RAPID ASSEMBLED TRUCK TRAILER HOUSE

A

PROJECT REPORT

Submitted in partial fulfillment to the requirement to the degree

of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Mr. Chandra Pal Gautam

(Assistant Professor)

by

Rajat Sheetal [211620]

Ashmit Sharma [211602]

to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN–173234

HIMACHAL PRADESH, INDIA

May 2025

DECLARATION

I hereby declare that work presented in this report entitled **“Rapid Assembled Truck Trailer House”** in partial fulfillment of the requirement for the requirements for the award of degree in bachelor of Technology in the Department of Civil Engineering from **Jaypee University of Information Technology Waknaghat, Solan, H.P** is original record of my own work carried out under the supervision of **Mr. Chandra Pal Gautam (Assistant Professor)**. This work has not been submitted elsewhere for the award of any other degree/diploma. I am fully responsible for the contents of my project report.

Rajat Sheetal	Ashmit Sharma
211620	211602
Department of Civil Engineering	Department of Civil Engineering
JUIT, Waknaghat	JUIT, Waknaghat

Date: 13/05/2025

CERTIFICATE

This is to ensure that the work which is being introduced in the venture report named "**Rapid Assembled Truck Trailer House**" in fractional satisfaction of the necessities for the honor of the level of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat** is a true record of work completed by **Rajat Sheetal (211620) & Ashmit Sharma (211602)** under the management of **Mr. Chandra Pal Gautam (Assistant Professor)** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge

Date:13/05/2025

Chandra Pal Gautam	Prof.&Dr. Ashish Kumar
Assistant Professor	HOD & Professor
Department of Civil Engineering	Department of Civil Engineering
JUIT, Waknaghat	JUIT, Waknaghat

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Rajat Sheetal
211620

Ashmit Sharma
211602

ABSTRACT

The Rapid Assembled Truck Trailer House project addresses urgent housing needs through innovative engineering solutions. This initiative focuses on rapid assembly structures designed for disaster relief, military applications, and low-income housing. The study highlights the necessity for quick-deployable shelters in response to natural disasters, the military's demand for efficient housing in remote locations, and the growing need for affordable living options for low-income families.

The project employ simulates disciplinary approach, integrating civil and mechanical engineering principles to ensure structural integrity and functionality. Key objectives include material selection for durability, stability analysis under various loads, and the development of efficient assembly mechanisms. A thorough literature review reveals strands in light weight and transformable structures, emphasizing their elegance in modern architecture.

Methodologically, the project involves stability testing of assembled structures, material analysis, and design evaluations using advanced software tools. Preliminary research has been conducted, with astructuredworkplanoutliningfutureactivitiesaimedatachievingprojectgoals. This report serves as a foundational document to guide the development of sustainable and adaptable housing solutions that meet contemporary challenges in urban planning and disaster management.

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INTRODUCTION

The Rapid Assembled Truck Trailer House project is all about tackling some of the toughest housing problems our world faces today. Whether its people displaced by natural disasters, military teams working in isolated areas, or families struggling to find affordable homes, there's a growing need for housing that's not just quick to build, but also safe, sturdy, and adaptable.

This project is pioneering a new kind of mobile home-one that can be set up or taken down in record time. These aren't your average trailers; they're designed using the latest engineering know-how to ensure their strong, reliable, and comfortable to live in, even in challenging conditions.

Fast and Easy to Set Up

- The main goal is speed. These homes are built in sections at a factory, and then shipped to where they're needed. Once on site, they can be put together in just a few hours or days, so people aren't left waiting for weeks or months for shelter.

Built to Last

- Even though they're quick to assemble, these homes don't cut corners on safety. Engineers use smart designs and tough materials-like steel, aluminum, and treated wood-to make sure each house can stand up to harsh weather and heavy use.

Lightweight Materials

- Using materials like aluminum and steel keeps the homes light enough to move easily, but strong enough to last. These materials also resist things like rust, fire, and pests, which is important for long-term use.

Simple Assembly

- The homes are designed to fit together like building blocks. Special connectors and modular parts make it possible for teams to put them up quickly, even without heavy machinery or a big crew.

Where to use:

Disaster Relief

- When disaster strikes, people need safe shelter right away. These rapid-assembly homes can be delivered to affected areas and set up fast, helping families get back on their feet. For example, after wildfires or floods, similar temporary housing has provided a lifeline for thousands.

Military Use

- The military often needs to set up bases, hospitals, or command centers in remote locations. These mobile houses are perfect for that-they're quick to deploy, energy-efficient, and can be customized for different needs.

Affordable Housing

- For people struggling with high housing costs, these homes offer a practical solution. They're more affordable than traditional houses because they're built in factories (which cuts down on waste and labor costs) and can be set up almost anywhere.

Sustainability

- The project also keeps the environment in mind, using recyclable materials and energy-efficient designs to reduce its footprint.

The Engineering Innovations behind the Project

- **Prefabrication:** Building most of the house in a factory speeds up the process and ensures quality.
- **Modular Design:** The homes can be expanded or reconfigured as needed, making them very flexible.
- **Smart Materials:** Using strong, lightweight, and recyclable materials means the homes are both durable and eco-friendly.

Need for Study:

Quick Shelter after Disasters

When natural disasters strike, people often lose their homes in an instant. Traditional construction just can't keep up with the urgent need for safe places to stay. That's where these rapidly assembled homes come in. They're designed to be set up in no time, offering families immediate protection from the elements. With these shelters, communities can focus on recovery, knowing they have a secure roof over their heads right when they need it most.

Meeting Military Needs Anywhere

Military operations don't always happen in convenient locations. Sometimes, teams are sent to remote or rugged areas where there's nothing but open land. The beauty of these mobile houses is that they can be delivered and put together quickly, providing everything from sleeping quarters to command centers. Their portability and fast setup mean the military can respond to new situations without delay, keeping personnel safe and operations running smoothly.

Affordable Housing for Everyone

For many people, especially those with limited income, finding a decent, affordable home is a real challenge. These quick-build houses offer a smart alternative. Because they're made in factories and assembled on-site, they cut down on both cost and construction time. That means more families can move into comfortable homes sooner, without breaking the bank. Plus, the flexible designs make it easy to adapt the houses to different family sizes and needs.

Promoting Smarter Building Methods

This project also helps shine a light on how modern engineering can change the way we build. By using new techniques like modular construction and sustainable materials, we can make homes that are faster to build, more adaptable, and better for the environment. Sharing these advances helps inspire others to rethink traditional construction and embrace more efficient, eco-friendly ways to create housing.

Objectives:

Checking Structural Stability

After assembling a mobile house, it's vital to confirm that it's not just put together correctly but is also safe for people to live in. To guarantee this, the house is put through a variety of practical tests that reflect real-world challenges. For example:

- **Extreme Temperature Exposure:** The house is subjected to both high heat and freezing cold to see if the materials hold up without bending, cracking, or losing strength.
- **Simulated Travel and Shaking:** The structure is shaken and moved to imitate the bumps and jolts it might experience during transportation or in windy conditions.
- **Moisture and Humidity Testing:** The house is exposed to damp environments to ensure it won't develop leaks, rot, or mold over time.
- **Wind and Load Resistance:** Engineers apply force to the house to simulate strong winds or heavy loads, making sure it stays upright and secure.
- **Impact Durability:** The house is given minor knocks and bumps to check if it can handle the rough and tumble of being moved or set up.

