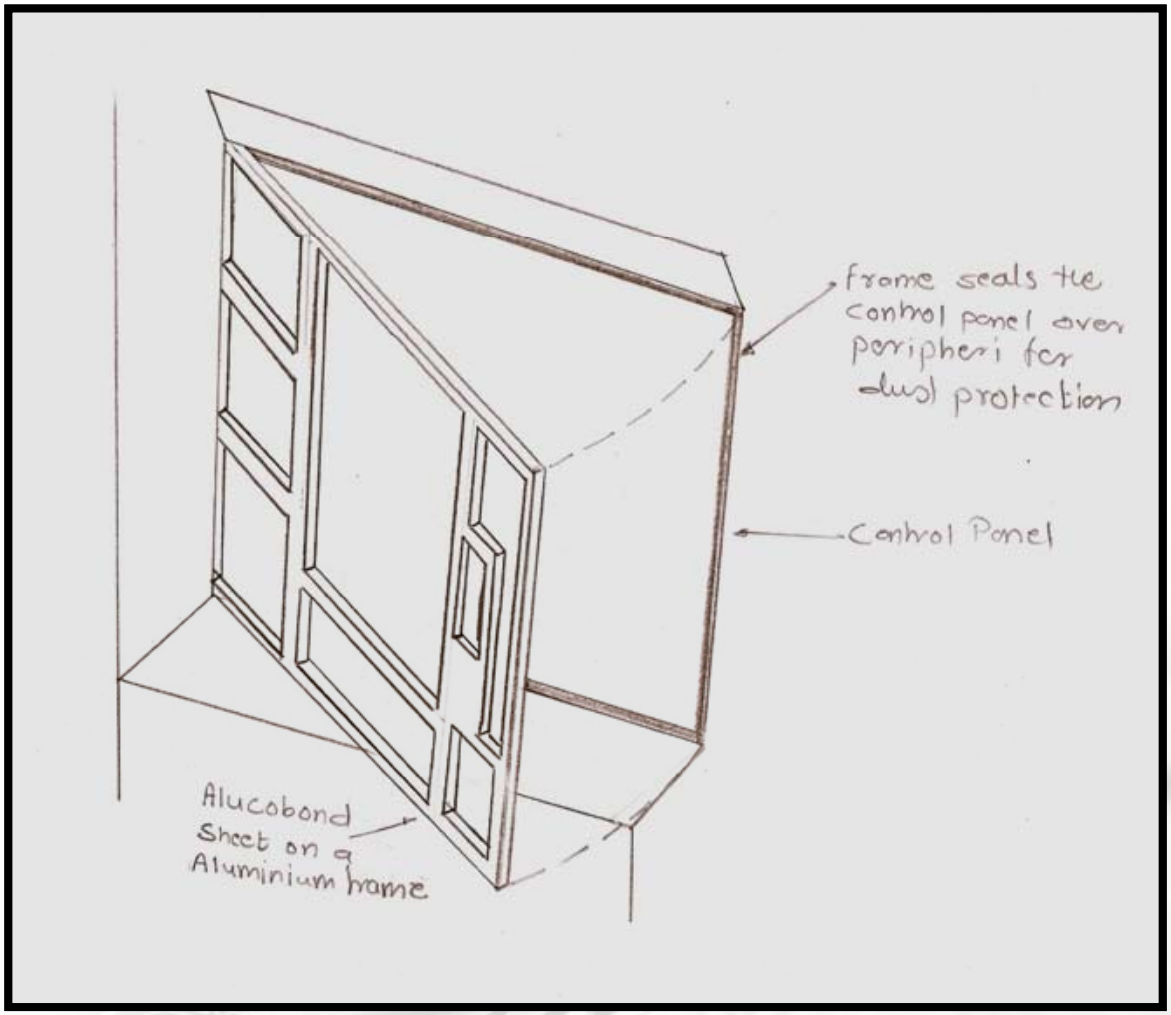
New

Control Panel- Module Interface (New)

