KLE TECHNOLOGICAL UNIVERSITY, HUBBALLI.

A Mini Project Report On

Reverse Engineering and CAD Modelling of Missile Launcher Truck

Submitted in partial fulfillment of the requirements of

Bachelor of Engineering in School of Mechanical Engineering

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Abstract—— a unique approach to design a 3D model of missile launcher toy truck (figure 1.1) using 3d experience software. The process begins with the reverse engineering of the physical model (missile launcher toy truck). Reverse-engineering is the act of dismantling an object to see how it works. It is done mostly to examine and learn how something works, but it is also frequently used to reproduce or improve the object [1]. Reverse engineering is adapted to design each component of the toy and eventually assemble the designed components using assembly design workbench in 3D experience.

Keywords: 3D experience, reverse engineering.

FIGURE 1.1

I. INTRODUCTION

Designing is a skill and every skill requires a tool. One of the tools used to master the design skill is 3D experience. The 3DEXPERIENCE platform is a collaborative environment that empowers businesses and people to innovate in entirely new ways and create products and services using virtual experiences. It provides a real-time view of business activity and ecosystem, connecting people, ideas, and data. Via the 3DEXPERIENCE (3DX) platform, we provide Industry Solution Experiences tailored for each industry. [2]

The product chosen to design is a missile launcher toy truck. Before finalizing the product, one must adhere to the standard selection procedure, which includes various parameters. Such as,

- The number of components in the product.
- Design detailing and critical part features of the components.
- Size of the product and each component.
- Material of the product.
- Economical/cost-effective.

The chosen product satisfies all the above-mentioned criteria.

The missile launcher truck has 11 components in total. They are as follows,

- Chassis
- Cabin
- Cabin component
- Launchpad
- Upper Launchpad
- Missile
- Missile cap
- Wheels (x4)
- Wheel axle (x2)
- Hexagonal bolt (x3)
- Nuts (x4)

II. METHODOLOGY

All the above-mentioned components are initially dismantled (The process of reverse engineering) and are measured using various measuring tools. After measuring the components 2D sketches are drawn. By referring to the hand-drawn 2D sketches all the components are designed in 3D experience software using a couple of workbenches namely, part design workbench and generative wireframe workbench. Eventually, all the 3D designed components are assembled using an assembly design workbench to build the ultimate 3D product.

III. MATERIAL PROPERTIES

The material used to build the toy is 'Polyethylene'. Polyethylene is a member of the important family of polyolefin resins. It is the most widely used plastic in the world.

Some of the material properties of polyethylene are listed in Table 1.1.

PROPERTY	VALUE
Density	952 – 965 kg/m^3
Yield strength	2.62e7 – 3.1e7 pa
Tensile strength	2.21e7 – 3.1e7
Hardness	40 BHN
Young's modulus	1.07e9 – 1.09e9 Pa
Melting temperature	130 – 137 ^{o}C

Table 1.1[3]

IV. TOOLS USED FOR MEASURING

1. DIGITAL VERNIER CALIPERS

Vernier Calipers is a measuring and layout tool typically used for measuring linear dimensions. It can measure the outer dimension using the main jaw, inner dimensions using the smaller jaw, and depth using the stem.

Few of the components such as missile, upper launchpad include holes that are hard to measure using conventional measuring tools. Hence to eliminate any intricate the Vernier calipers are used. The usage of Vernier calipers can be seen in figure 1.2

Figure 1.2

Figure 1.2 shows the measurement of the diameter of the hole using digital Vernier calipers.

2. MEASURING SCALE

The most conventional yet highly effective device for measurement is the measuring scale. When the measuring component is linear and easy to measure the measuring scale is used.

Almost all the components of the product had the usage of measuring scale. Figure 1.3 shows the usage of measuring scale in one of the components.

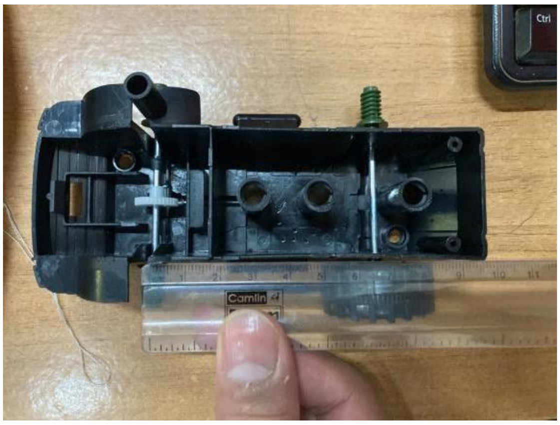

Figure 1.3

Figure 1.3 shows the measurement of the length of the chassis using a cm measuring scale.

3. PROTRACTOR

The protractor tool helps us measure an angle in degrees. A radian scale protractor measures an angle in radians. Since all the dimensions cannot be measured by using the linear measuring instrument, the usage of a protractor is significant.