These tests are based on trusted industry standards, so when a mobile house passes, you know it's ready for real-life use. Any weaknesses found during testing are fixed, so the final product is even more dependable.

Selecting the Best Building Materials

Choosing what the house is made from is just as important as how it's built. The aim is to use materials that are strong, lightweight, and affordable. Here's how the selection process works:

- **Lightweight and Strong:** Materials like aluminum, special steels, and engineered wood are considered because they're easy to transport but still very durable.
- **Long-Term Performance:** Each material is tested for things like rust resistance, ability to handle temperature changes, and general wear and tear.
- **Cost-Effectiveness:** The price and availability of each option are compared to keep the houses affordable for everyone.
- **Environmental Responsibility:** Whenever possible, materials that are recyclable or have a low environmental impact are chosen to make the houses eco-friendly.

Design Analysis Using Software Tools:

1. Using Modern Design Software

To get the best results in both how the mobile house looks and how it works, the team will use advanced programs like SolidWorks and Karamba3D. These tools let designers create detailed 3D models and run simulations to see how each part will perform in real life. By doing this, they can tweak the design to make sure it's both strong and visually appealing before anything is actually built.

2. Checking the Strength of Each Part

Every main part of the house-like the walls and roof-needs to be checked to make sure it can handle different kinds of stress. Using simulation software, engineers will test how these parts react to things like heavy loads, strong winds, or even earthquakes. This helps ensure everything meets safety standards and keeps people safe inside.

3. Designing Flexible Foundations

Since these mobile houses might be set up on all sorts of ground, from rocky hills to soft soil, the foundation needs to be adaptable. The team will come up with different foundation options that can be adjusted depending on where the house is placed. This way, the house stays stable no matter the terrain.

4. Testing for Wind and Earthquake Resistance

The house has to stand up to tough weather and natural disasters. Engineers will use simulations to see how the structure holds up against strong winds and earthquakes. This helps them make improvements so the house can protect its occupants in any situation.

5. Making Assembly and Disassembly Easy

One of the main goals is to make the house simple to put together and take apart. The team will design special mechanisms-like snap-together joints or modular connectors-that make assembly quick and hassle-free, but still keep the structure solid and safe.

6. Ensuring Long-Lasting Performance

Moving parts and joints need to last a long time, even with repeated use. To check this, the team will run virtual tests that simulate years of wear and tear. This helps them spot any weak points and make improvements, so every part of the house works smoothly for as long as it's need.

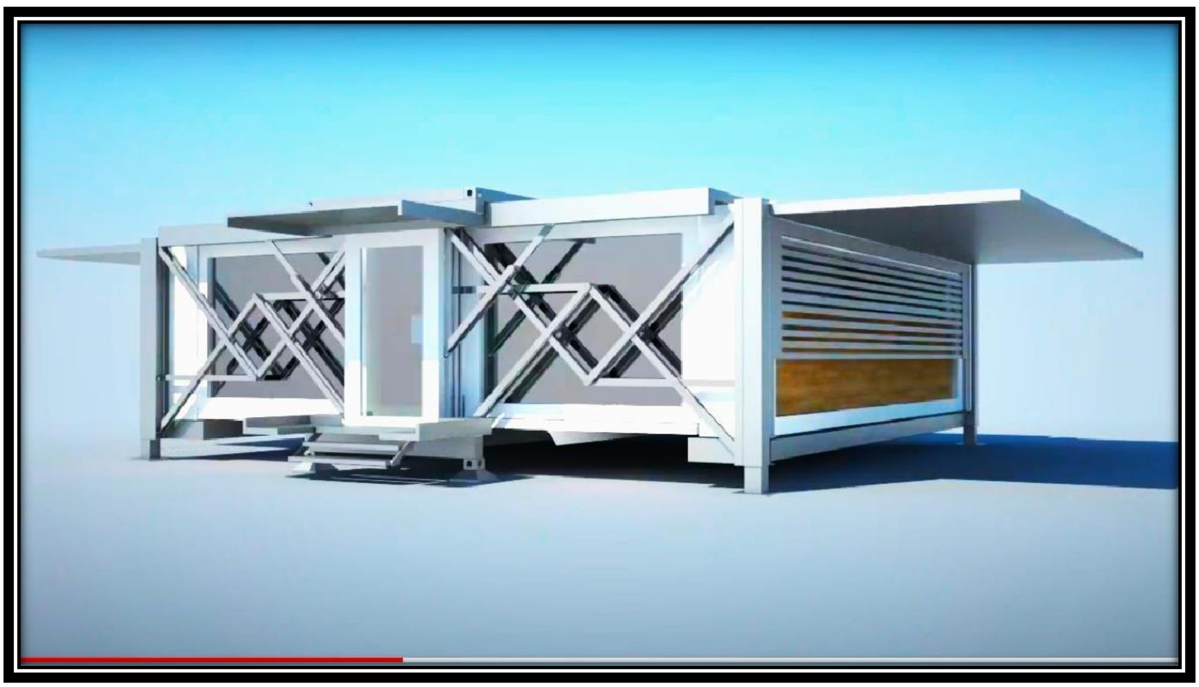

FIGURE1. 1 RAPID ASSEMBLED HOUSE

CHAPTER – 2

LITERATURE REVIEW

Research paper and journals:

1. N. De Temmerman, 2007, Design and Analysis of Deployable Bar Structures:
Transformable structures are a new wave in building design, created to adjust their form or purpose as needed. This flexibility is especially valuable today, as we seek smarter, greener ways to build spaces that can keep up with our changing lifestyles. Rather than being stuck in one shape or use, these structures can adapt, move, or even be reused, making them practical for many different scenarios.

Main Types:

- **Kit-Based Systems:** Imagine a building made of parts you can take apart and reassemble somewhere else. These systems use connections that can be undone, so if you need to move the building or change its layout, it's easy to do.
- **Mechanically Changing Structures:** These are designed to switch between different shapes quickly, like unfolding a tent or expanding a shelter. They're ideal for situations where you need to set something up fast and take it down just as quickly.

Lightweight Deployable Structures:

A big focus in designing these structures is making them as light and portable as possible. The idea is to minimize the time and effort needed to set them up, take them down, and move them to a new spot. This approach not only saves on materials and labor but also helps lessen the environmental impact.

Movement and Mechanisms:
Many of these designs include clever mechanisms so they can fold up small for storage or transport, then open up to full size when needed. This makes them perfect for things like emergency shelters or roofs that need to open and close.

Structures Uses:

These adaptable designs shine in situations where flexibility and speed matter:

- **Temporary Spaces:** Whether it's for disaster relief, an exhibition, or a festival, these structures can be put up quickly and taken down just as fast.
- **Innovative Frameworks:** Some use scissor-like supports, others take inspiration from origami, and some use flexible fabrics. Each approach has its own benefits, depending on what's needed.

Making Permanent Buildings Smarter

Transformable features aren't just for temporary buildings. Permanent spaces can also benefit from elements that adjust to the environment:

- **Moving Roofs and Adjustable Shades:** Buildings with roofs that can open or close, or sunshades that can be moved, can better handle changing weather and light. For example, the famous Wimbledon tennis court roof and smart shading systems on modern office buildings help save energy and keep people comfortable.