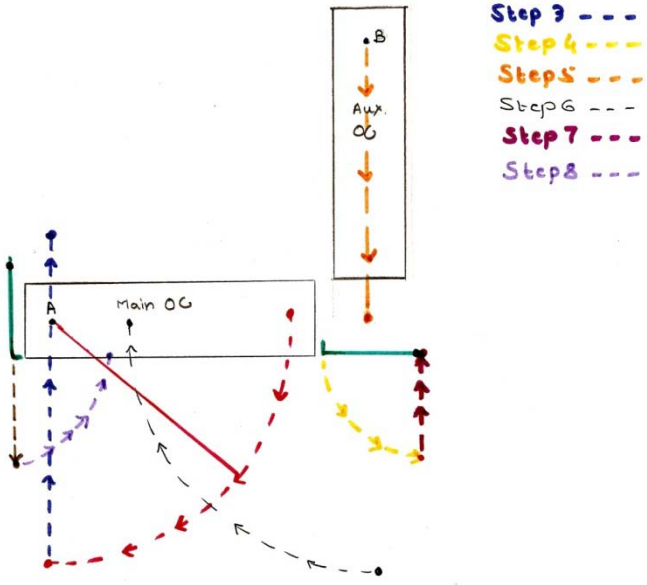


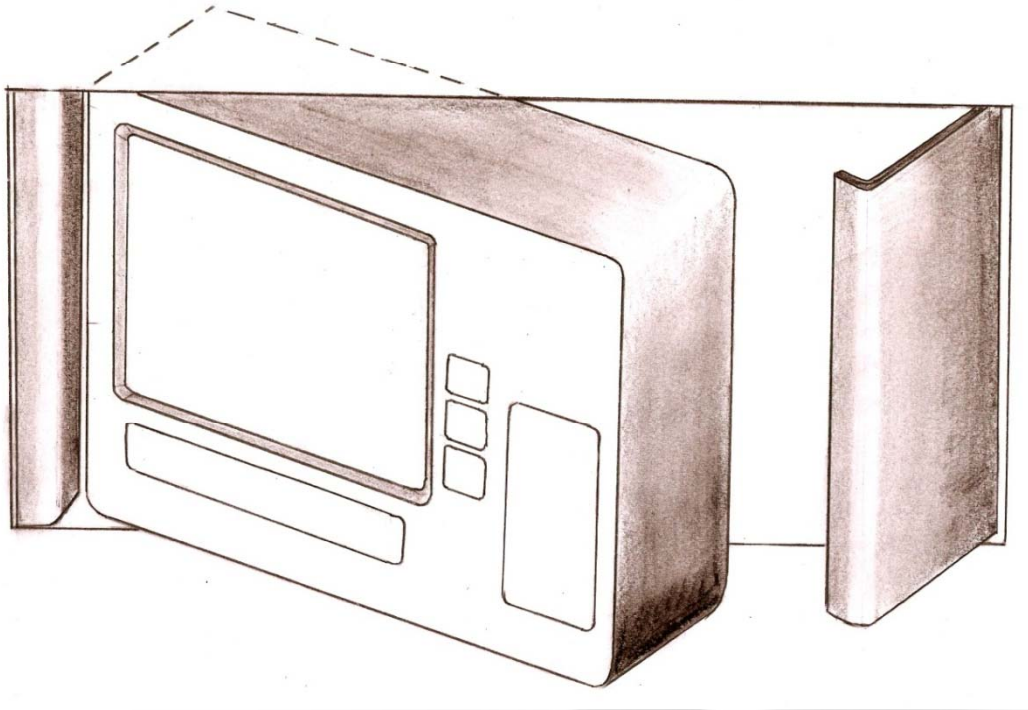


Control Panel- Dust Protection



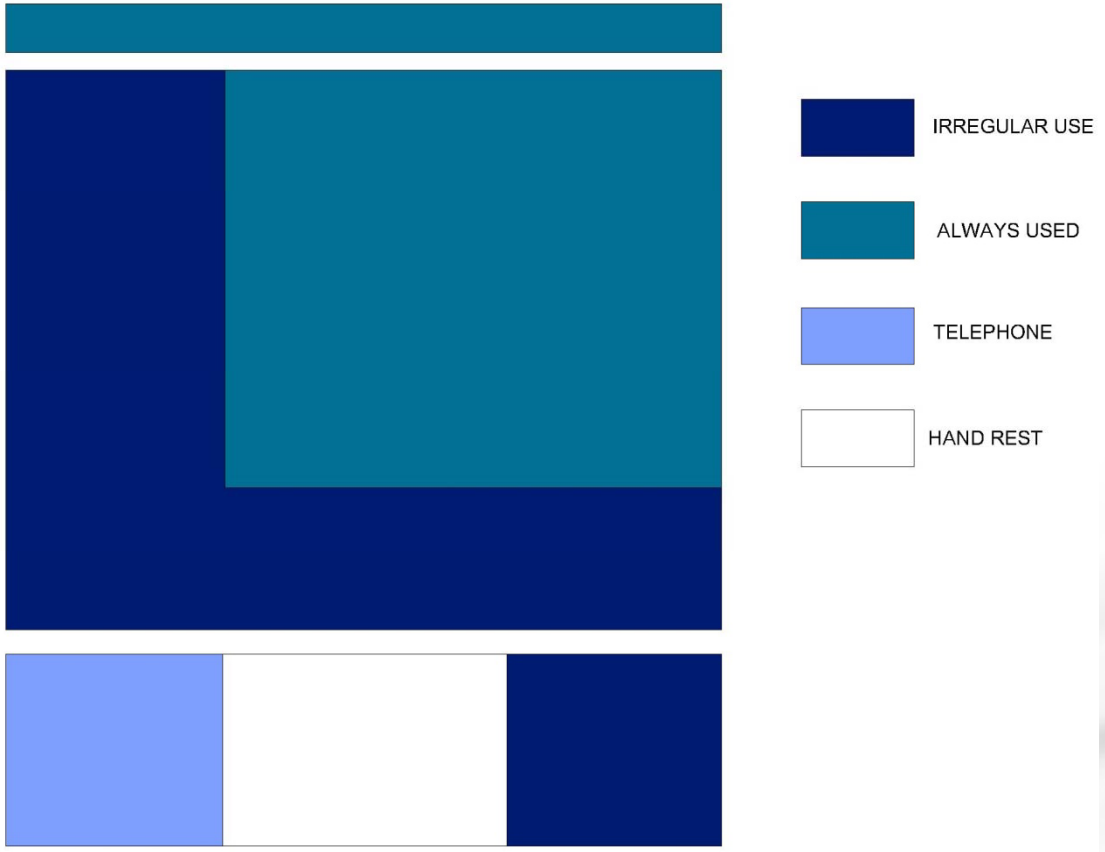
Single OC


B
Aux OC
A
Main OC
Step 1
Step 2
Step 3
Step 4
Step5
Step6
Step 7
Step8



Control Panel- Final Layout

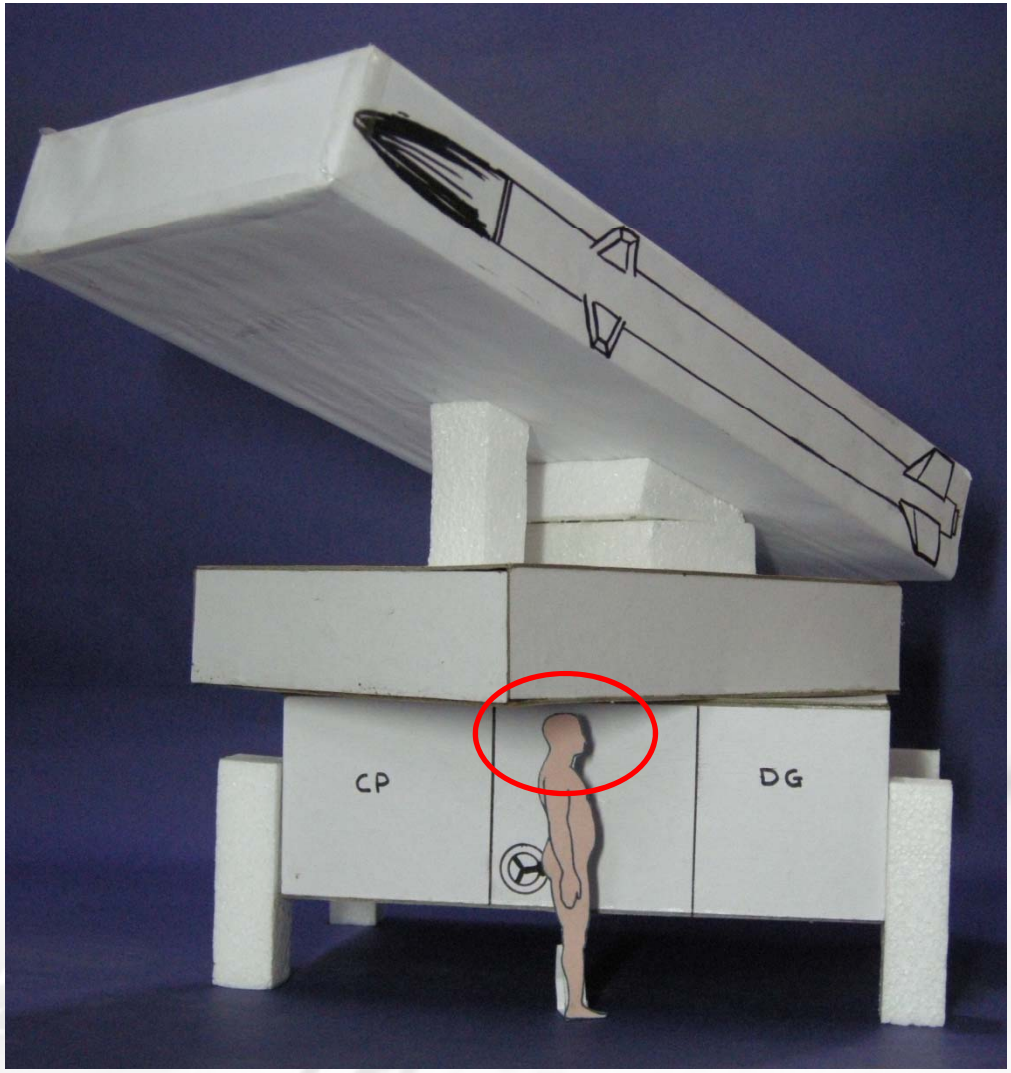
- Reduced the visual clutter.
- Clean look for the fascia
- Arranging the modules according their type and usage: regular or irregular.
- Utility panel removed



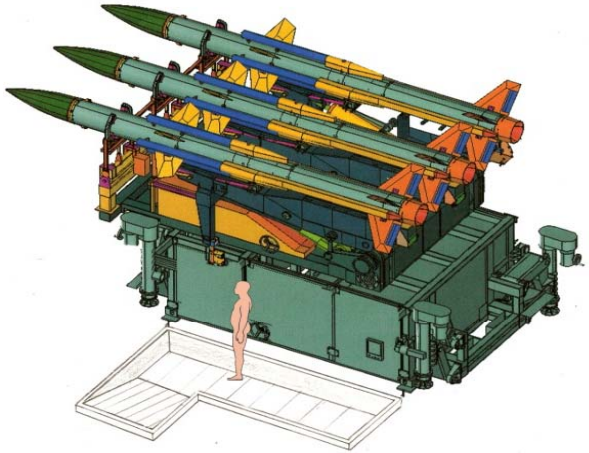
Basic Ergonomics

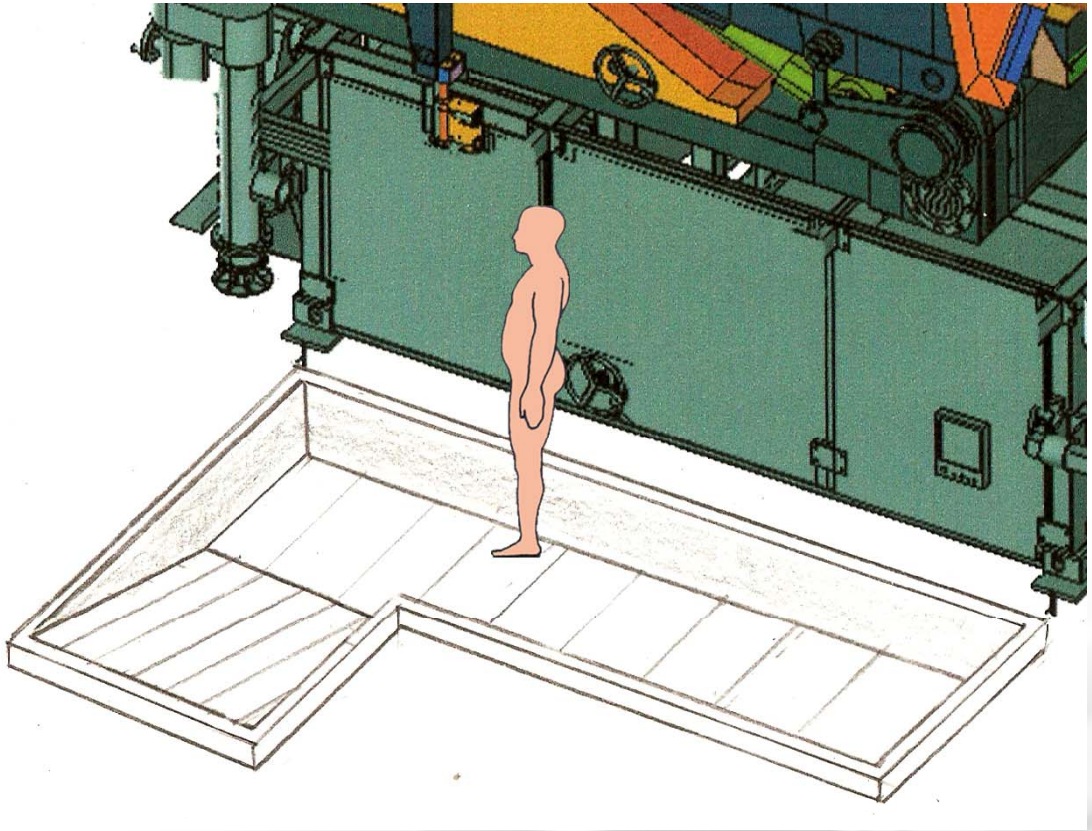
Control Panel:

- Swiveling deck can hit the head of the user.
- Height of the LCD display (OC) is much below the eye level.
- Sunshade is required while working with the OC.

