ALCOP X NED INNOVATORS 2024

CONDUCTED BY :

IMD STUDENTS

alcop
Since 1973

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ACKNOWLEDGEMENT

We wish to express our profound gratitude to ALCOP for granting us the opportunity to undertake an enriching internship within their esteemed organization. This experience has been instrumental in bridging the gap between theoretical knowledge and practical application, providing us with invaluable insights into the aluminum manufacturing process and window production. We are deeply grateful to the management team for their unwavering support and the technical staff for their patience, guidance, and expertise. Their willingness to share knowledge and involve us in diverse activities, from analyzing production layouts to implementing lean strategies, has been crucial in shaping our understanding of modern manufacturing practices.

Our sincere appreciation goes to the professionals who mentored us during the internship, especially those who guided us through stress analysis of aluminum frames and glass panels, inventory management practices, and hands-on activities such as drilling, riveting, and gasket installation. Their detailed explanations and practical demonstrations allowed us to gain a comprehensive perspective on industry standards and operational challenges.

We are also indebted to our academic mentors, whose constant encouragement and insightful feedback inspired us to approach our tasks with diligence and creativity. Their support enabled us to apply theoretical concepts effectively and propose actionable suggestions to enhance productivity and reduce inefficiencies.

This report is a reflection of the collaborative efforts and learning experiences gained during our time at ALCOP. It is a testament to the expertise and dedication of everyone involved, and we are deeply thankful for the opportunity to contribute to and learn from such a forward-thinking and dynamic organization.

TEAM MEMBERS OF PROJECT

We are a group of ten third-year undergraduate students from the Department of Industrial and Manufacturing Engineering at ***NED University of Engineering and Technology***. Together, we formed the team ***ALCOP NED Innovators*** to embark on an enriching internship journey at ALCOP. Our internship experience allowed us to explore the dynamic field of aluminum manufacturing and window systems, gaining hands-on exposure to both technical processes and managerial methodologies.

Our group comprises the following members:

- Hassan Ali Shahid
- Maviya Wadood
- Khizar Jamali
- Nabeel Siddiq
- Syed Uzair Ali
- Muhammad Osama Sajid
- Faiza Hamid
- Arisha Fazal
- Umm e Hani Naveed
- Namira Waseem

Our group's focus throughout the internship was on learning, collaboration, and innovation. By leveraging our diverse skill sets and academic backgrounds, we successfully analyzed and addressed challenges in ALCOP's operations. This report documents our learning experiences, technical contributions, and the value we added during this internship. It highlights our ability to work effectively as a team while showcasing our potential as future industrial and manufacturing engineers.

With this report, we aim to present not only our accomplishments but also the insights gained that will help us grow as professionals in the manufacturing sector.

INTRODUCTION

ALCOP is a highly respected name in the aluminum manufacturing and construction industry, renowned for producing high-quality aluminum products and innovative window solutions. With a rich history of excellence,ALCOP's commitment to precision and quality is evident in every aspect of its operations, from the initial design phase to the final product delivery.