Few of the component designs were at an angle such as missile's toe and front end, chassis' backend, etc. To measure such design complications protractor has been used. The usage of the protractor can be seen in figure 1.4.

Figure 1.4

Figure 1.4 shows the measurement of the chassis' backend which is at a certain angle using a degree scale protractor

4. THREAD

As far as the measuring is concerned, the thread is not used vividly. The usage of the thread seems uncanny yet very effective. When one cannot measure the diameter of circles or holes in the vicinity of the Vernier calipers, the thread is used.

Thread gives the perimeter of the circle. By using the formula, perimeter of the circle = $2\pi r$ one can easily find the radius of the circle. The usage of thread in finding the perimeter of the missile can be seen in figure 1.5

Figure 1.5

Figure 1.5 shows the measurement of the perimeter of the missile using thread.

5. MEASUREMENT OF CURVED SURFACES

The curved surfaces cannot be measured by any of the above-mentioned measuring tools. The technique used to measure the radius or diameter of the curved surface is tracing.

To begin with, the curved surface is traced down in the paper. With the help of a compass, the traced curve is completed to full circle. Eventually, the diameter is measured using a measuring scale.

The curved surfaces in the cabin are measured similarly. Figure 1.6 shows the measurement of curved surfaces.

Figure 1.6

V. FUNCTIONS OF UTILISED WORKBENCHES

The **3DEXPERIENCE** platform is a collaborative environment that empowers businesses and people to innovate in entirely new ways and create products and services using virtual experiences. It provides a real-time view of business activity and ecosystem, connecting people, ideas, and data. Via the 3DEXPERIENCE (3DX) platform, we provide Industry Solution Experiences tailored for each industry. The platform also acts as a marketplace, or trading platform, that connects service providers and buyers.

The different types of workbenches used are part design, Assembly design, Generative shape design, and drafting.

The **Part Design** application makes it possible to design precise 3D mechanical parts with an intuitive and flexible user interface, from sketching in an assembly context to iterative detailed design. Part Design application will enable you to accommodate design requirements for parts of various complexities, from simple to advance. This application, which combines the power of feature-based design with the flexibility of a Boolean approach, offers a highly productive.

Generative Shape Design allows you to quickly model both simple and complex shapes using wireframe and surface features. It provides a large set of tools for creating and editing shape designs. Its intuitive interface offers the possibility to produce precision shape designs with very few interactions. It offers the capability to model complex surfaces in various engineering applications.

The **Assembly Design was** used to create an assembly starting from scratch. Assembly Design is easy to use and powerful. The basics of product structure, constraints, and moving assemblies and parts can be learned quickly. We will see the facility to use sub-assemblies and constraints.

Drafting workbench provides a simple method to create and modify views on a predefined sheet. You may also add, modify and/or delete dress-up and 2D elements to these views. All this is performed on a sheet that may include a frame and a title block and will eventually be printed [4].