Real-World Innovations and Research

Experts like N. De Temmerman have explored a wide range of creative ideas for transformable structures:

- **Folding Bridges:** Some pedestrian bridges can fold up when not in use and unfold when needed, making them both practical and space-saving.
- **Scissor Mechanisms:** These allow structures to stretch out or collapse, offering lots of flexibility for different uses.
- **Digital Design Tools:** Today's designers use advanced software to experiment with shapes and movement, making sure their ideas are both practical and strong before building anything.

Digital Experimentation:

Architects and engineers rely on powerful computer programs to play with different forms and movement options. These tools provide instant feedback, helping teams make smart design choices early on.

Testing for Strength and Flexibility:

Before construction begins, virtual simulations are run to see how the structure will handle real-world forces. This ensures the final product is not only adaptable but also safe and reliable.

FIGURE2. 1 ANGULAR SCISSOR STRUCTURE

FIGURE2. 2 RAPID ASSEMBLED STEEL BRIDGE

2. Tiny houses movement or moment by Sherer & Barton 2021:

Why Are Tiny Houses Gaining Attention?

Tiny houses have become a hot topic, especially in countries like the United States and Australia, where people are searching for new ways to tackle high housing costs and live more sustainably. This movement is about more than just downsizing-it reflects a shift in values. Many are rethinking what it means to have a "home," embracing simpler living and a smaller environmental footprint. But since there's no single definition of a tiny house, it's hard to say if this trend will stick around or fade away.

What Counts as a Tiny House?

One of the challenges with tiny houses is that everyone seems to have their own idea of what qualifies. Some say it's any home under 400 square feet, while others include only those that can be moved on wheels or small backyard cottages known as ADUs (Accessory Dwelling Units). This lack of agreement makes it tricky for local governments to create clear rules or guidelines.

According to researchers like Shearer and Burton, tiny houses can be sorted by factors like whether they're mobile or fixed, their size, design, affordability, eco-friendliness, legal status, and whether they're part of a community. This shows just how varied the tiny house lifestyle can be.

What are Driving People to Go Tiny?

People are choosing tiny homes for all sorts of reasons:

- **Saving Money:** With traditional homes getting pricier, many see tiny houses as a way to cut costs and avoid big mortgages. For some, it's also about focusing less on things and more on experiences, a mindset that's become more common thanks to social media.
- **Looking for Security:** In uncertain housing markets, tiny houses can offer a sense of stability and control that's hard to find elsewhere.
- **Going Green:** Many tiny house fans care deeply about the environment. Living small means using fewer resources, creating less waste, and often adding features like solar panels or composting toilets to shrink their ecological footprint.
- **Seeking Freedom:** For lots of people, tiny house living is about breaking free from the expectations and financial pressures of owning a big home. The flexibility to move or live with less is a huge part of the appeal.

3. Sustainable Prefabricated Buildings: a Holistic Approach Authors: K. Tsikaloudaki et al. Published in2022:

Sustainability:

When you compare how homes are built, prefabricated (or "prefab") construction comes out ahead in terms of sustainability. Because most of the work happens in a factory, there's less waste, and the process is more energy-efficient. Prefab homes also tend to use materials more wisely and leave a smaller carbon footprint, both during construction and after people move in. Features like improved insulation and energy-saving designs help keep these homes eco-friendly in the long run.

Affordability:

At first, prefab houses might look pricier because the initial costs can be higher than building a traditional home. But if you look at the bigger picture, prefab homes can actually save money over time. They're much faster to build, which means you spend less on labor and avoid costly delays. Factory-made components are also more precise, so you waste fewer materials and run into fewer repair issues later. For families with limited budgets in India, these long-term savings can make a real difference.

What Does This Mean for Indian Housing?

- **Better for the Environment:** Prefab construction helps cut down on pollution and waste, which is great for the planet.

- **Saves Money Over Time:** Even if you pay a bit more upfront, you’re likely to spend less in the long run thanks to quicker builds and lower upkeep costs.
- **Some Challenges Remain:** There are still obstacles, like updating building codes, making sure prefab homes are high quality, and encouraging more people to give them a try. Studies show prefab does well environmentally, but there’s room to improve on cost and quality.
- **A Real Opportunity:** With the right support and improvements, prefab homes could be a big help for families who need affordable housing options.

CHAPTER – 3

RESEARCH METHODOLOGY

To make sure the Rapid Assembled Truck Trailer House is practical, safe, and easy to build, the research process is broken down into clear, focused stages. Here's how the work unfolds:

1. **Learning from what's Out There**

- **Diving into Existing Research:**
  The first step is to look closely at what's already been done in the world of mobile homes, lightweight structures, and fast assembly methods. By reviewing published studies and reports, we gather ideas and spot what works (and what doesn't).

- Studying Real-Life Examples:
  We also examine successful projects from around the world. These case studies help us understand which designs and construction methods actually deliver results, guiding our own choices.

2**. Picking the Right Materials**

- Exploring Material Options:
  We compare different building materials to find those that are strong, light, affordable, and environmentally friendly.

- Testing for Strength and Suitability:
  Selected materials are put through physical tests-like checking how much force they can withstand-to make sure they're up to the job.

3**. Designing and Analyzing the Structure**

- Using Modern Design Software:
  Tools like Motion gen pro, SolidWorks, and Karamba3D help us create detailed digital models. These programs let us see how the house will look and function before anything is built.

- **Running Simulations:**
  We simulate the assembly process and test how the structure holds up under different loads and conditions, making sure everything is safe and stable.

4. **Testing Stability in the Real World**

- Building and Testing Prototypes:
  We construct small-scale models or prototypes and put them through tests that mimic real-life challenges, such as strong winds or earthquakes.

- Improving the Design:

  Data from these tests help us spot weaknesses, so we can tweak and strengthen the design as needed.

5**. Creating Flexible Foundations**

- Designing for Different Terrains:

  The house needs to stand firm on a variety of ground types. We develop foundation solutions that can adapt to different soils and environments, always keeping stability in mind.

6. **Making Sure It Stands Up to the Elements**

- Simulating Harsh Conditions:

  We use computer models to see how the house performs in tough situations, like storms or earthquakes, and check that it meets all safety standards.

7. Streamlining Assembly and Disassembly

- Designing User-Friendly Mechanisms:

  Special attention goes into making the house quick and easy to put together or take apart. We create and test prototypes of moving parts to ensure they work smoothly and reliably.

8**. Bringing It All Together**

- On-Site Assembly and Final Checks:

  Once everything is ready, the house is assembled on location. We carry out thorough inspections to make sure everything meets our quality and safety standards.

- Gathering Feedback:

  After assembly, we listen to feedback from the people building and living in the house, using their insights to make future versions even better.

CHAPTER – 4

SOFTWARE USED

Software Tools behind the Rapid Assembled Mobile House:

To bring the Rapid Assembled Mobile House concept to life, a combination of modern software tools is used. Each plays a unique role in the design, visualization, and engineering of the project.

Blender (Version 4.3)

Blender is free and versatile 3D software that's popular with designers and animators worldwide. It's packed with features for modeling, animation, and rendering, making it a great choice for visualizing complex ideas.

What Makes Blender Useful:

- 3D Modeling: You can build detailed digital models, perfect for planning out every corner of the mobile house.
- Animation: Blender makes it simple to animate parts and show how the house unfolds or how different spaces can be used.
- Rendering: The software can turn your models into high-quality images and videos, ideal for presentations and walkthroughs.
- Video Editing: It even comes with basic tools for editing video clips, so you can put together polished project videos.