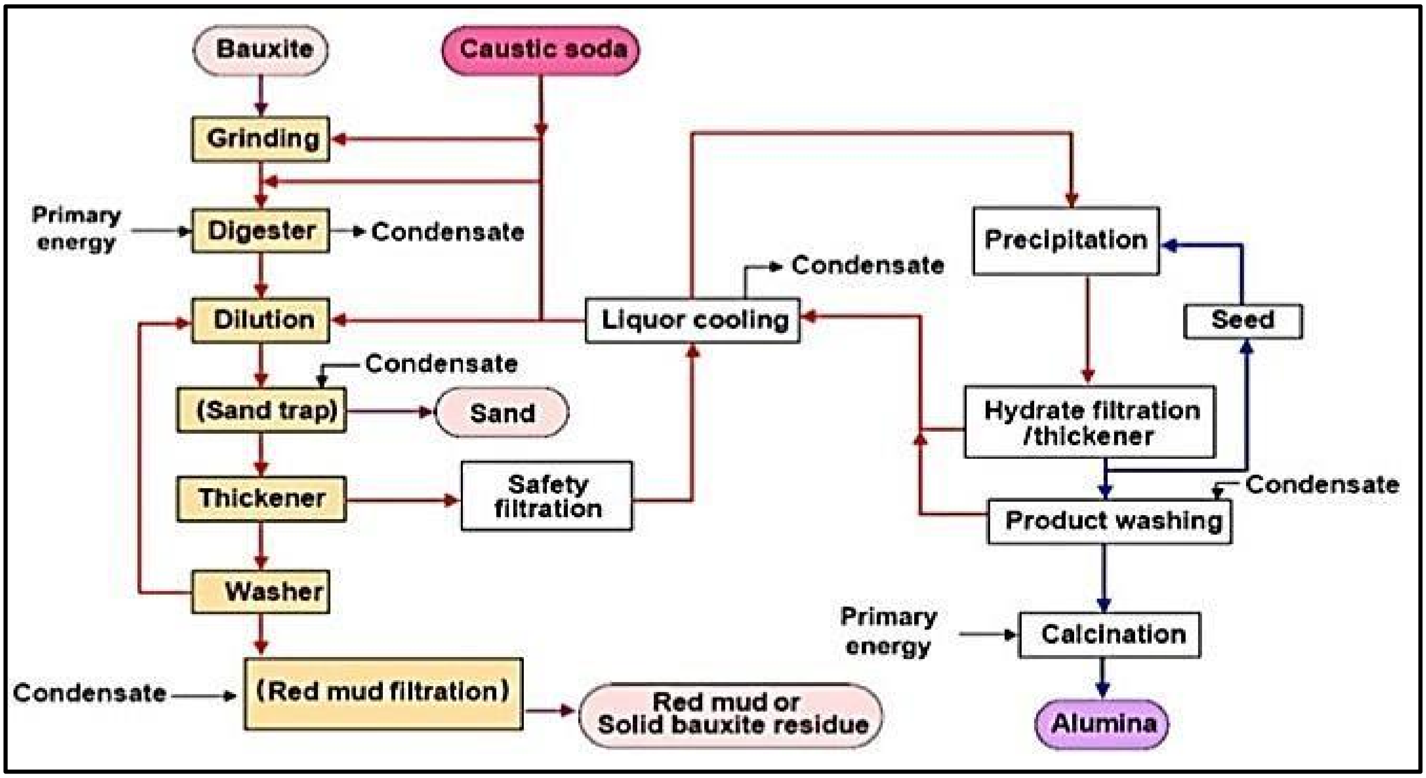
ALCOP’s mission is rooted in the goal of designing and delivering exceptional aluminum solutions that set new standards of innovation and quality. The company is dedicated to creating sustainable and durable products that cater to the evolving needs of its clients, ensuring that every design not only meets but exceeds customer expectations. ALCOP prides itself on its ability to inspire innovation in the aluminum industry, offering cutting-edge solutions that enhance the architectural beauty and structural functionality of buildings on a global scale.

A key focus of ALCOP's operations is sustainability. The company actively works to minimize its environmental footprint by adopting eco-friendly manufacturing practices and promoting the use of recyclable materials. This commitment to environmental responsibility reflects ALCOP’s dedication to fostering a cleaner, greener future. Beyond its environmental efforts, ALCOP is also committed to community growth. By creating job opportunities, supporting local economies, and contributing to social development initiatives, the company ensures that its success positively impacts the communities it serves.

Through its innovative approach, commitment to quality, and emphasis on sustainability and community welfare, ALCOP aims to inspire architectural excellence and establish itself as a trusted leader in the global aluminum industry.

ALCOP envisions becoming a globally trusted leader in delivering sustainable aluminum solutions that redefine modern architecture. By combining innovation, eco-conscious practices, and advanced technology, the company aims to inspire creativity, build long-term trust, and contribute to greener, more sustainable construction worldwide. This report provides a comprehensive overview of our learnings and experiences, highlighting ALCOP's dedication to innovation, quality, and efficiency in the aluminum manufacturing and construction industry.