VI. 2D HAND DRAWINGS

1. CHASSIS

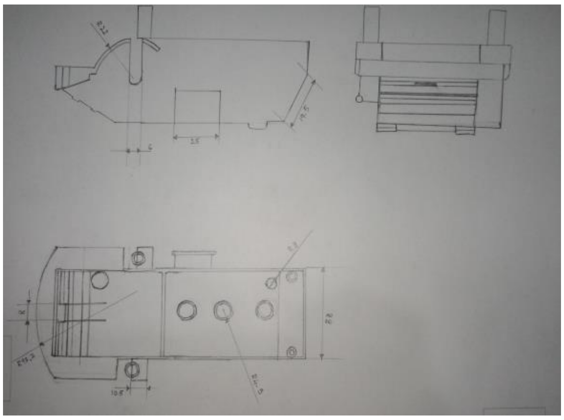

FIGURE 1.7

2. LAUNCHPAD

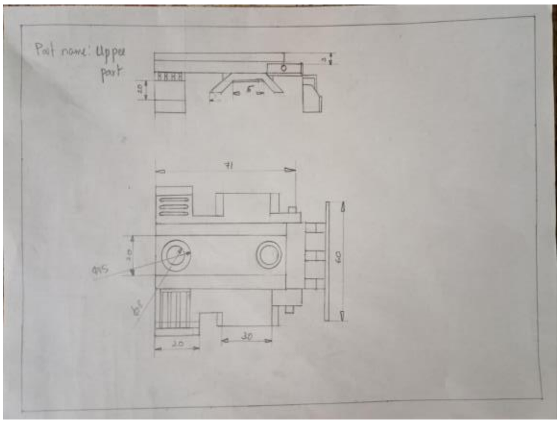

FIGURE 1.8

3. UPPER LAUNCHPAD

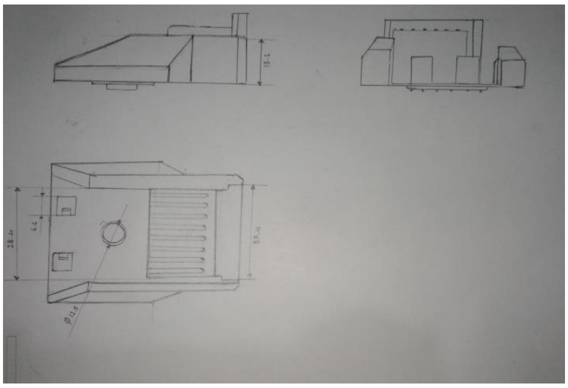

FIGURE 1.9

4. MISSILE

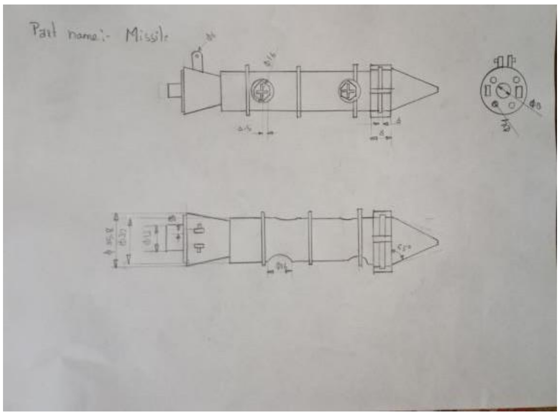

FIGURE 2.0

5. MISSILE CAP

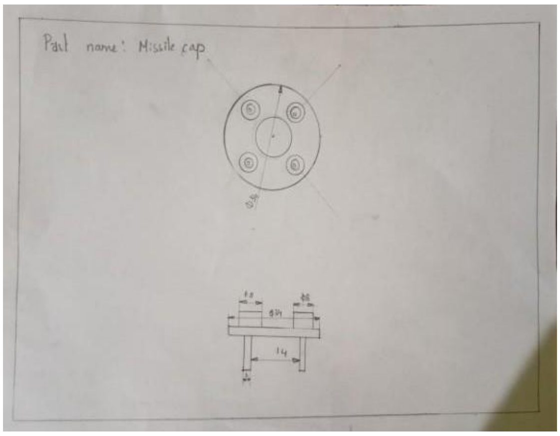

FIGURE 2.1

6. CABIN

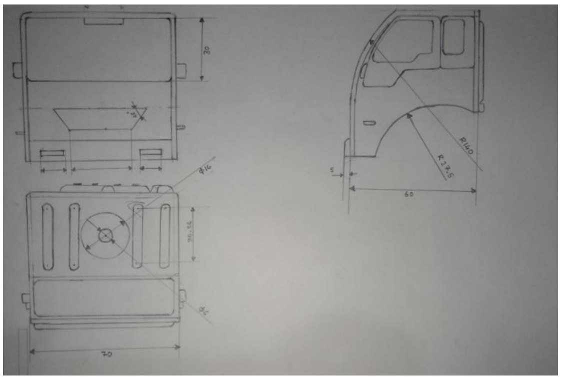

FIGURE 2.2

7. CABIN COMPONENT

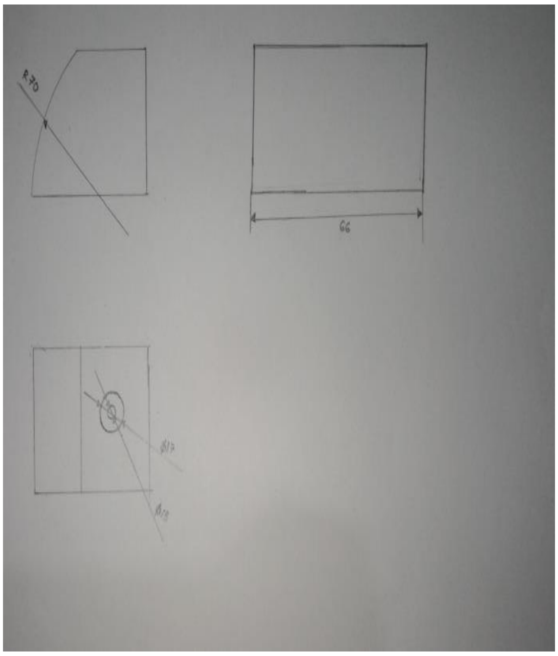

FIGURE 2.3

8. WHEEL

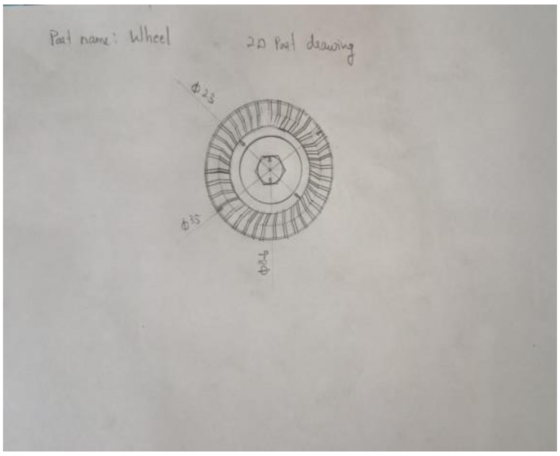

FIGURE 2.4

9. HEXAGONAL BOLT