Blender helps the team create realistic visuals and animations that make the house easy to understand for everyone involved.

Revit 2025:

Revit 2025 is a powerful design and documentation tool used by architects and engineers. It's built for creating accurate building models and managing all the details that go into a construction project. The latest version puts a big emphasis on sustainability and teamwork.

Key Advantages of Revit 2025:

- Carbon Analysis: Designers can measure and reduce the environmental impact of their projects from the start.
- Advanced Site Tools: Working with real-world terrain is easier, thanks to improved 3D site modeling features.

- Efficient Modeling: Automatic wall connections and enhanced design tools help speed up the modeling process and improve accuracy.
- Sheet Organization: Projects with lots of drawings are easier to manage with the new sheet collections feature.
- User-Friendly Interface: The updated home screen and cloud features make accessing and sharing project files smoother.
- Better Collaboration: Integration with Autodesk Docs means teams can work together more effectively and keep everyone on the same page.

For this project, Revit ensures the design is practical, sustainable, and ready for real-world construction.

Motion Gen:

Motion Gen is a specialized tool for simulating how mechanical systems move. This is especially important for the mobile house, which uses hydraulic and sliding mechanisms to assemble itself. With Motion Gen, the team can test and refine these movements virtually, making sure everything works as planned before building the real thing.

How the Software Works Together

By using Blender, Revit 2025, and Motion Gen, the project team can:

- Create and animate the house design in Blender, making it easy to show how the house is assembled or lived in.
- Plan and document the technical details in Revit, ensuring the design meets construction and sustainability standards.
- Test and perfect the assembly mechanisms in Motion Gen, guaranteeing smooth and reliable operation.

Together, these tools help transform the vision of a rapid-assembled mobile house into a practical, efficient, and visually compelling reality.

Blender:

- **Design:**

  Blender was used to create detailed 3D models of the truck trailer house. This helped in visualizing how the house would look after assembly and how all the parts fit together.

- **Assembly:**
  The software allowed us to make animations showing how the trailer unfolds and transforms into a house. This made it easier to explain the assembly steps and how the hydraulic and mechanical systems work.
- **Layout:**
  Blender helped in arranging the interior spaces, such as where to place bunk beds, kitchen, and washrooms. This made sure the space was used in the best way possible for 36 people.
- **Presentation:**
  The 3D images and animations made with Blender were used in project presentations and the report. This made it easier for others to understand the design and features of the house.
- **Improvement:**
  By seeing the model in 3D, we could spot problems or areas for improvement before building anything in real life. This saved time and resources.