EXTRACTION OF ALUMINIUM



Process Flow of Extraction of Aluminum:

The Bayer Process is a complex industrial process used for extracting alumina, or aluminum oxide, from bauxite ore. The process begins with the input of raw materials, including bauxite and caustic soda. The bauxite is first ground to increase its surface area, making it more efficient for processing. The ground bauxite is then mixed with caustic soda and heated under pressure in a digester, where aluminum hydroxide dissolves, forming a sodium aluminate solution. The residual solid impurities remain undissolved and are separated later in the process.

The sodium aluminate solution is then diluted and passed through a series of steps, including a sand trap, where sand is separated as an impurity, and a thickener and washer, where the slurry is thickened and red mud, a waste product, is removed through filtration and washing. The red mud is separated and discarded as waste. The aluminate solution is then cooled, and seed crystals, or fine alumina, are added to induce precipitation of aluminum hydroxide. The precipitated aluminum hydroxide is then filtered, thickened, and washed to remove any remaining impurities.

The final step in the process is calcination, where the washed aluminum hydroxide is heated at high temperatures in a kiln, converting it to alumina, or aluminum oxide, the final product. The Bayer Process also produces red mud as a by-product, which requires proper disposal. Overall, the Bayer Process is a critical step in the production of aluminum, as it allows for the efficient extraction of alumina from bauxite ore.

Physical properties of aluminum include: -

(a) Aluminum is a silvery – white metal.

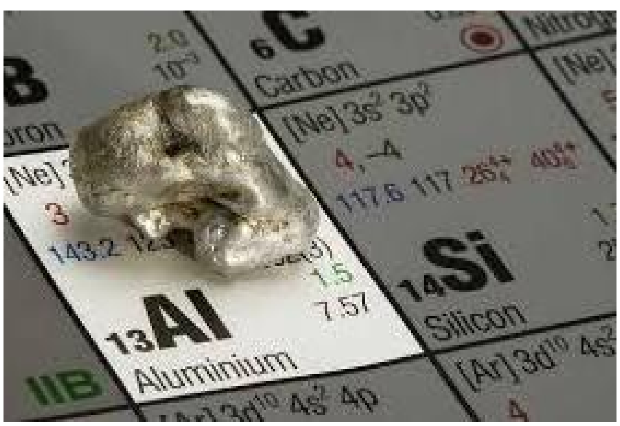
(b) It has a melting point of 660oC and boiling point of 2450oC.

(c) It has a density of 2.74gcm-3

(d) It has a moderate tensile strength

(e) It is ductile and malleable. Thus, it can be made into foil, sheets and wire.

(f) It is a good conductor of heat and electricity.



EXTRUSION OF ALUMINIUM

Q) What is Aluminum Extrusion?

Aluminum extrusion is a process by which aluminum alloy material is forced through a die with a specific cross-sectional profile.

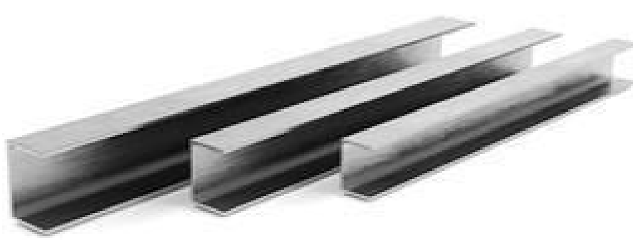
A powerful ram pushes the aluminum through the die and it emerges from the die opening. When it does, it comes out in the same shape as the die and is pulled out along a runout table. At a fundamental level, the process of aluminum extrusion is relatively simple to understand. The force applied can be likened to the force you apply when squeezing a tube of toothpaste with your fingers.

Q) What Kinds of Shapes Can be Extruded?

There are three main categories of extruded shapes:
Solid, with no enclosed voids or openings (i.e. a rod, beam, or angle).
Hollow, with one or more voids (i.e. square or rectangular tube).