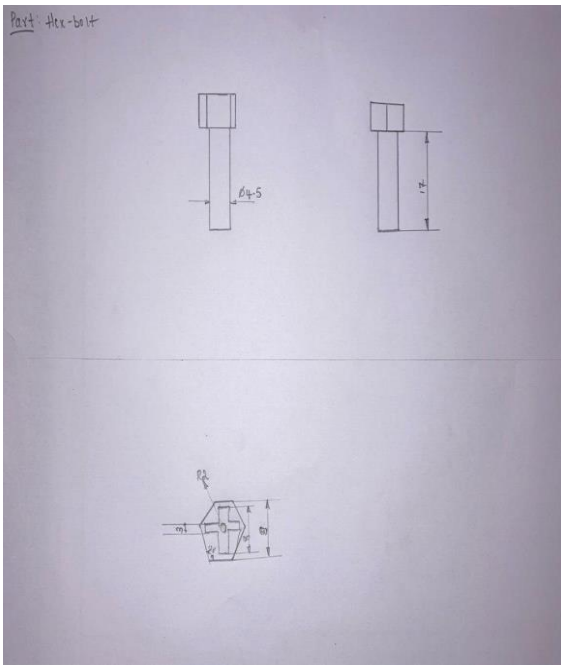

FIGURE 2.5

10. NUT

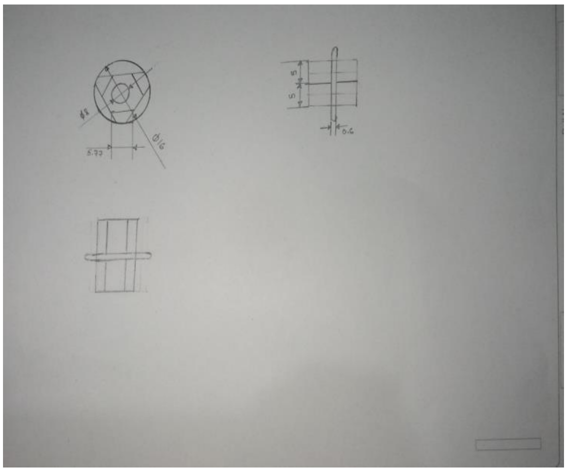

FIGURE 2.6

VII. DETAILED 2D DRAWINGS

1. CHASSIS

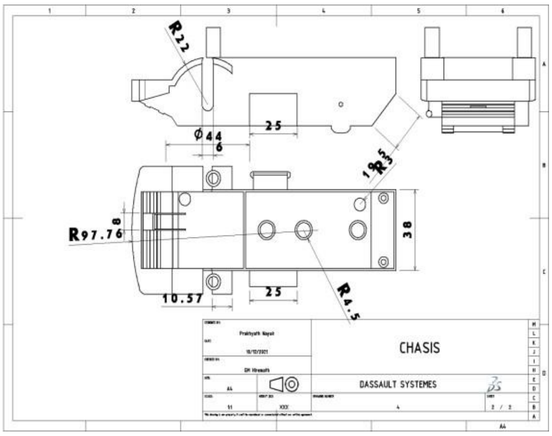

FIGURE 2.7

2. UPPER LAUNCHPAD

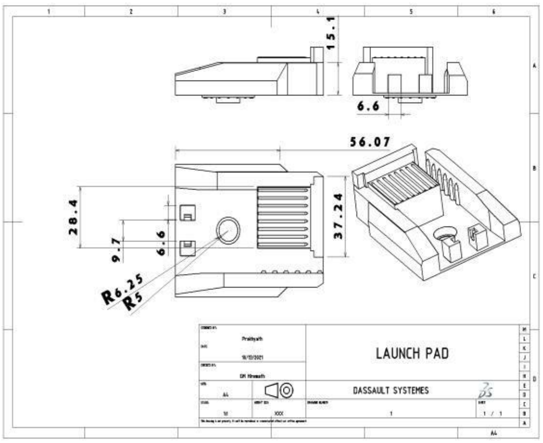

FIGURE 2.8

3. LAUNCHPAD

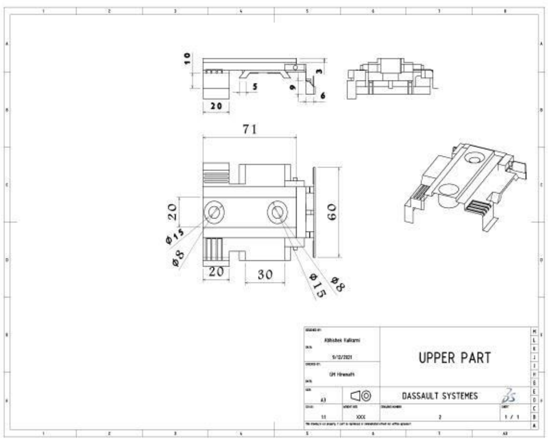

FIGURE 2.9

4. MISSILE

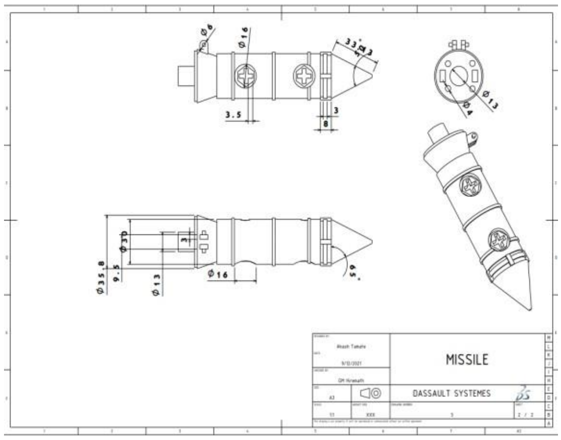

FIGURE 3.0

5. MISSILE CAP

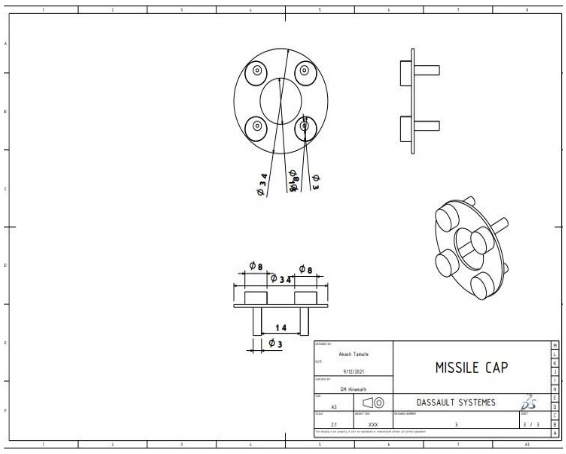

FIGURE 3.1

6. CABIN

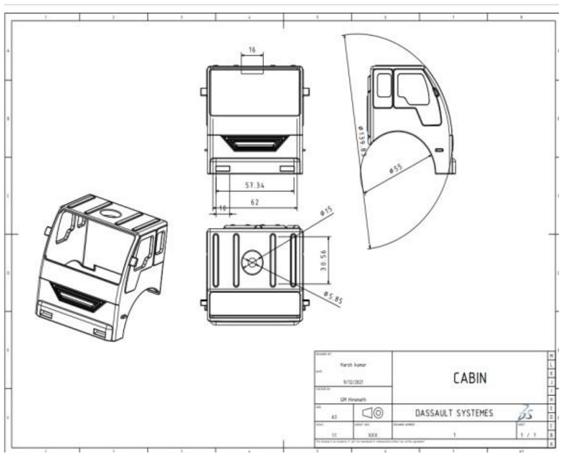

FIGURE 3.2

7. CABIN COMPONENT