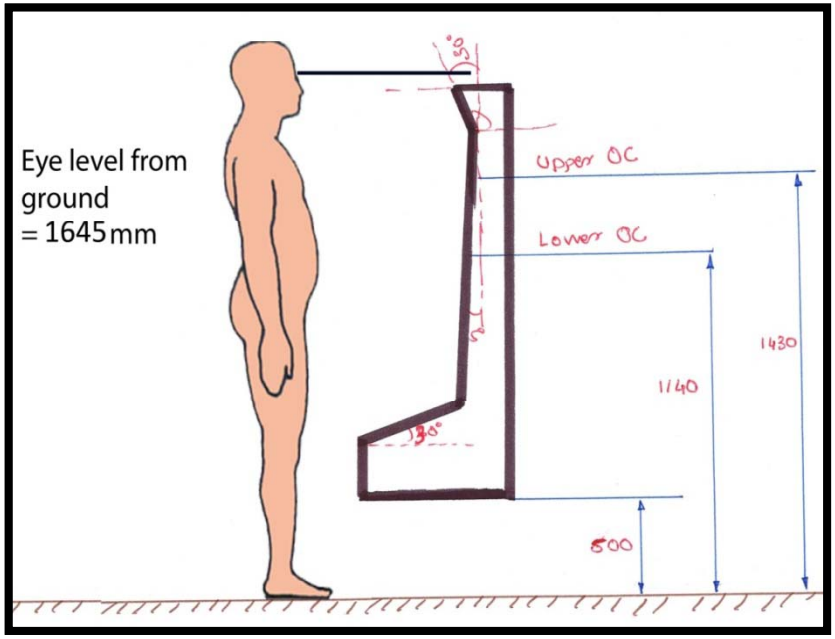


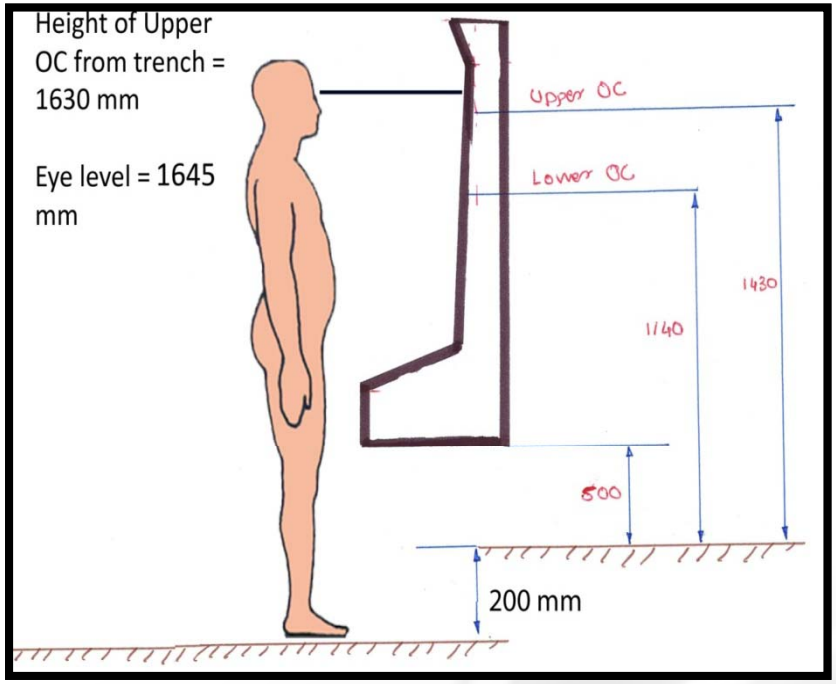
Trench





Trench

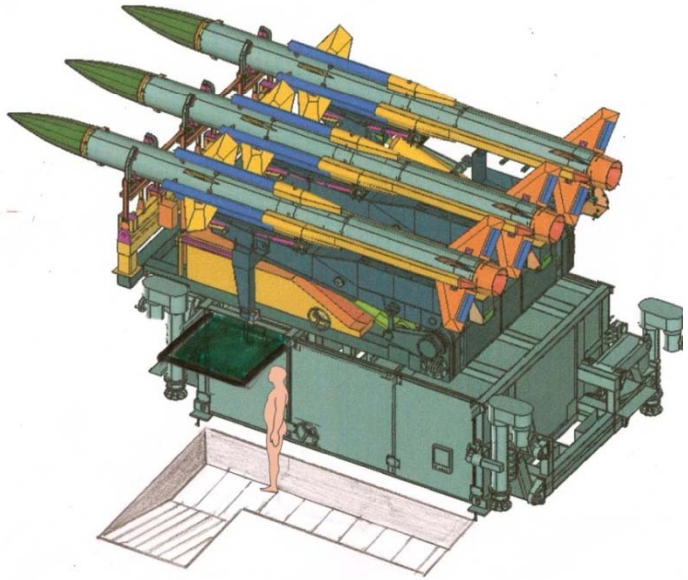


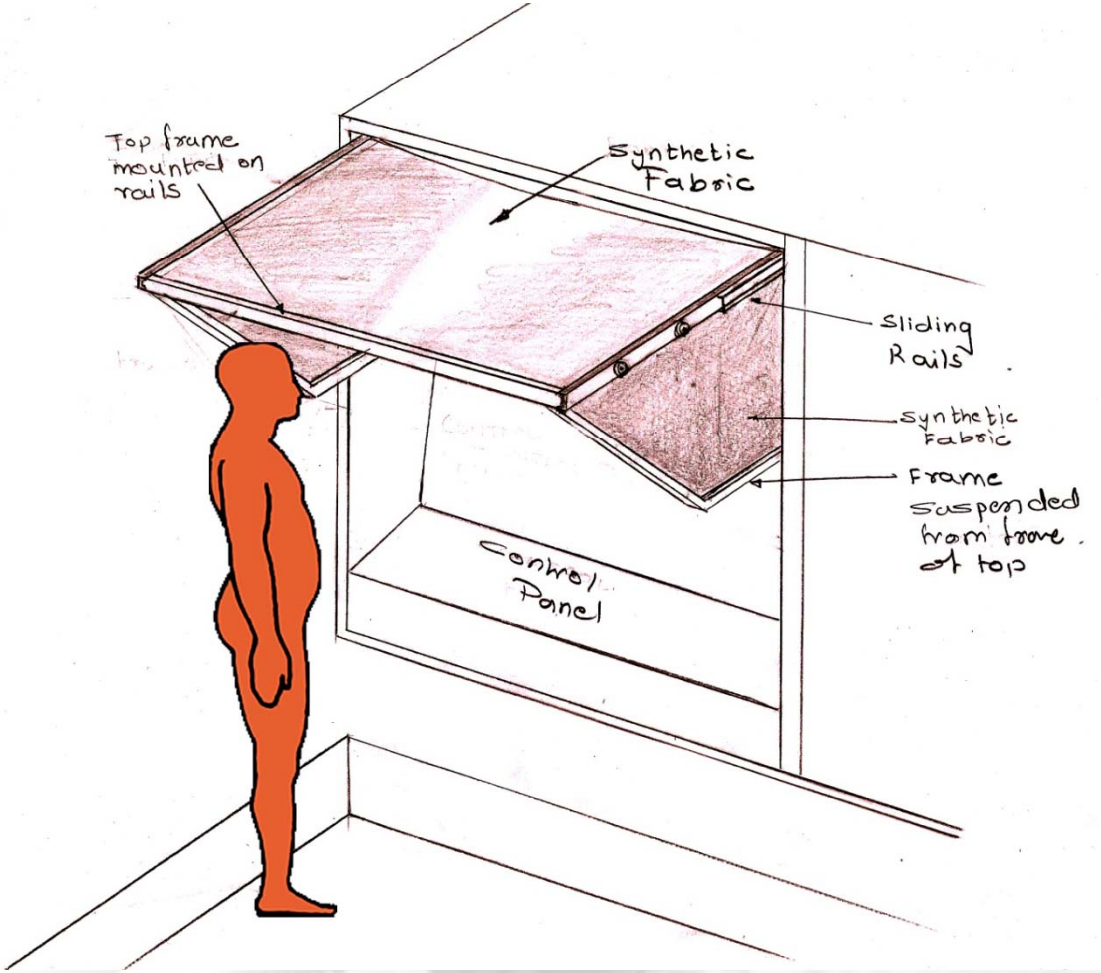


Human stature	1781 mm
Height of lowermost point of swiveling deck from ground	1785 mm
Human eye level	1645 mm
Height of upper OC from ground	1430 mm

Control Panel

Operation Scenario – Sun Protection

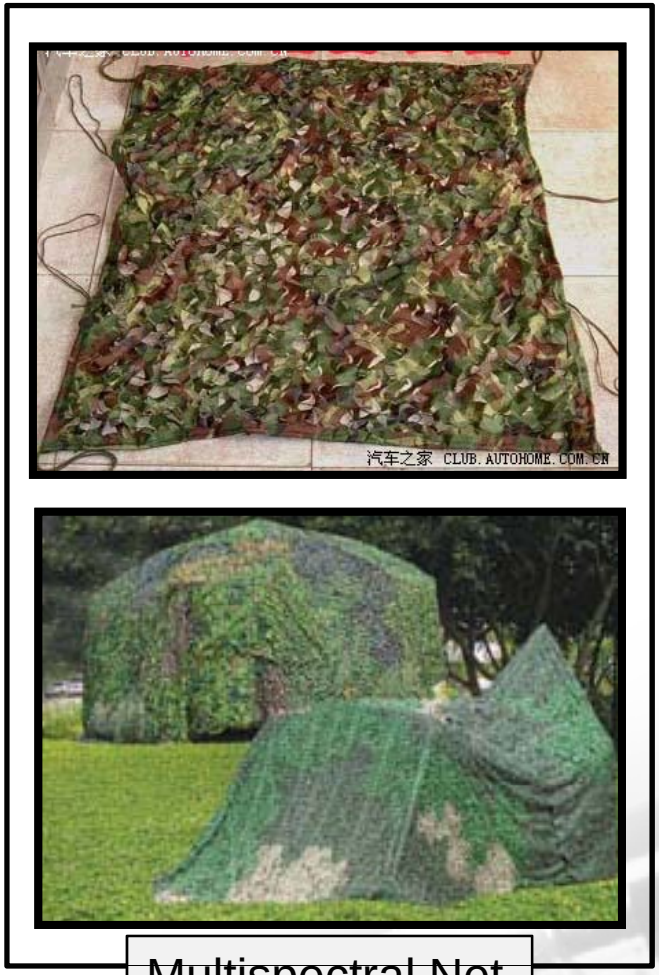




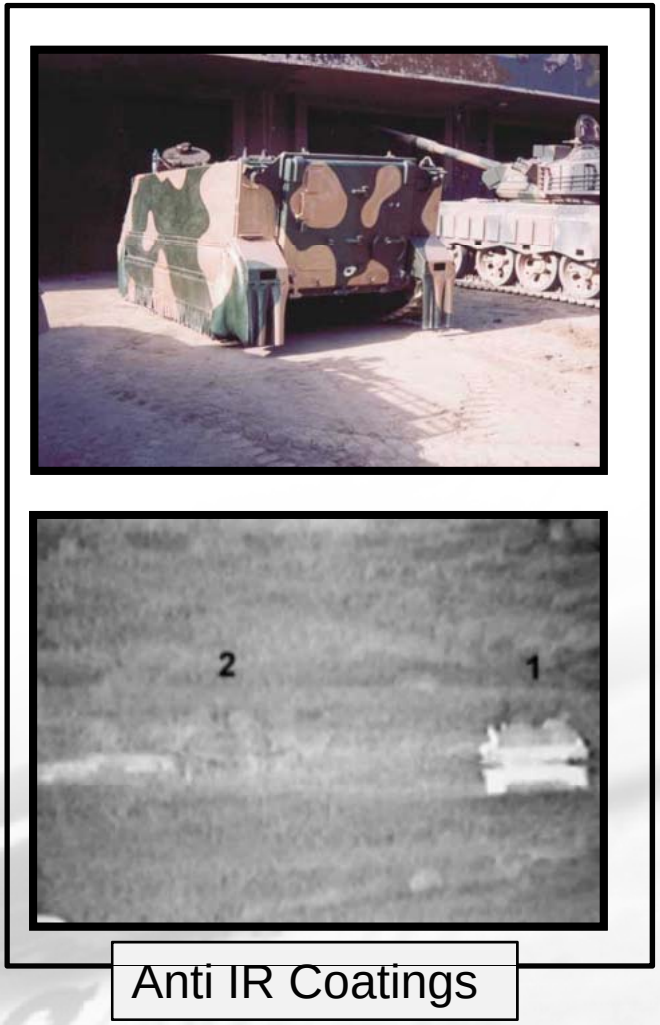
PROTECTION OF THE LAUNCH SYSTEM

Camouflaging – Visual, Radar & Thermal

- **Multispectral Net** – For Visual & Radar camouflaging
- **Anti-IR coatings** – For thermal camouflaging