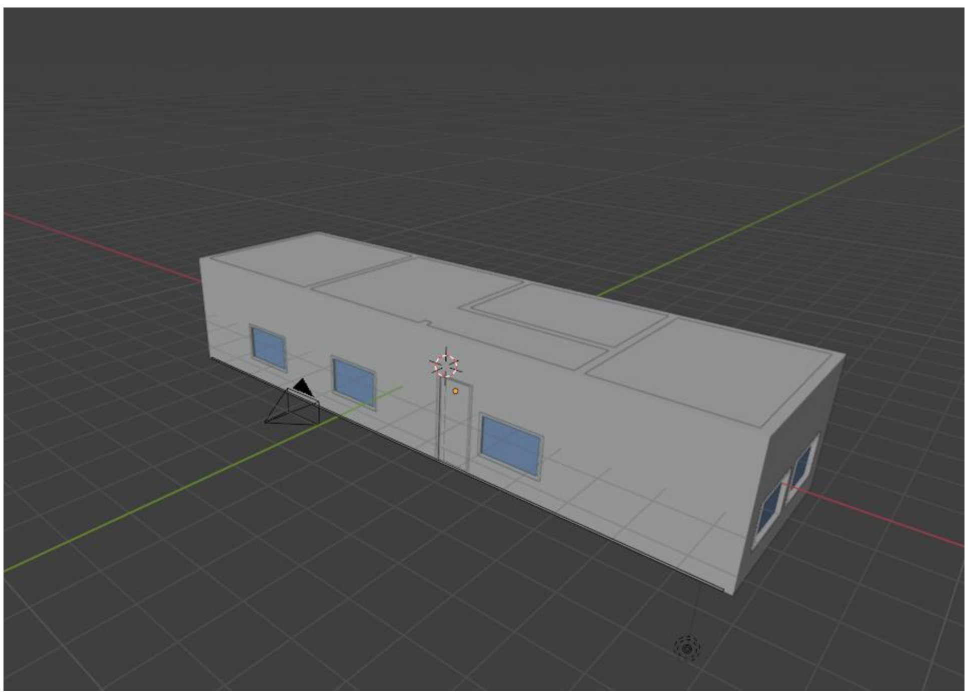

FIGURE4. 1 TRAILER HOUSE IN BLENDER

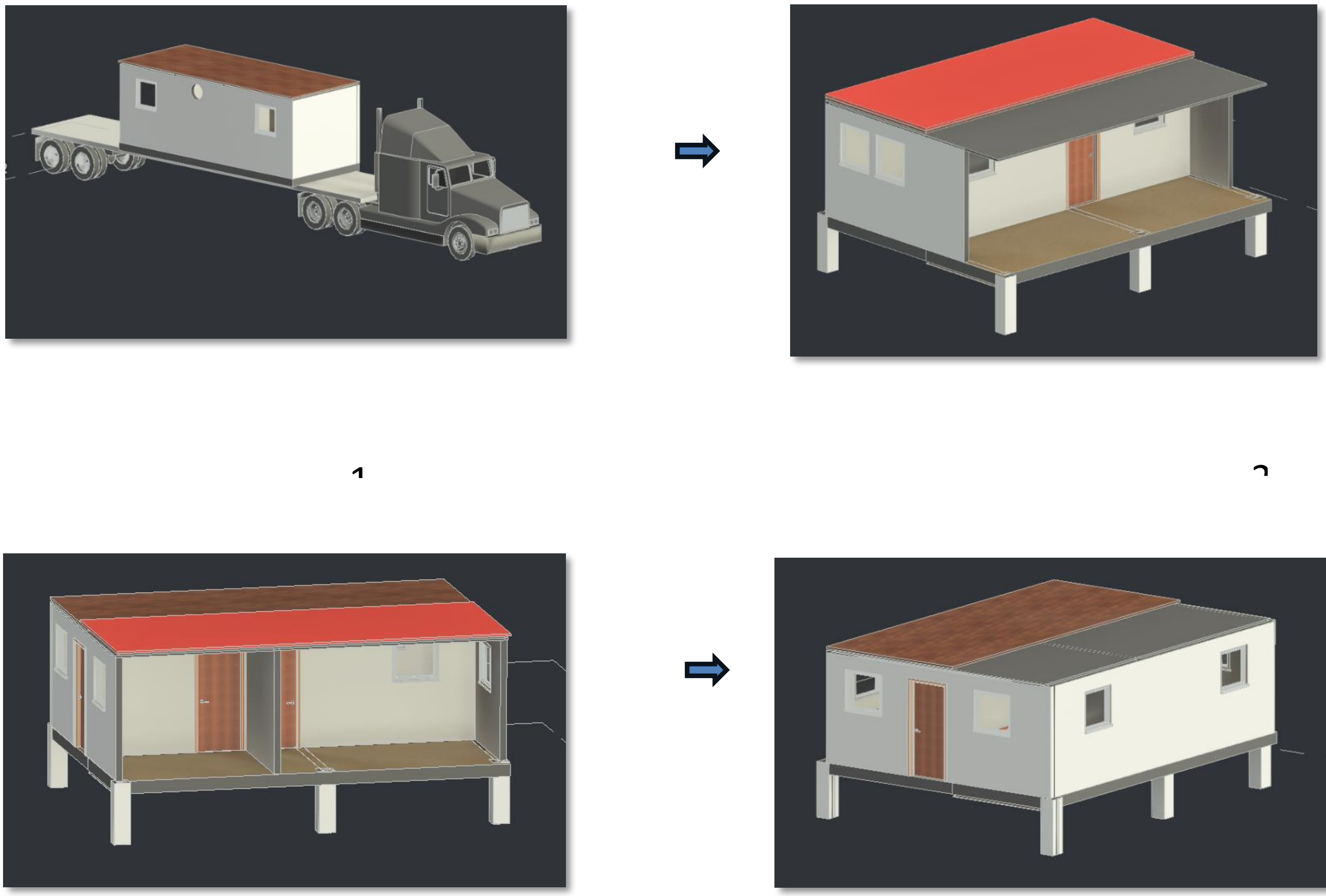

FIGURE4. 2 TRANSPORTATION AND ASSEMBLY OF TRUCK TRAILER HOUSE

FIGURE4. 3 3D PLAN OF RAPID ASSEMBLED HOUSE

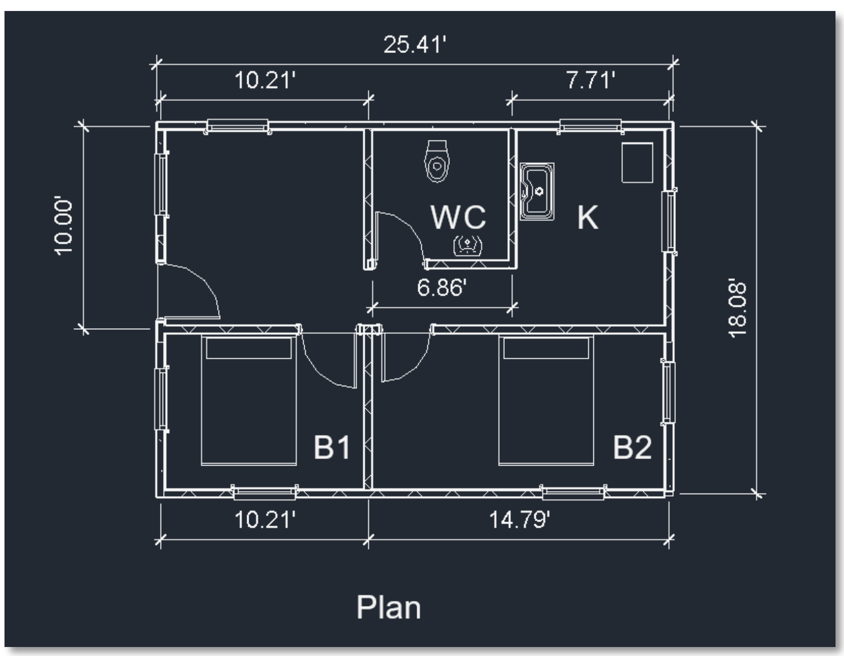

FIGURE4. 4 PLAN OF RAPID ASSEMBLED HOUSE

FIGURE4. 5 Real Model/Prototype Truck Trailer house

Modified design:

Quick Setup

- The trailer opens up by itself using special machines (hydraulic arms and pistons).
- Water and electricity start working right away when the house opens.

Smart Use of Space

- Bunk beds (two beds, one above the other) let 36 people sleep inside.
- Foldable walls can be put up to give people some privacy around their beds.

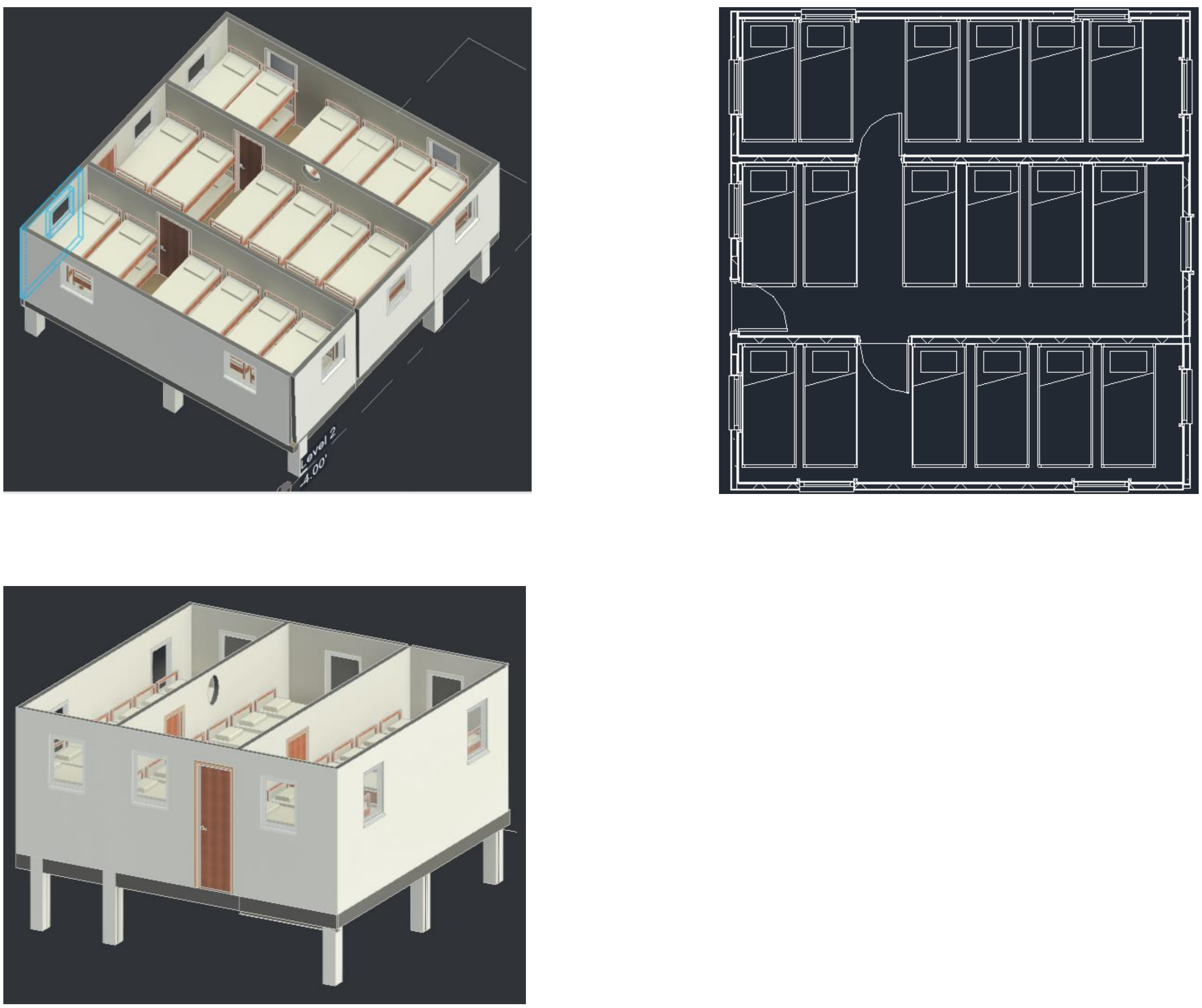

FIGURE4. 6 MODIFIED DESIGN

Assembly Process:

How the Setup Works

1. Rolling in
when the mobile house arrives, it's transported on a truck trailer and parked exactly where you want your new home to be.