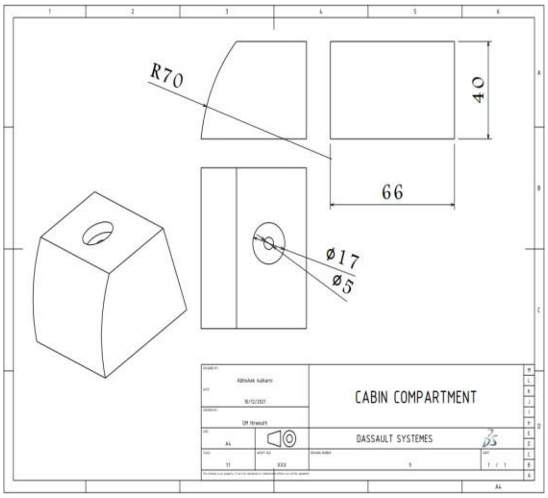

FIGURE 3.3

8. WHEEL

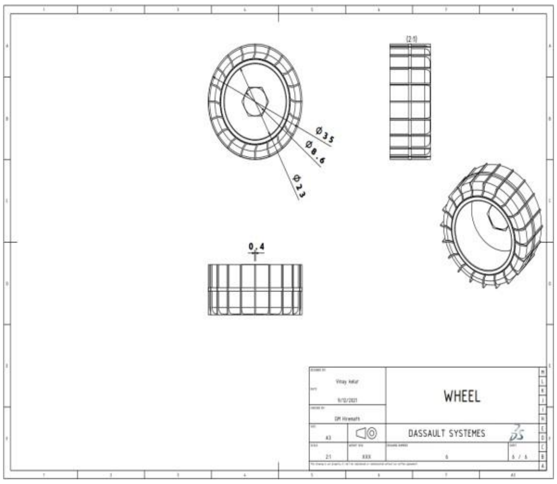

FIGURE 3.4

9. HEXAGONAL BOLT

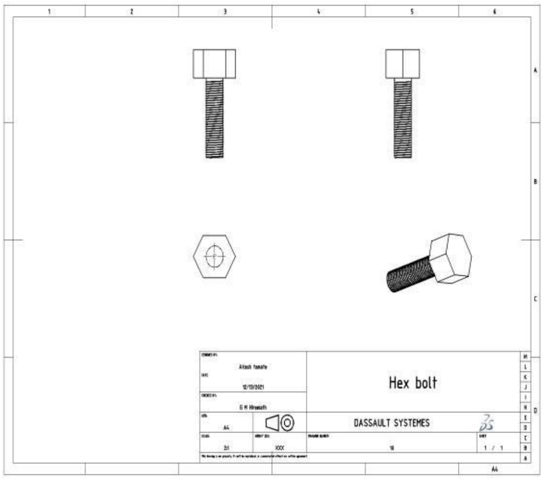

FIGURE 3.5

10. NUT

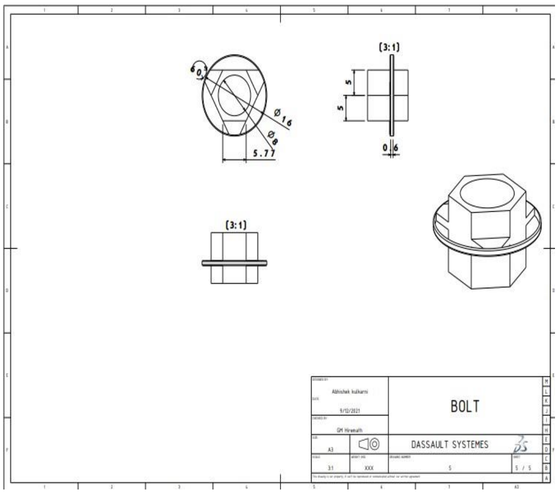

FIGURE 3.6

VIII. COMPARISION OF PHYSICAL COMPONENTS TO 3D MODELLED COMPONENTS

1. CHASSIS

FIGURE 3.7

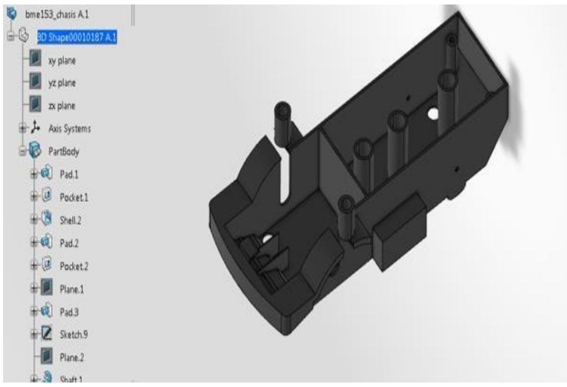

FIGURE 4.0

2. LAUNCHPAD

FIGURE 3.8

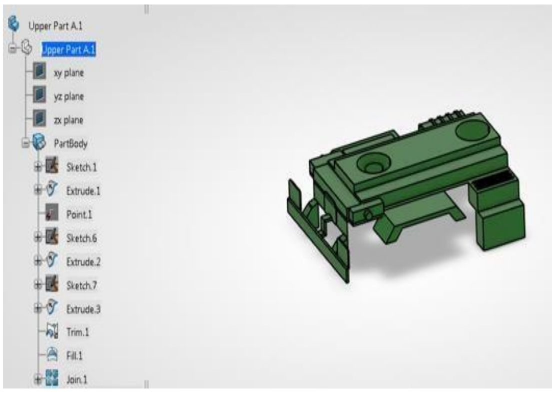

FIGURE 4.1

3. UPPER LAUNCHPAD

FIGURE 3.9

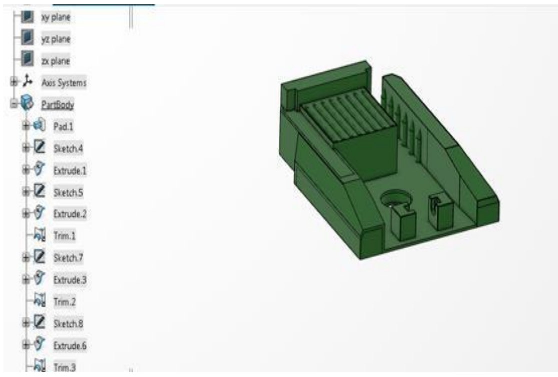

FIGURE 4.2

4. MISSILE

FIGURE 4.3