Rendering: Round Tube

Rendering: Aluminium Angle

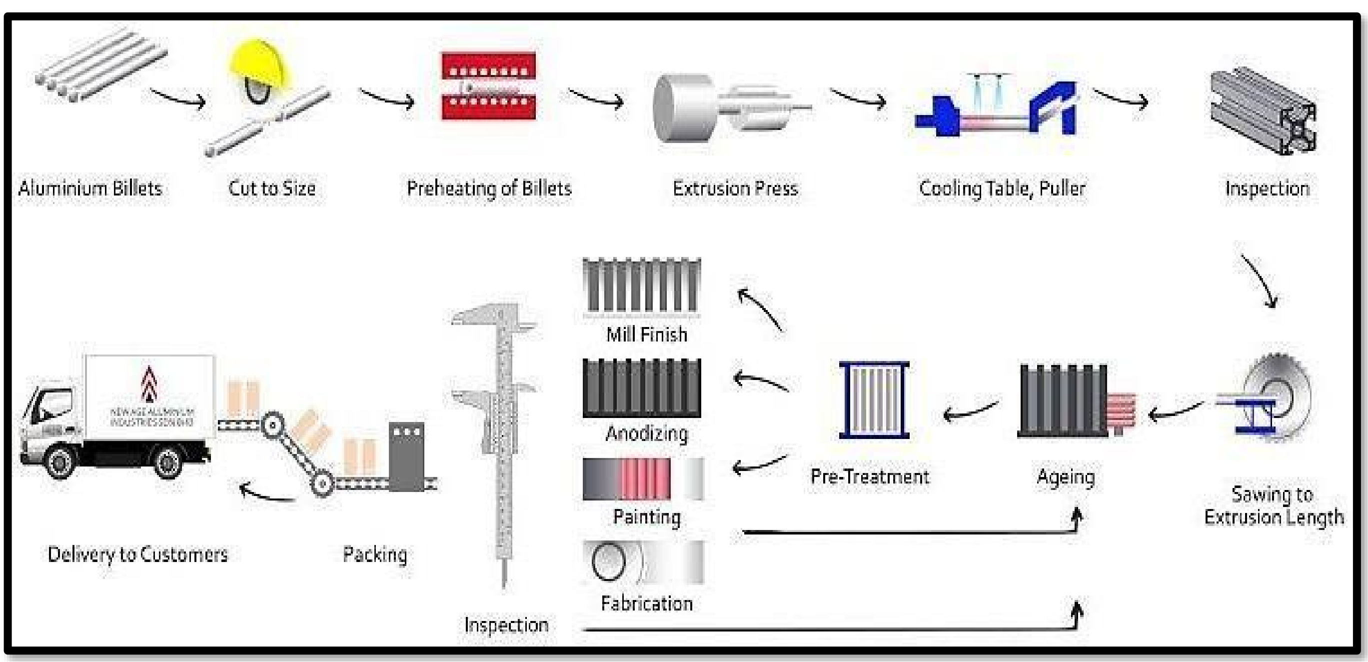


Rendering: Aluminium Channel

The shapes we see above are all relatively simple, but the extrusion process also allows for the creation of shapes that are much more complex.

Extrusion has innumerable applications across many different industries, including the architectural, automotive, electronics, aerospace, energy, and other industries.

Below are some examples of more complex shapes that were designed for the architectural industry.