2. Lifting into Place
once the trailer is in position, hydraulic jacks underneath the house are activated. These jacks gently raise the house off the trailer and lower sturdy columns down to the ground. This step makes sure the house is stable and perfectly level, even if the ground isn't.

3. Trailer Pulls Away
With the house now standing securely on its own supports, the truck trailer is unhooked and driven away. The house is now completely freestanding.

4. Expanding the Space
Next it's time to make the house feel like home. Special sliding wall panels are pulled out from their compact positions, opening up the inside and creating separate rooms. This system is designed to be smooth and easy, so you won't need a team of builders or any heavy lifting.

5. Final Adjustments
once the main structure is set, you can add or adjust windows, doors, and any other features you need. The inside layout is flexible, so you can arrange the space to fit your lifestyle and preferences.

How It All Works

- **Hydraulic Jack Columns:**
  These adjustable supports keep the house steady and level, no matter what kind of ground it's sitting on.
- **Plug-and-Play Utilities:**
  The house comes pre-fitted with electrical wiring and plumbing. Once it's set up, connecting to power and water is quick and straightforward.

Why This Design Stands Out

- **Quick Assembly:**
  You can go from an empty lot to a livable home in just a few hours-no weeks or months of noisy construction.

- **Easy to Move:**
  If you need to relocate, the house can be packed up and moved to a new site with minimal hassle.
- **Cost Savings:**
  By using prefabricated parts and cutting down on the need for on-site labor, the overall cost is much lower than building a traditional house from scratch.

CHAPTER – 5

MATERIAL SELECTION & ESTIMATION

Material Selection:

1. Angle L Sections, I-Beams, and Iron Sheets

- **Angle L Section (1.5):**
  These are steel pieces shaped like an "L" and are used at the corners and joints of the house. They help hold everything together and add strength where it's needed most.

- **I Section (I-Beam):**
  I-beams are the backbone of the structure. They support heavy loads and keep the house stable, especially when it's being moved or set up on different sites.

- **Iron Sheets (2mm & 5mm):**
  Thin iron sheets (2mm) are used for lighter parts like some wall panels or the roof, while thicker sheets (5mm) go in spots that need to be extra tough, like floors or areas that get a lot of use. These sheets protect the house from weather and bumps.

2. Walls Made from Powder-Coated Mild Steel and Polycarbonate

- **Mild Steel Sheets:**
  The main part of the walls is made from mild steel, which is strong and reliable for everyday use.

- **Powder Coating:**
  The steel is coated with a special powder that's baked on, making it resistant to rust and giving it a clean, colorful finish.

- **Polycarbonate Inserts:**
  Polycarbonate is a clear, tough plastic that's built into the walls. It helps keep the inside temperature comfortable and blocks harmful UV rays, making the house more energy-efficient and pleasant to live in.

3. Fiber Sheets Combined with Precast Concrete

- **Fiber Sheets:**
  These panels are made from materials like glass or carbon fibers. They're light but strong, making them perfect for areas where you want to save weight but still need durability.

- **Precast Concrete:**
  Concrete parts are made in a factory and brought to the site ready to go. This method gives you sturdy, fire-resistant, and soundproof sections that are quick to install when assembling the house.

4. Shipping Container Structure

- **Container Base:**
  The main frame of the house can be made from recycled shipping containers. These are already built to be tough and weather-resistant, so they make a great starting point for a mobile home.

- **Modular Design:**
  Containers can be used alone or combined to create bigger living spaces. They're easy to stack or arrange in different layouts, giving lots of flexibility.

5. Aluminum Components

- **Where Aluminum Is Used:**
  Aluminum is chosen for things like window and door frames because it's lightweight, doesn't rust, and is easy to work with.

- **Aluminum**
  It's simple to install, lasts a long time with little upkeep, and can be recycled, making it a smart, eco-friendly choice for modern construction.

S. No	Type of Material	Estimated Cost (Rs)
1.	Angle L section (1.5) I section and iron sheets 2mm and 5 mm thick	98623.25
2.	Wall Using MS sheet Power coated Embedded with Poly carbonated Highly Compressed	750000
3.	Using Combination of Fiber sheets and Precast Concrete	650000
4.	Raw Container House	450000-750000
5.	Using Aluminum Application	1000000

TABLE1. 1 ESTIMATION AND COSTING WITH DIFFERENT MATERIAL

Estimation And Costing:

1. Angle L Section (1.5 inches) and I Section with Iron Sheets (2mm and 5mm thick)

Item no.	No	Description of items	Dimensions in m				Volume in m3	Area(m2)	Explanatory note
			No.	Length (m)	width (m)	Height (m)			
1	1	**Angle L section**							
	2	side A		182	0.0381	0.006	**0.0416**		
		side B		182	0.032	0.006	**0.0349**		
2	1	**Girder I section (length)**							
	2	Flange	2	7.62	0.07	0.006	**0.0128016**		
		web	1	7.62	0.15	0.006	**0.006858**		
3		**Girder I section (width)**							
	1	Flange	2	3.084	0.07	0.006	**0.00259056**		
	2	web	1	3.084	0.15	0.006	**0.0055512**		Deduction for the thicness of angle section(0.0381-0.006=0.032)
	1	**Floor and Roof sheet**							
	2	Cabin 1	2	7.62	3.084			**47.00016**	
		cabin 2	2	7.62	2.43			**37.0332**	
	1	**wall Sheets**							
	2	Cabin 1							
		Long walls	2	7.62	2.43			37.0332	
		Short wall	2	3.084	2.43			14.98824	
		Door	3		0.91	2.1		5.733	
		window	4		0.91	0.91		3.3124	
		Total area						42.97604	
5	1	**Wall sheetd**							
		cabin 2							
	2	Long wall	1	7.62	2.43			18.5166	
	2	short wall	2	2.43	2.43			11.8098	
	2	deduction							
		windows	4		0.91	0.91		3.3124	
		Total area						27.014	
		Total wall sheet area						**69.99004**	

	Item	Density kg/m^3	Volume /Area	weight (Kg)	Price/kg	Total
1	L-Sec	7850	0.0765	600.525	70	42036.75
2	Girder	7850	0.027	211.95	70	14836.5
3	Floor and Roof sheet		43		450	19350
4	Wall sheet		70		320	22400
					Total IND Rs	**98623.25**

FIGURE5. 1 ESTIMATION & COSTING

Hydraulic unit Design:

Step 1: Calculate the Required Force

The force required to lift the load can be calculated as follows:

F= mg

For a load of 24,000 kg

$F = 24000 * 9.81 \text{ m s}^2 = 235440 \text{ N}F$

Step 2: Calculate the Pressure

Given that the hydraulic system operates at a pressure of 200 bar, we convert this pressure into pascals (Pa):

200 bars =200×100000 =20000000 pa

Step 3: Calculate the Required Flow Rate

The flow rate required for each cylinder can be determined by rearranging the hydraulic power formula. The power required to lift the load can be calculated using:

P=F*v

Where:

P is power (W),

v is velocity (m/s).