Multispectral Net



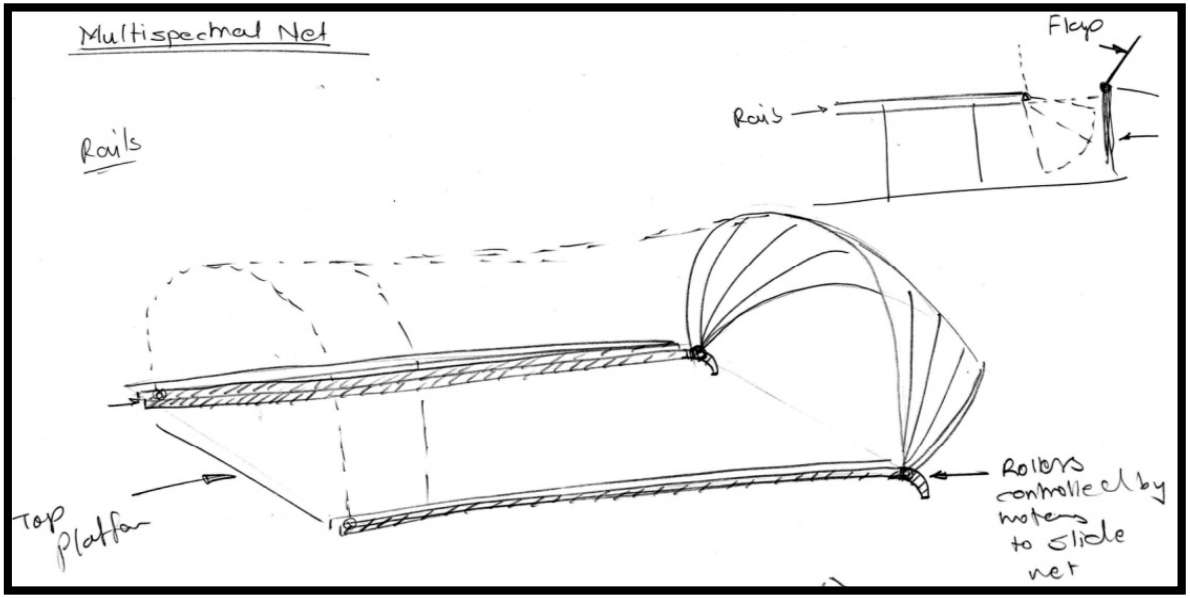
Anti IR Coatings

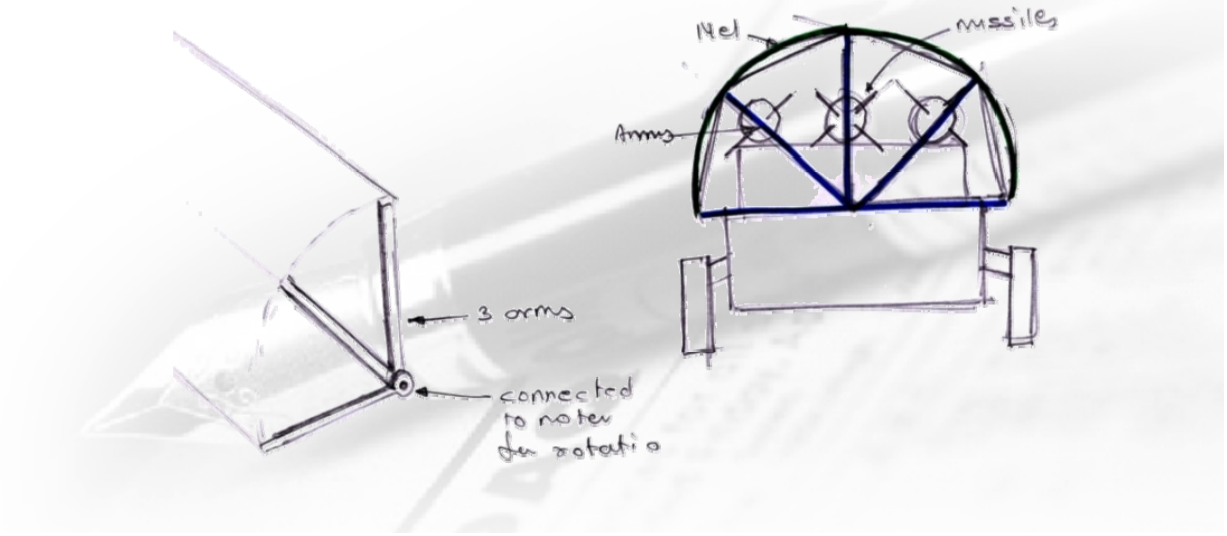
Design Requirements for Camouflaging

- Quick removal 1 minute approx.
- Minimum surface area and small footprint.
- Minimizing number of tasks
- Ideally, the removal should happen without any human intervention with only a click of a button.

Concept Generation

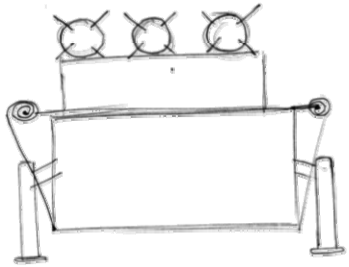
Camouflaging –Cluster #1

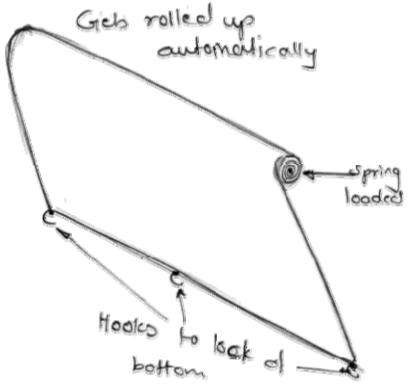


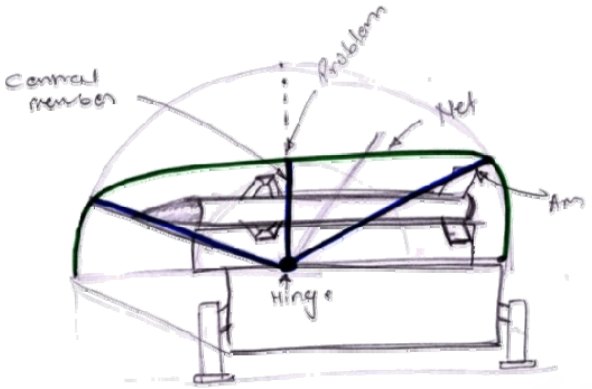


Camouflaging –Cluster #1

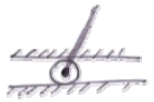
auto roll up
mechanism like
curtain shutter used
in small shops