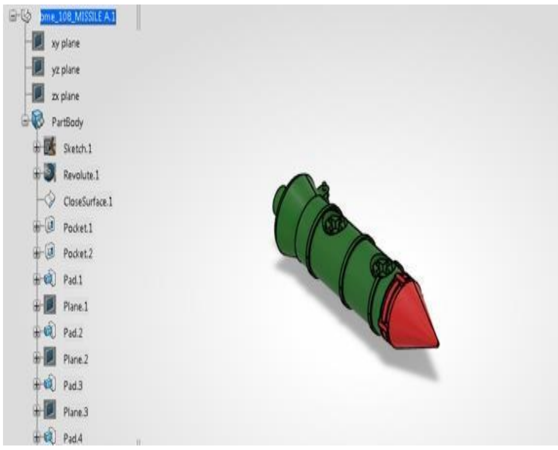

FIGURE 4.6

5. MISSILE CAP

FIGURE 4.4

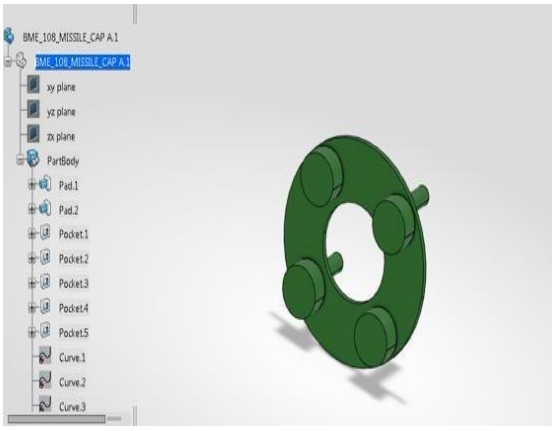

FIGURE 4.7

6. CABIN

FIGURE 4.5

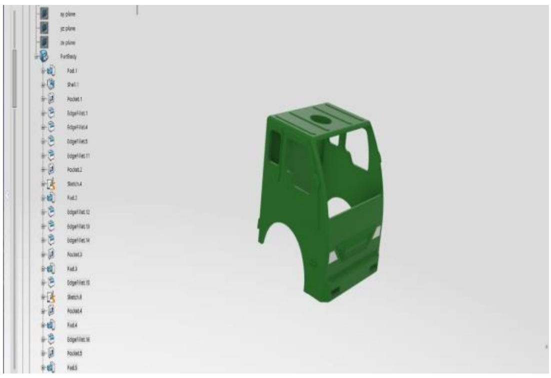

FIGURE 4.8

7. CABIN COMPONENT

FIGURE 4.8

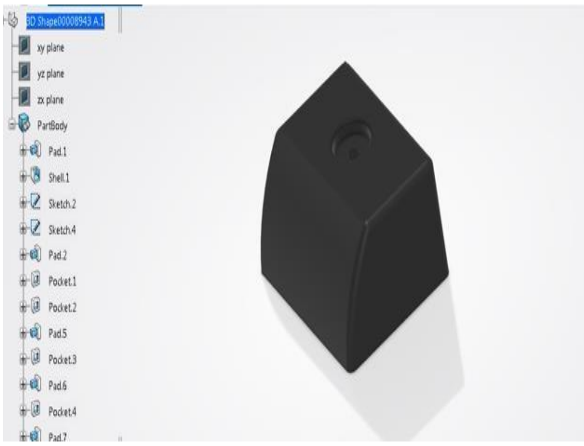

FIGURE 5.1

8. WHEEL

FIGURE 4.9

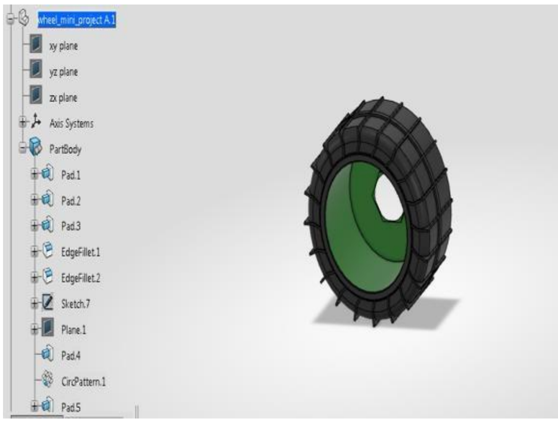

FIGURE 5.2

9. HEXAGONAL BOLT

FIGURE 5.0

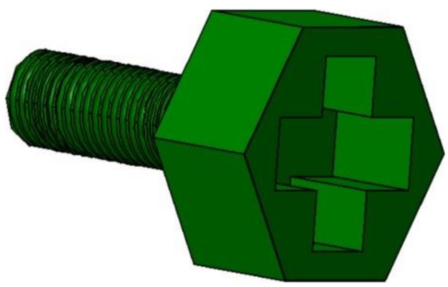

FIGURE 5.3

10. NUT

FIGURE 5.4

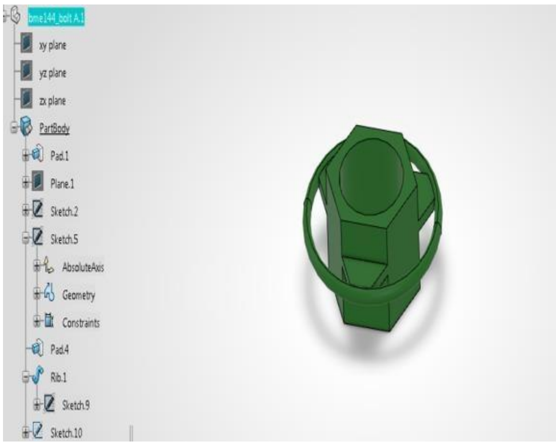

FIGURE 5.6

11. WHEEL AXLE

FIGURE 5.5

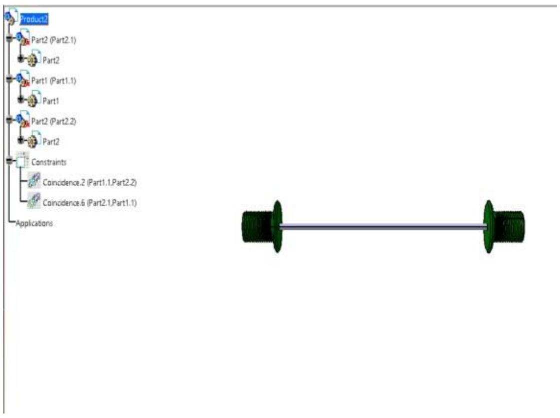