To find *Q*, we first need to determine how quickly we want to lift the load (velocity). For this example, let's assume we want to lift it at a speed of 0.1 m/s.

Step 4: Calculate Flow Rate

The total area of the six cylinders is:

$A \text{ total 6 cylinder} = 6*0.04 \text{ m}^2 = 0.24 \text{ m}^2$

The velocity of fluid through one cylinder can be calculated as:

V = Q/A

Rearranging this gives us:

$Q=v* A=0.1 \text{ m/s}*0.24 \text{ m2}=0.024 \text{ m}^3/\text{s}$

Converting cubic meters per second to litters per minute ($1 \text{ m}^3/\text{s} = 60000$ L/min)

$Q=0.024 \text{ m}^3/\text{s}\times 60000 \text{ L/m3}=1440 \text{ L/min}$

Step 5: Calculate Pump Power Requirement

PkW = (1440 L/min×200 bar/600=480 kW)

FIGURE5. 2 HYDRAULIC UNIT DESIGN

CHAPTER - 6
DESIGN PROCEDURE

1. Designing the House

- **Design Completion:**
  The first step was to map out every detail of the mobile house. This included drawing up floor plans that feature two bedrooms, a kitchen, and a bathroom, making sure the space is both functional and comfortable.
- **Bringing Ideas to Life in 3D:**
  To really see how everything would fit, the team used 3D modeling software like AutoCAD or Sketch Up. This digital model acts as a virtual prototype, allowing designers to spot and fix any issues before building starts.

2. Picking the Best Materials

- **What Was Chosen:**
  The materials were selected with care to match the house's needs:
  - Sturdy Angle L and I sections form the frame.
  - Powder-coated mild steel sheets with polycarbonate inserts are used for the walls.
  - Lightweight fiber sheets are paired with precast concrete for added strength.
  - Shipping containers serve as the main structural base.
  - Aluminum is used for windows and doors.
- **Materials**
  Each material was chosen for its specific benefits: strength, durability, insulation, and ease of assembly. The goal was to make the house robust, energy-efficient, and quick to put together.

3. Making sure it's Structurally Sound

- **Calculations:**
  It's essential to ensure the house can handle its own weight, as well as everything and everyone inside it.
- **Types of Loads Considered:**
  - **Dead Load:** The weight of the house's structure.
  - **Live Load:** The weight from people, furniture, and daily use.
  - **Environmental Loads:** Forces from wind, snow, or even earthquakes.

- **Using Engineering Software:**
  Programs like SAP2000 or ETABS will be used to simulate how the house would respond to these loads. This step helps catch any weak spots and guides any needed changes to the design or materials to keep the house safe.

4. Building and Testing a Prototype

- **Creating a Model:**
  After the design and calculations were finalized, a prototype or scale model was built using the chosen materials. This hands-on model helps the team see how everything works together in real life.

- **Testing and Tweaking:**
  The prototype goes through a series of tests to check its stability, strength, and usability. If any issues pop up, the team goes back to the drawing board to make improvements before full-scale construction begins.

CHAPTER – 7

FOUNDATION

Hydraulic Jack:
A hydraulic jack foundation in a Pump concrete machine (such as a backhoe loader) uses hydraulic power to lift, support, and stabilize heavy loads or structures. The system works on Pascal's Law, which states that when pressure is applied to a confined fluid, it is transmitted equally in all directions. In a JCB, hydraulic jacks are typically used to stabilize the machine during digging or lifting operations and sometimes to lift the chassis for maintenance or foundation work.

Key Components:

- **Hydraulic Cylinders:** These are filled with hydraulic fluid and act as the main lifting mechanism.
- **Pump:** Generates pressure by pushing fluid into the cylinders.
- **Reservoir:** Stores the hydraulic fluid.
- **Control Valves:** Direct the flow of fluid to control lifting and lowering.
- **Base Plate:** Distributes the load to prevent sinking into the ground.

Working Principle:

when the operator activates the pump, hydraulic fluid is pushed into the cylinder, creating pressure. This pressure moves the piston inside the cylinder, which lifts the JCB and Pump Concrete machine or stabilizes its foundation. The force generated depends on the area of the piston and the pressure applied, allowing the jack to lift very heavy weights with relatively little manual effort.

Application in JCB Foundation:
For Example:

For foundation work, hydraulic jacks are placed under key points of the JCB to ensure stability on uneven or soft ground. They help keep the machine level and prevent tipping during heavy operations. In some cases, hydraulic jacks are also used to lift sections of a building foundation for repair or leveling, using the same principles as in vehicle jacks.

Advantages:

- Provides strong and stable support.
- Allows precise control over lifting and lowering.
- Increases safety during heavy-duty operations

 

FIGURE7. 1 HYDRAULIC JACK FOUNDATION

Problem with Hydraulic jack:

- Hydraulic jack foundations in machine must always be used on firm and level ground.
- A stable and flat surface ensures that the hydraulic jack can safely lift and support the heavy weight of the machine without risk of sinking or tilting**.**
- Using the jack on uneven or soft ground can cause instability, making the machine unsafe and increasing the risk of accidents or equipment damage.
- The base of the jack is designed to distribute weight evenly, which only works effectively on solid, even surfaces.
- Before operating the hydraulic jack, always check that the ground is not sloped, loose, or filled with debris.
- For best safety and performance, avoid using hydraulic jacks on irregular, sloping, or muddy surfaces. Always choose a location that is hard, dry, and flat.

Drilled Pile with Hydraulic Application:

- **Definition and Purpose**
    - A borehole hydraulic rotary steel pile is a deep foundation system where a steel pile (pipe or tube) is installed into a drilled borehole to support heavy structures like bridges, towers, or industrial buildings.
    - This type of pile is used when only steel is required, without any concrete filling.
- **Site Preparation**
    - The ground is prepared and leveled to provide a safe and stable base for the drilling equipment.
    - Access roads and storage areas for steel piles and machinery are set up nearby.

- **Drilling the Borehole**
  - A hydraulic rotary drilling rig is used to drill a vertical hole into the ground to the required depth and diameter.
  - The drilling tool rotates and cuts through soil or rock, creating a clean, straight borehole.
  - The spoil (excavated soil or rock) is removed from the hole and taken away from the site.
- **Borehole Stabilization**
  - If the soil is loose or water is present, drilling fluid or temporary casing may be used to keep the borehole open and prevent collapse.
  - The stability of the borehole is checked throughout the process.
- **Steel Pile Installation**
  - A steel pile (usually a hollow steel tube or pipe) is lifted and positioned above the borehole using a crane or the rig's lifting system.
  - The steel pile is carefully lowered into the borehole, making sure it remains vertical and reaches the required depth.
  - If needed, the pile can be driven further into the ground using hydraulic hammers or vibratory drivers for extra support.
- **Alignment and Depth Check**
  - The verticality and depth of the steel pile are checked using measuring tools to ensure correct placement.
  - Adjustments are made if necessary to keep the pile straight and at the proper depth.
- **Finishing Steps**
  - Once the steel pile is in place, any temporary casing used for stabilization is removed.
  - The top of the steel pile is cut or trimmed as per the design requirements.
  - The pile may be capped or connected to the structure above using steel plates or other connectors.
- **Advantages**
  - Fast installation compared to concrete piles.
  - Can be used in difficult soil conditions or where concrete is not suitable.

- Steel piles can be removed or reused if needed.
- Minimal site disturbance and less curing time.