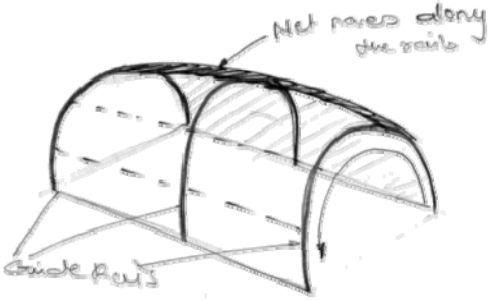


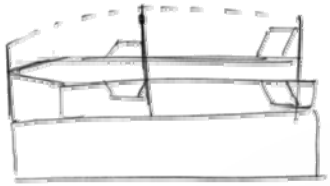


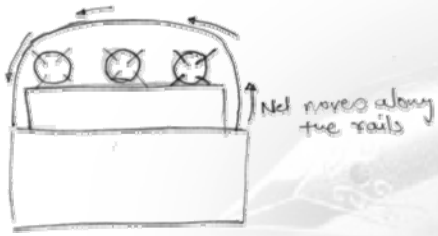


Central member
can be hinged
roller

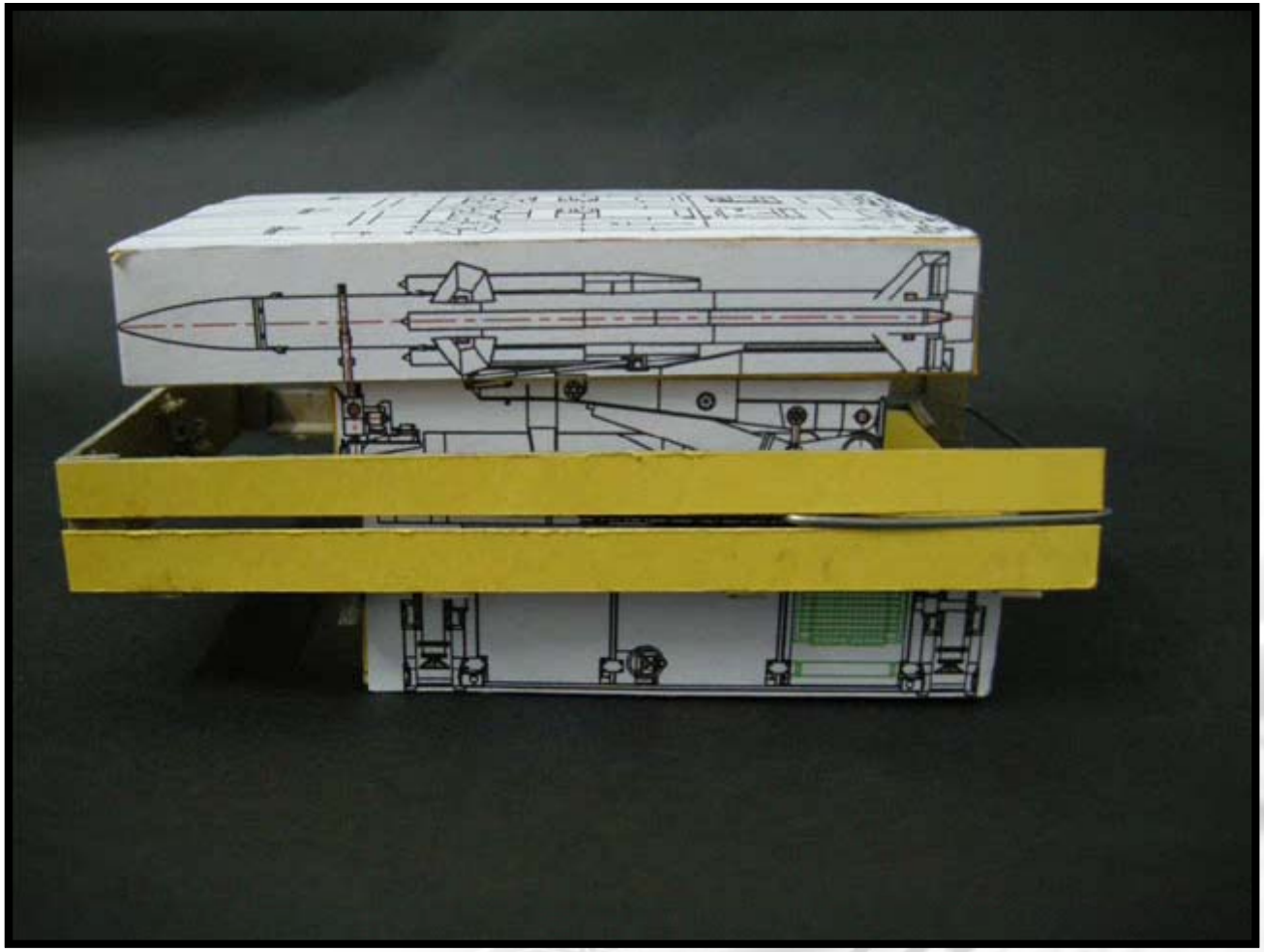




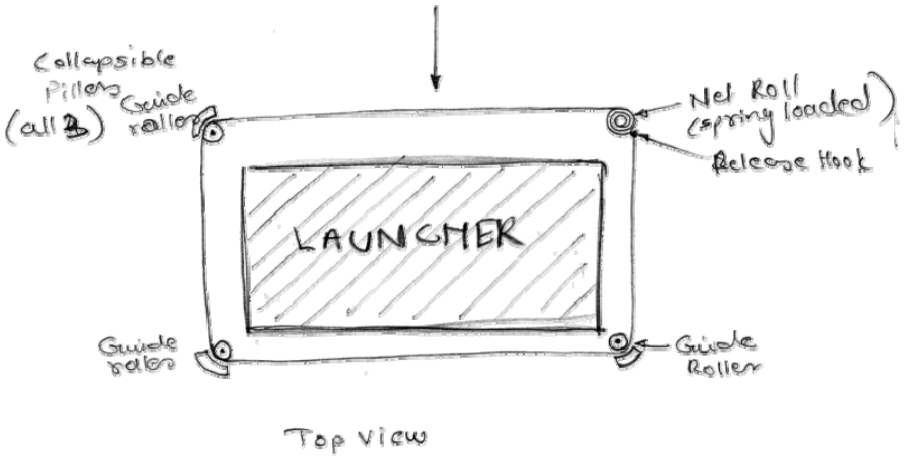


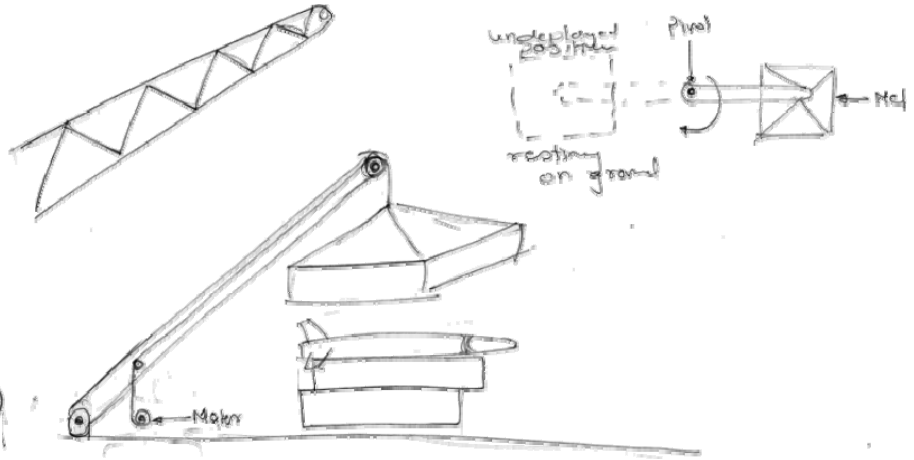


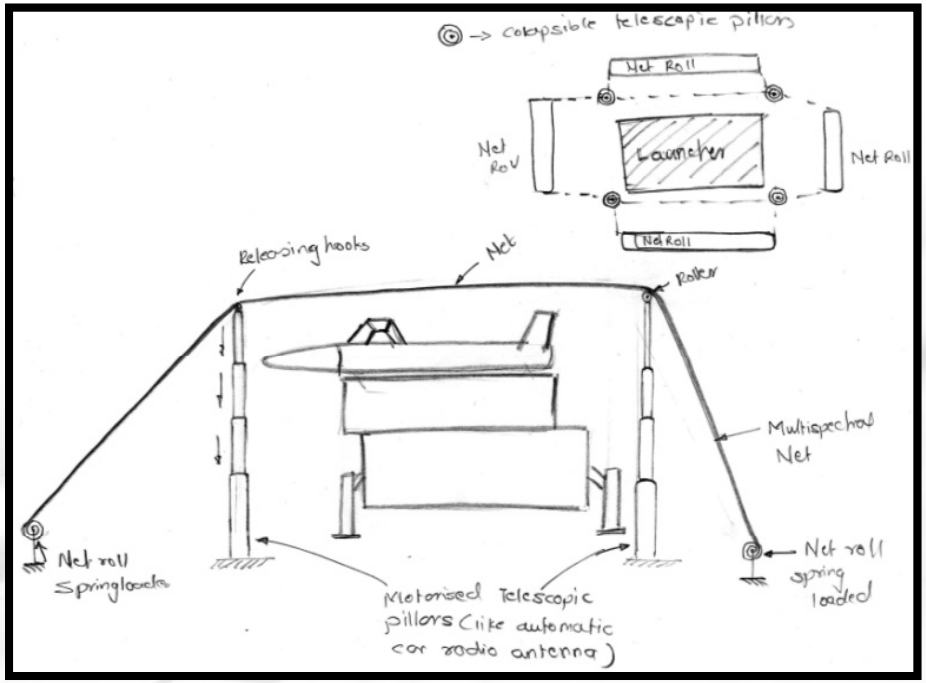
Camouflaging –Concept #1



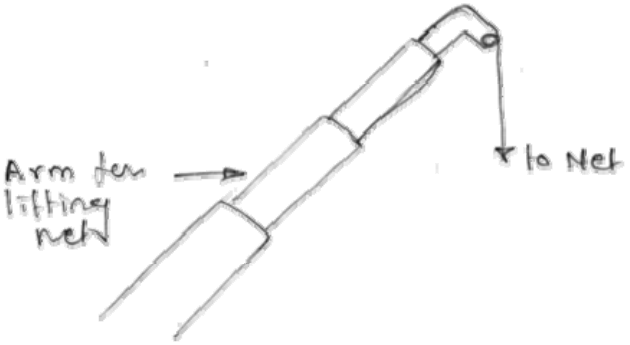
Camouflaging –Cluster #2

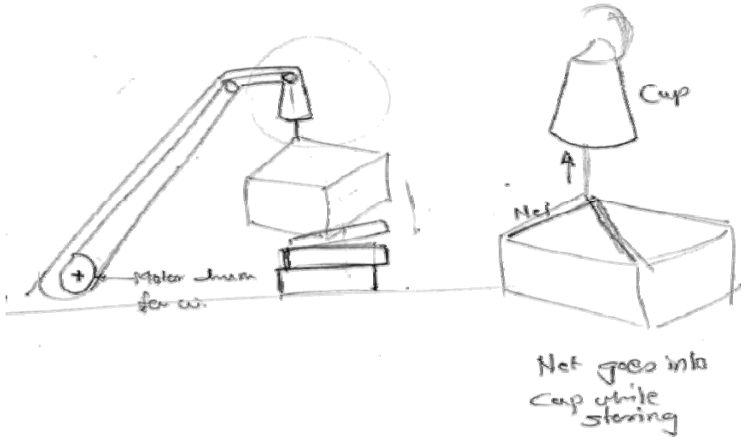






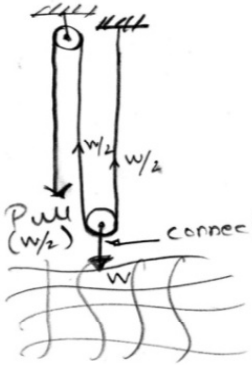
Camouflaging –Cluster #2

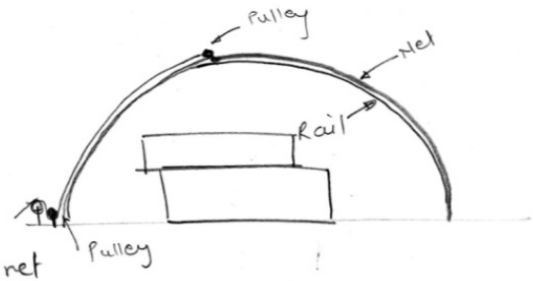


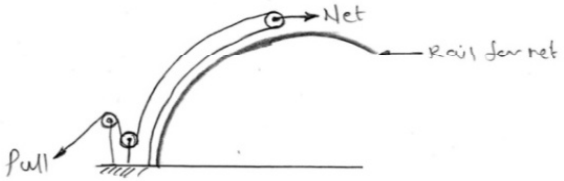


MSN deployment mechanism like Hay (2 pulley system) manually done

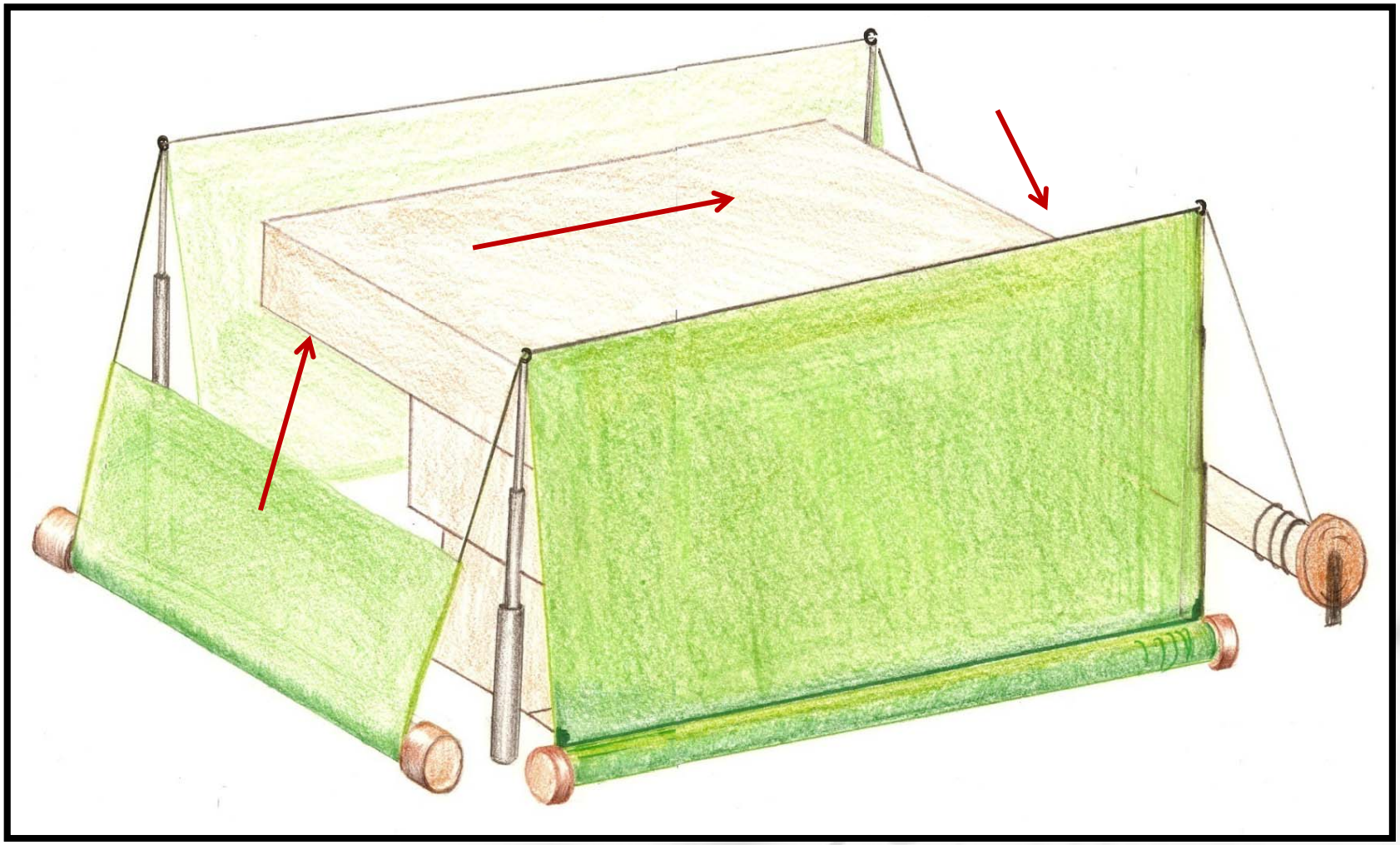
Easy to pull of weight of net is halved.