FIGURE 5.7

IX. ASSEMBLY

FIGURE 5.8

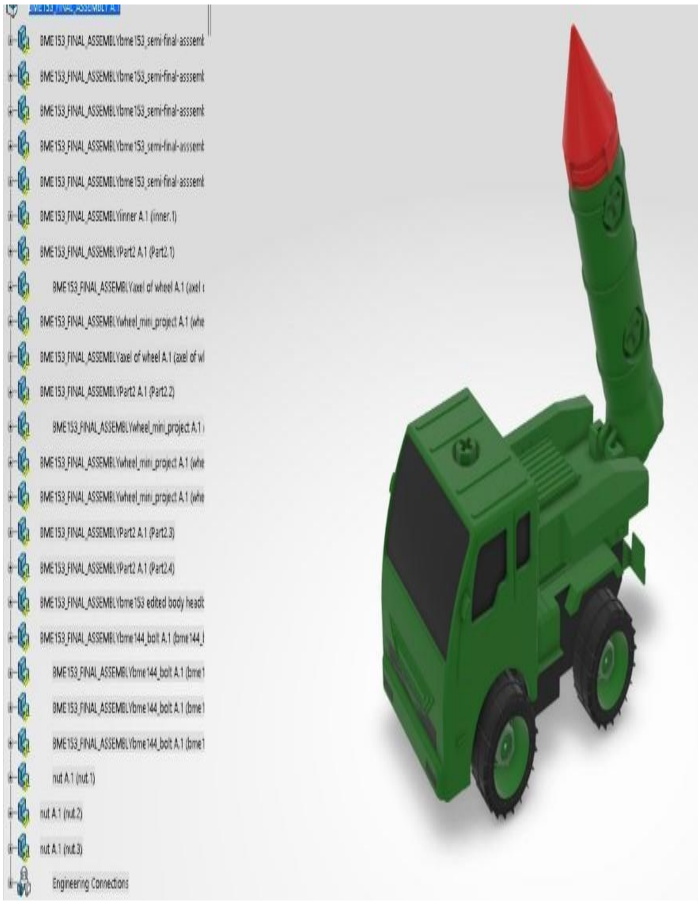

FIGURE 5.9

ASSEMBLY RENDERING

FIGURE 6.0

EXPLODED VIEW

FIGURE 6.1

X. EXPERIENCE USING 3DEXPERIENCE

3D experience is a comprehensible designing tool that was very interesting to learn and a great tool to start the designing journey as a beginner. It was enhancing experience to explore this software.

Working in 3D experience is easy when compared to other 3D designing software. The interface is user-friendly. The PLM feature of 3D experience is a privilege, which compressively helps in editing and saving the files.

3DEXPERIENCE is versatile. It offers various workbenches which help the users to stick to a single software.

Although there are a lot of features to explore, we look forward to learning those features in the coming days and getting acquainted with the software and we hope the designing methods learned through this would help us in the future.

XI. REFERENCES

[1] reverse-engineering, By

Ben Lutkevich, Technical Write

[2] 3DEXPERIENCE® platform

[3] Dielectric manufacturing, polyethylene (HDPE/LDPE)

[4] Index of /CATIA-B18/basug_C2/