- **Applications**
  - Ideal for temporary structures, marine works, bridges, and areas with poor soil where deep support is needed.
  - Also used in places where quick installation and removal are important.

FIGURE7. 2 DRILLER FOUNDATION

CHAPTER – 8
LOAD CALCULATION

Angle L section (1.5mm)I section and iron sheets 2mm and 5 mm thick:

A	B	C	D	E	F	G	H	I
Basic Data	**Number**	**Density(kg/m3)**	**Length (m)**	**Breadth(m)**	**Thickness (m)**	**Area(m2)**	**Weight(kg)**	**weight kg/m2**
Area of Structure:			20	24		480		
Number of People:	50							
Dead Load Calculation								
Steel Structure (ISA Angle and I-Section)								
Unit Weight of Steel=7850 kg/m^3 (standard value)		7850						
For a conservative estimate, use steel weight =60 kg/m^2								
Total Steel Weight:							28800	
Iron Sheet Roofing								
2 mm thick sheet:					0.002			15.7
Thickness: 0.002 m								
Density: 7850 kg/m^3								
5 mm thick sheet:								
Thickness: 0.005 m					0.005			39.25
Assume 50% area with 2 mm, 50% with 5 mm sheets:								
Total area with 2 mm:						240		
Total area with 5 mm:						240		
Total iron sheet weight:							13188	
Total Dead Load							41988	
Live Load Calculation								
Standard live load for residential buildings: 3 kN/m^2 = 300 kg/m^2								
Total Live Load:							144000	
480 m2×300 kg/m2								
Occupancy Check:							3750	
(50 people × 75 kg/person)								
Total Load (DL+LL)							**231726**	**kg**

FIGURE8. 1 LOAD CALCULATION

Load Type	Calculation	Total Weight (kg)
Dead Load	ISA (1.5mm) + Iron sheet (2mm & 5mm)	41988
Live Load	3kn/m^2 * 480 m^2	144000
Occupancy Load	50 person * 75 kg	3750
Total Load	DL+LL+ occupancy Load	231726

TABLE1. 2 LOAD CALCULATION

D.L.

The dead load includes the weight of the steel frame and the iron sheet roofing. The total dead load is about 42 tons. This was calculated by estimating the weight of all steel parts and iron sheets used in the structure.

L.L.

The live load accounts for people, furniture, and other movable items. According to standard codes, the live load is 300 kg per square meter. For the entire area, this results in a total live load of 144 tons. The weight of 50 people is much less than the live load considered, so the design is safe for occupancy.

LoadDistribution:

The total load (dead load plus live load) is 186,000 kg. This load is shared equally by 4 main beams and 4 columns. Each beam and each column supports 46,500 kg. The calculated load per square meter for beams is about 43,056 kg/m², and for columns, it is about 68,889 kg/m²

Load Distribution:

Member Type	**Area (m^2)**	**Total Load (kg)**	**Load per m^2 (kg/m^2)**
Beam	$(2.4*0.45)\ m^2 = 1.08m^2$	186000	43056
Column	$(0.45*1.5)\ m^2 = 0.675m^2$	186000	68889

TABLE1. 3 LOAD DISTRIBUTION ON MEMBERS

CHAPTER – 9
RESULT & CONCLUSION

Result:

The Rapid Assembled Truck Trailer House project successfully demonstrates that it is possible to create strong, safe, and comfortable homes that can be quickly built and moved to where they are needed most. The main achievement of this project is the development of a modular housing unit that can be assembled in a short time, making it ideal for emergency situations like natural disasters, for military use in remote areas, and for providing affordable housing to low-income families. The project used a multi-disciplinary approach, combining civil and mechanical engineering principles to ensure the house is both stable and practical.

The design process focused on using lightweight yet durable materials such as steel and aluminum, which make the house easy to transport but also strong enough to withstand harsh weather and heavy use. The assembly process is simple, using modular sections and special connectors, so the house can be put together quickly without needing a large crew or heavy machinery. The team also paid close attention to load calculations and foundation design, using hydraulic jacks and drilled piles to make sure the house remains stable on different types of ground.

Testing and analysis showed that the assembled house meets safety standards and can handle various loads and stresses. The use of advanced software tools like Revit, Motion Gen, and Blender helped in optimizing the design and ensuring that all parts fit together correctly. The project also included cost estimation and material selection, showing that the house can be built affordably without sacrificing quality.

The Rapid Assembled Truck Trailer House project achieved its main goals by creating a home that can be quickly built, easily moved, and safely used in many situations. The project team designed a house that comes in parts, which are easy to transport and put together. This makes it very useful for emergencies, like after earthquakes or floods, where people need shelter fast. It can also help the military or workers in remote areas, and it offers a low-cost housing option for families who cannot afford traditional homes.

The project achieved its goal of creating a rapid-assembly, mobile house that is practical, safe, and cost-effective. The results prove that this kind of housing can be a real solution for urgent shelter needs, combining speed, strength, and flexibility in one package.

Conclusion:

The Rapid Assembled Truck Trailer House project concludes that modern engineering and smart design can solve some of today's most urgent housing problems. By focusing on modular construction, the project created a house that is not only quick to assemble but also strong, safe, and comfortable. The use of durable materials and simple assembly techniques means that these homes can be deployed rapidly in disaster zones, used by the military in remote locations, or provided as affordable housing for those in need.

One of the key takeaways is that rapid assembly does not have to mean lower quality. The project showed that with careful planning, material selection, and design optimization, it is possible to build homes that meet safety and comfort standards while still being quick and easy to put together. The use of advanced software tools and detailed load analysis ensured that every part of the house is designed for real-world conditions.

The project also highlights the importance of adaptability. The modular design allows for easy customization and expansion, so the house can be adjusted to fit different needs and locations. This flexibility makes it suitable for a wide range of applications, from emergency shelters to long-term housing solutions.

Overall, the project demonstrates that rapid-assembled mobile homes are a practical and effective answer to urgent housing needs. They offer a balance of speed, safety, affordability, and adaptability that is hard to achieve with traditional construction methods.

This kind of housing can make a big difference for people who need shelter quickly and can be adapted for many uses in the future. With further improvements, these houses could help even more people around the world.

Future Scope:

Looking ahead, the Rapid Assembled Truck Trailer House concept has significant potential for further development and wider use1. One area for future work is the integration of more sustainable and eco-friendly materials, which could reduce the environmental impact of the houses and make them even more suitable for long-term use. Research into solar panels, rainwater harvesting, and better insulation could make these homes more energy-efficient and comfortable in different climates.

Another direction is the improvement of the assembly process. With advances in automation and prefabrication, it may be possible to make the assembly even faster and require less skilled labor. Digital tools like Building Information Modeling (BIM) and augmented reality could be used to guide assembly teams and reduce errors.

There is also scope for expanding the design to accommodate different family sizes and community needs. By developing a range of modular units-such as kitchens, bathrooms, and communal spaces-the concept can be adapted for use in larger settlements or special-purpose camps.

Finally, collaboration with government agencies, NGOs, and private companies could help bring these houses to more people in need, especially in disaster-prone or underserved areas. Pilot projects and real-world testing in different environments will provide valuable feedback for further improvements.

In conclusion, the future for rapid-assembled mobile housing is bright, with many opportunities for innovation and impact. Continued research, testing, and collaboration will help make this solution even more effective and widely available.

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Rajat Sheetal [211620]

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