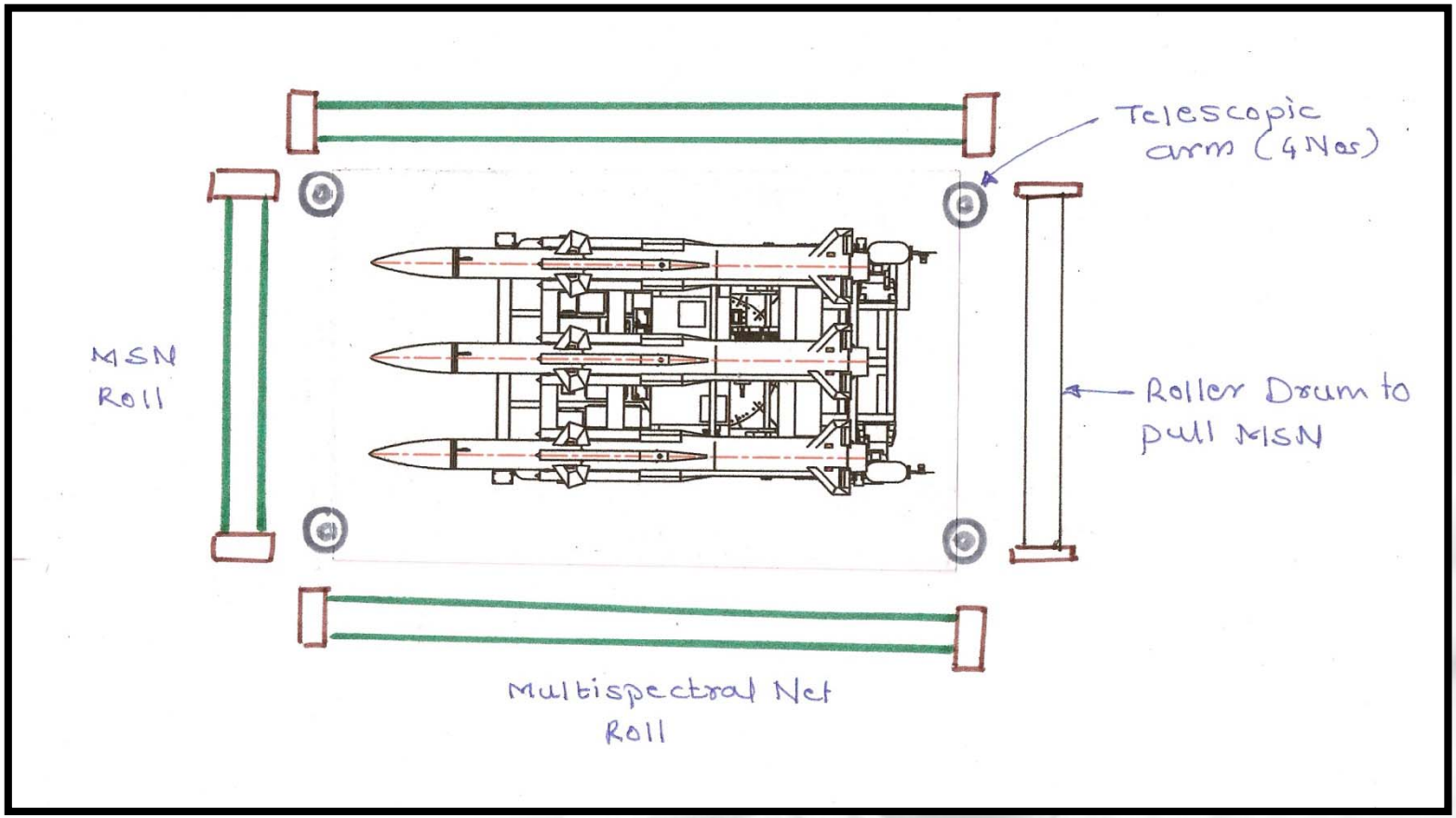




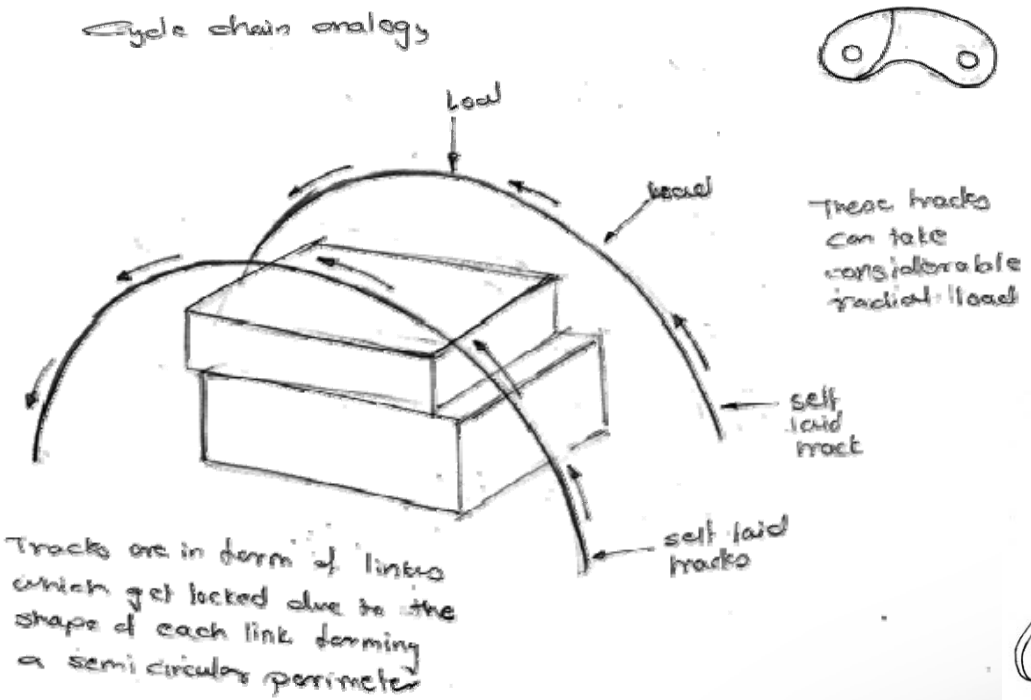
Camouflaging –Concept #2

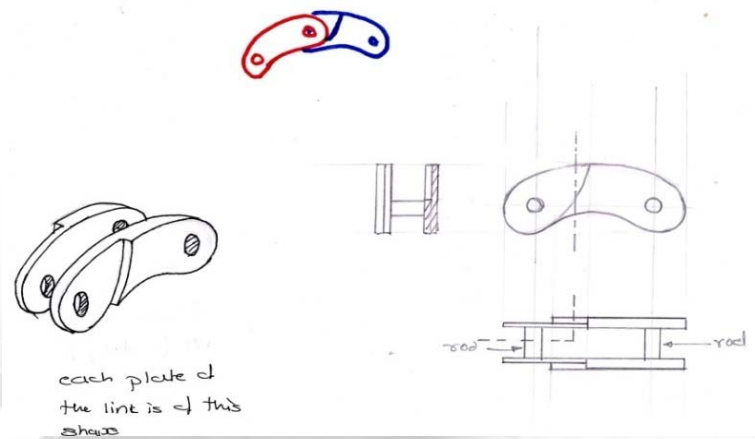


Camouflaging –Concept #2

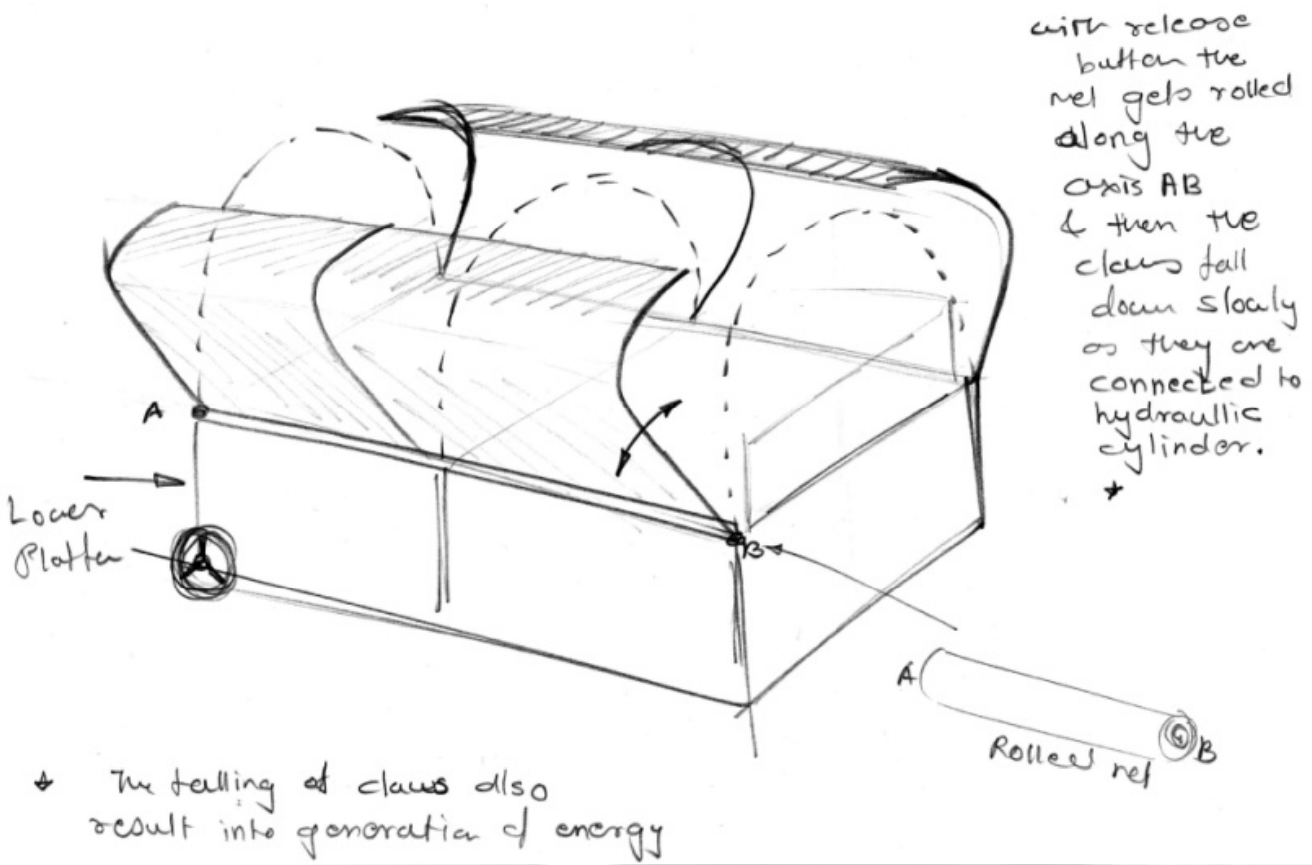


Camouflaging –Radical Ideas



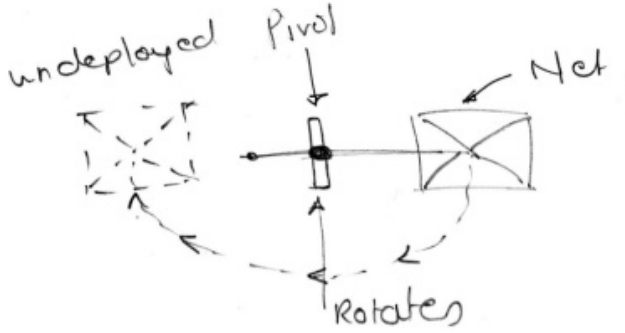


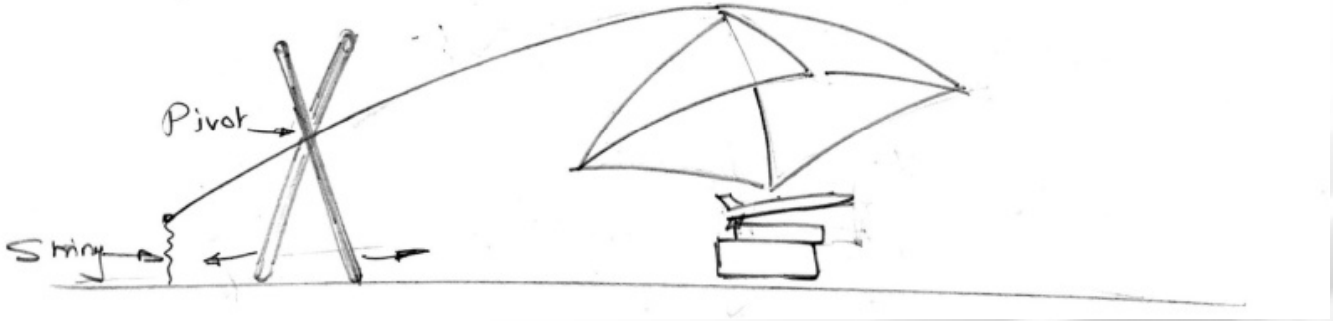
Camouflaging –Radical Ideas



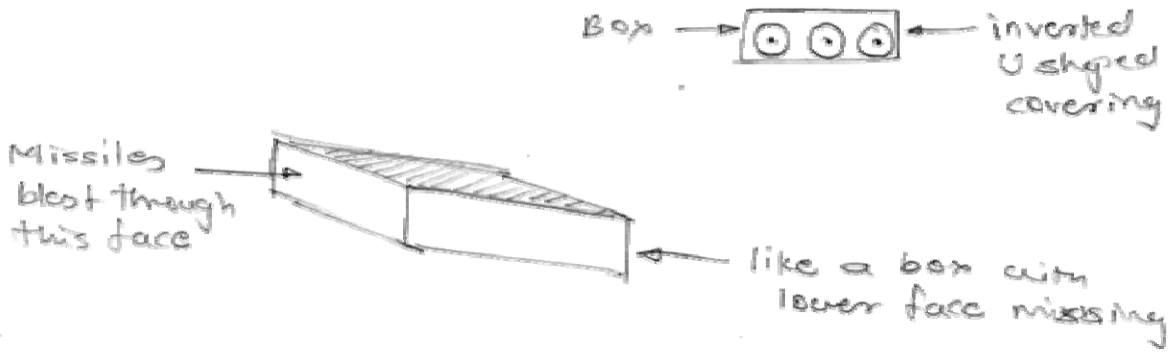
Camouflaging –Radical Ideas

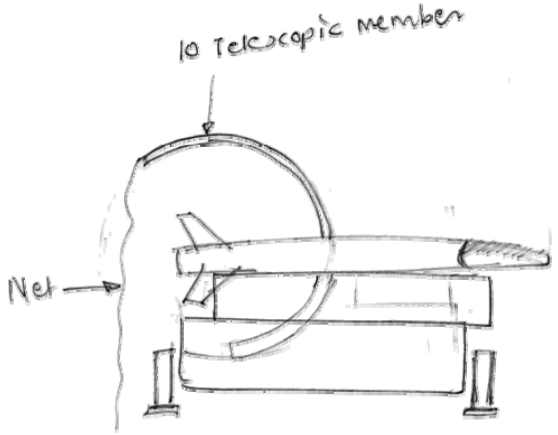
Fishing Nets in Kerala

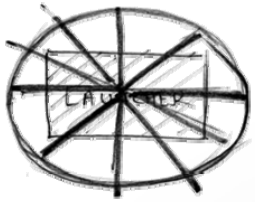


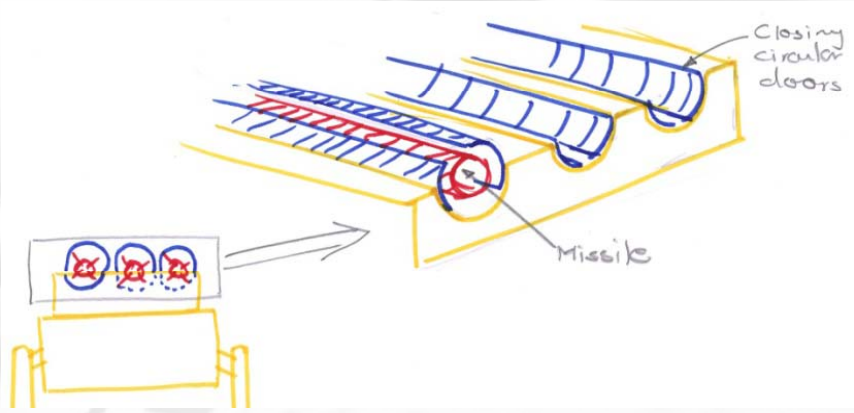


Camouflaging –Radical Ideas





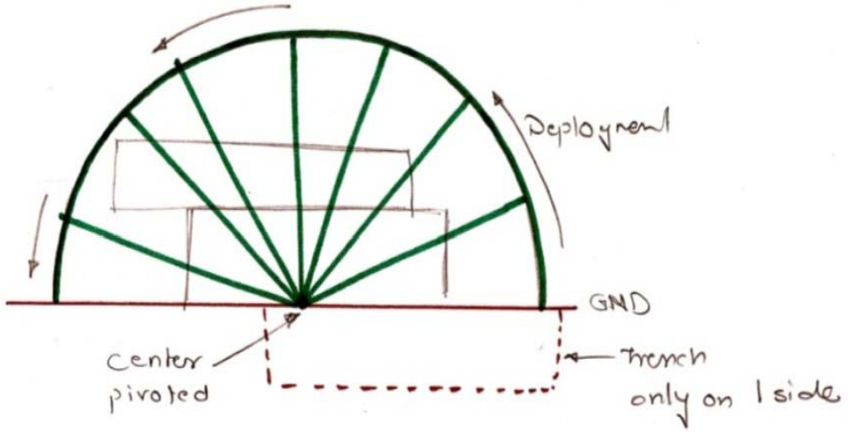


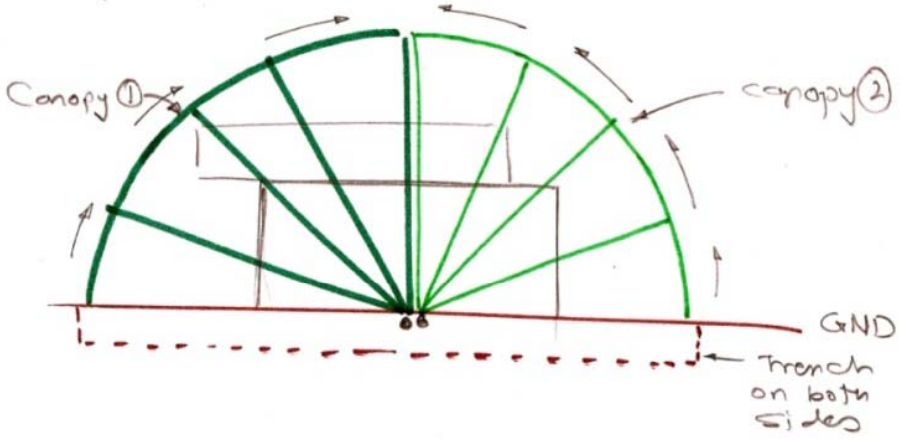


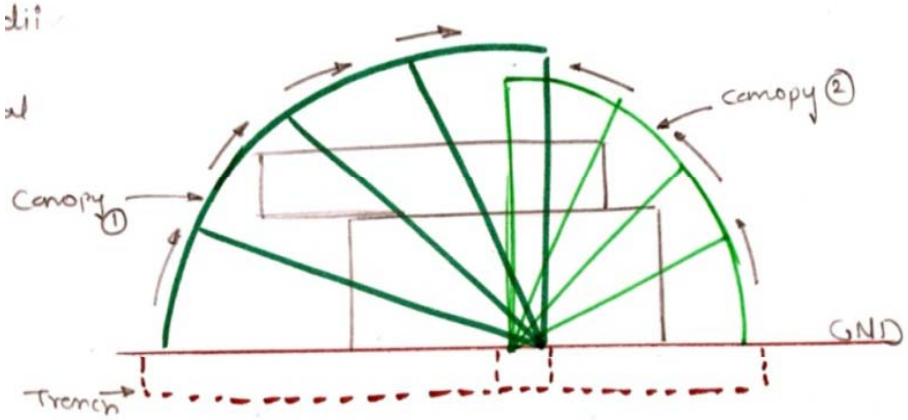
Camouflaging –Cluster #4

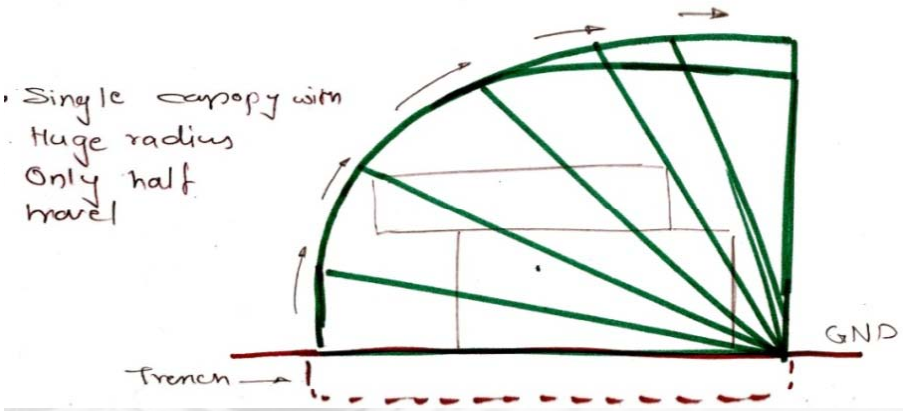
Bellow Concept

Camouflaging –Cluster #4



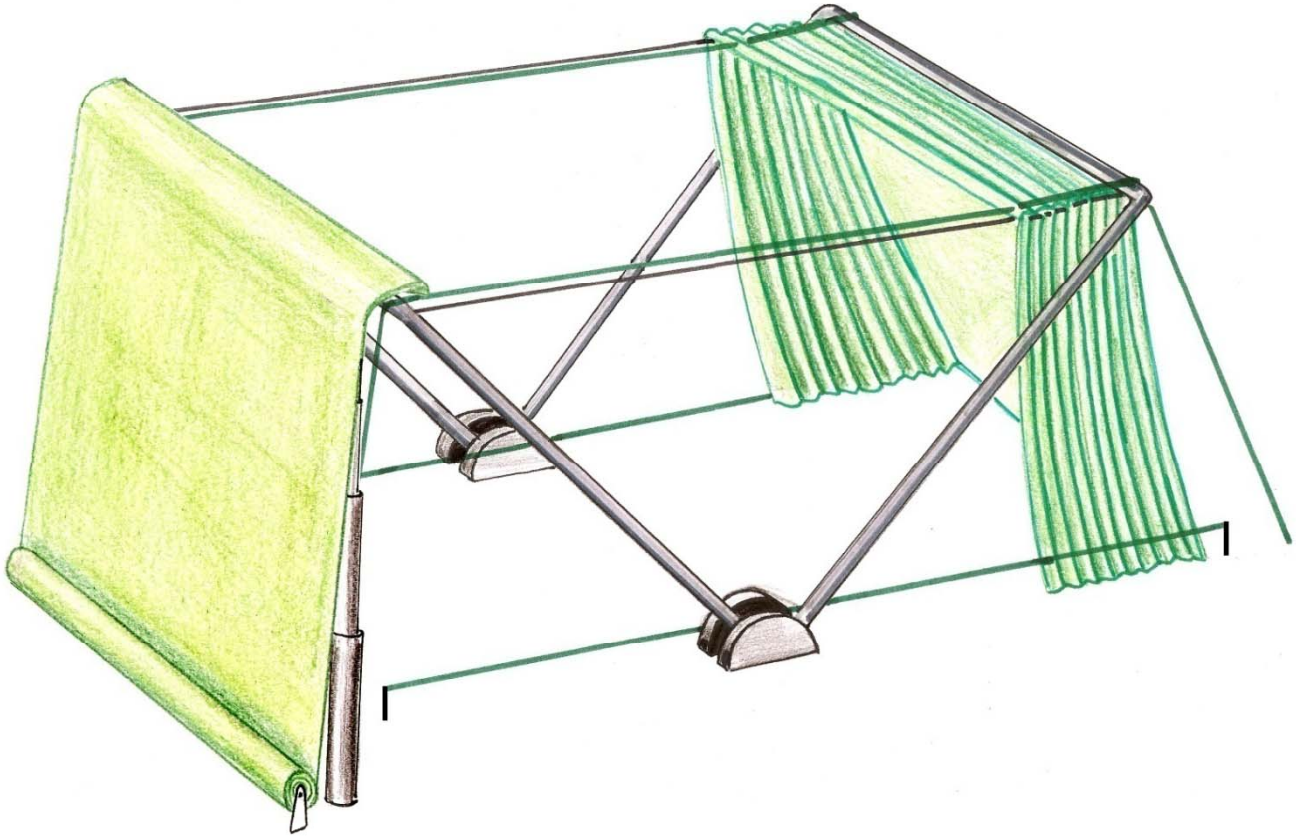


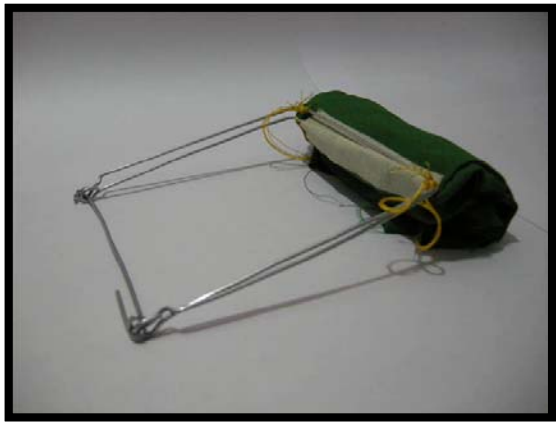




Camouflaging –Concept #3

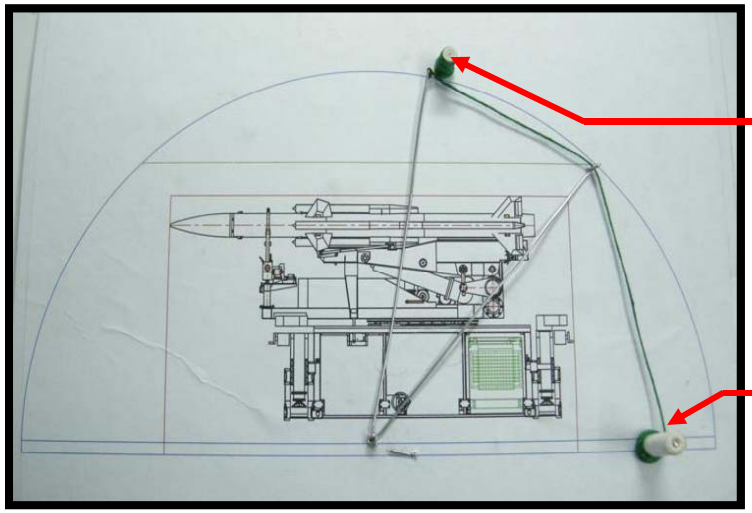
Camouflaging –Refinement 1





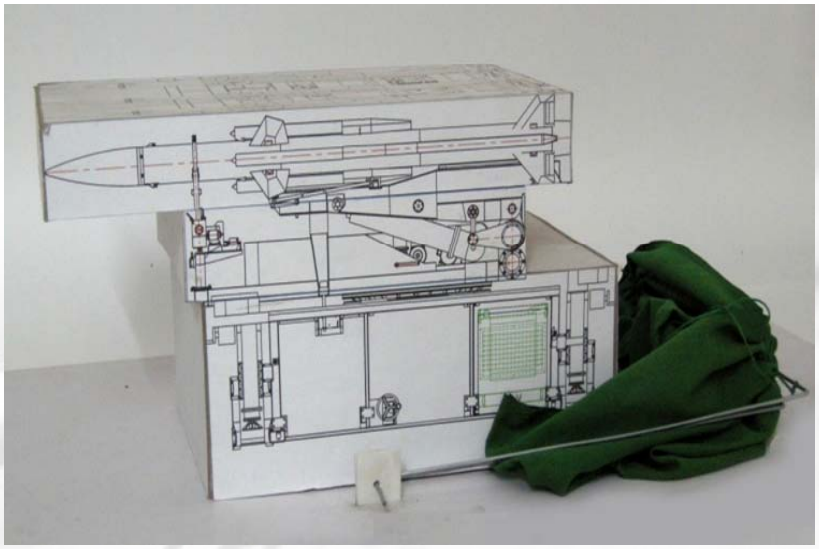
	Concept #3	Refinement: stage 1
Surface area	151.73 m^2	131.71 m^2
Footprint	45.77 m^2	32.64 m^2

Camouflaging –Refinement 2



Motor to roll up the MSN mounted on the front member

Motor to wind string



Final Concept

Final Concept Features

- Minimum size (surface area as well as footprint).
- Quick removal due to lesser number of operations
- Easy to deploy.
- Irregular shape due to waved surface at top, hence low probability to getting detected.
- Allows air flow.
- Very low weight camouflaging system. Energy efficient.

Future Scope

- Replace existing control panel with newer interactive systems.
- Ergonomic study of actual working prototype.
- User study and feedback.

Challenges & Limitations

- New user.
- New user will be a service level Jawan with very little technical knowhow
- Need to be trained to use the launch system.
- This being the first version, the specific users of the launch system are not available.
- User information is limited by the information available through the technicians and engineers at L&T.

THANK YOU

References

Literature

Indian Anthropometric Dimensions for Ergonomic Design Practice –D. Chakrabarty

Design Data book for Engineers – PSG college of Technology, Coimbatore

Collapsibles – Per Mollerup

Websites

www.drdo.org

www.larsentoubro.com

www.army-technology.com

www.bharat-rakshak.com

www.inetres.com

www.live-fist.blogspot.com

www.saabgroup.com

www.oztektekstil.com.tr

www.wikipedia.org

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