ALCOP'S INNOVATIVE BUILDING PRODUCTS

Aluminum Sliding Doors

Aluminum Sliding Windows

Aluminium Curtain Wall System

Aluminium louvers

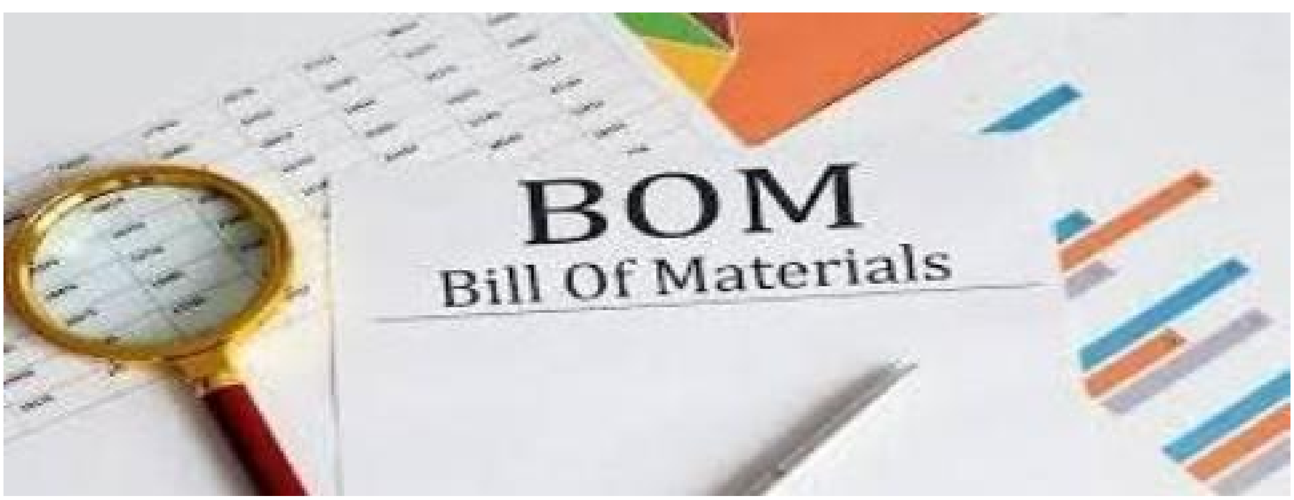
Aluminium handrails

Alpolic facade

MANUFACTURING OPERATIONS AT ALCOP

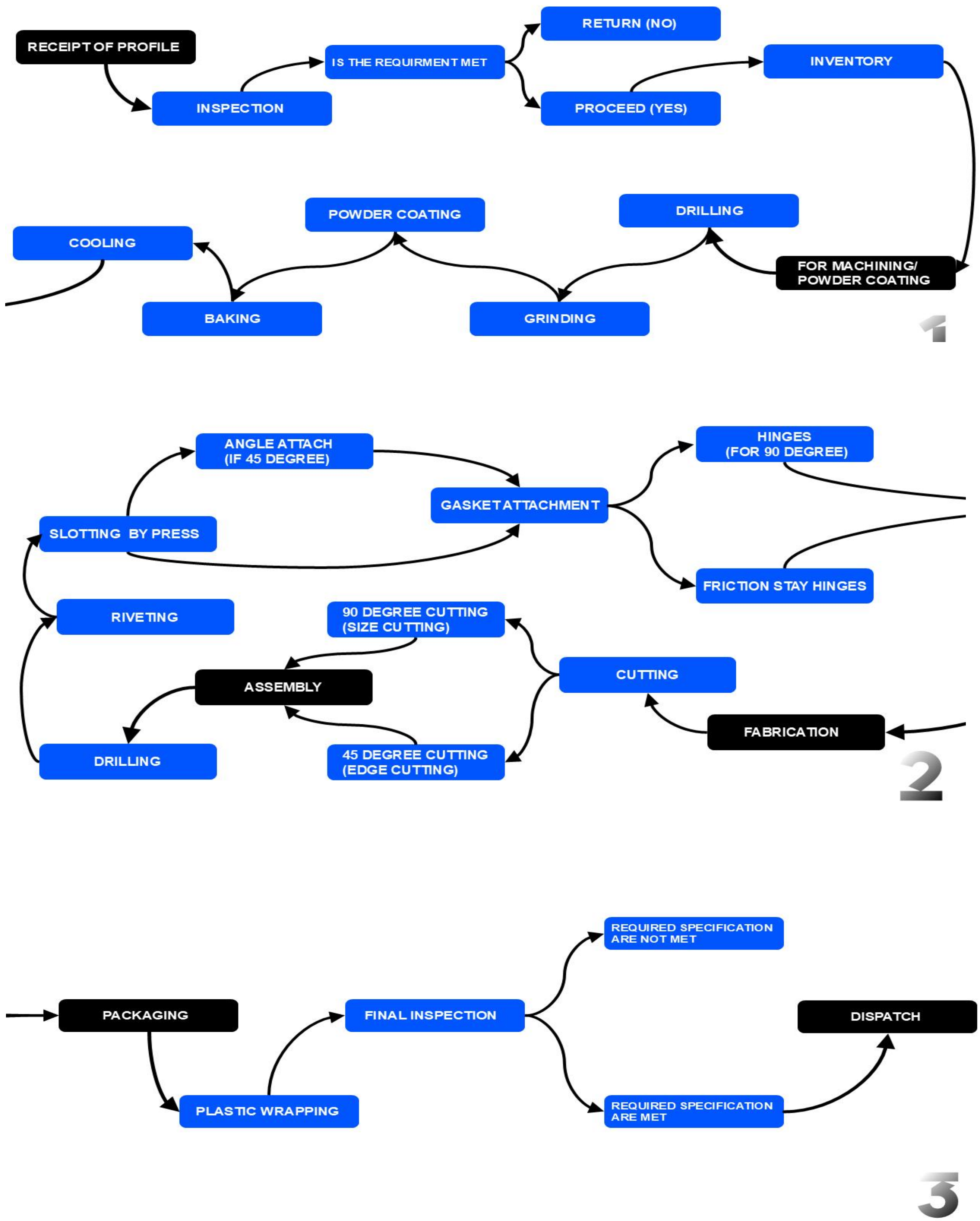
INITIAL STEPS:

1. **Order Reception:** Orders are received from clients.
2. **Quotation:** A price estimate is prepared & shared with the client.
3. **Client Approval:** The client approves the quotation and gives a go-ahead.
4. **Bill of Materials:** A detailed list of required materials is prepared.
5. **Material Procurement:** Necessary materials, such as aluminum profiles, are sourced.



Q) HOW ARE PRODUCTS MANUFACTURED?

PROCESS FLOW CHART



POWDER COATING

Drilling Process

The drilling process involves creating precise holes in the frame to facilitate smooth powder coating. This is achieved by:

1. Securing the frame in place to ensure stability and accuracy.
2. Utilizing a precise drilling method to create accurate holes.

Grinding Process

The grinding process is used to smooth small parts or edges of the frame. This involves:

1. Manually guiding the part against a rotating abrasive surface.
2. Removing imperfections and achieving a polished surface finish.

Powder Coating Process

The powder coating process encompasses several stages:

1. Preparation: Frames are carefully prepared and arranged to ensure uniform coverage.
2. Application: A powdered coating is applied using an electrostatic process, ensuring uniform adhesion
3. Curing: The coated frames are then subjected to a controlled heat process, causing the powder to melt & bond permanently to the metal surface.

FABRICATION PROCESS

Cutting Process:

Saw Machine Operation: The profiles are classified based on whether they are for Outer Frames or Inner Frames.

Outer Frames: Profiles are cut at 90 degrees using a 90° saw machine.

Inner Frames: Profiles are cut at 45 degrees using a 45° saw machine to achieve mitered corners.

Size Validation:

"Is the Aluminum Profile Cut to Size?": A check is performed to ensure profiles are accurately cut to the required dimensions.

If Not: The profile is re-cut until it meets size requirements.

If Yes: The process proceeds to the next stages.

ASSEMBLY PROCESS

Routing: Machining profiles to make slots for locks proper fitting.

Drilling: Holes are drilled in the profiles for assembly purposes.

Assembly: Assembly involves the precise placement of an angular attachment to connect two aluminum profiles. The attachment is aligned at the required angle and secured in place by inserting rivets into pre-drilled holes. A rivet gun is then used to fasten the rivets, ensuring a strong and durable joint between the profiles and the angular attachment.

Lock Installation: Locks are added to the assembly.

FINAL STEP: Opening Mechanism Integration: Depending on design requirements, hinges or friction stays are installed for 90° or 30° openings.

Gasket Installation and Cleaning: Gaskets are installed to seal and cushion the frame. Cleaning ensures no debris interferes with the process.

Adhesive Sealing: Adhesive is applied for additional strength and sealing.

-

Window Screening:

"If Window Screening is Required?":

Yes: Screening or net installation is performed for producing Mesh Windows.

No: The process skips this step.

PACKAGING PROCESS

Packaging and Dispatch:

Packaging: Completed windows or doors are securely packaged for transportation.

Dispatching and Shipment: The packaged units are shipped to clients.

Project Completion: The production process concludes.

FACTORY LAYOUT CREATION & ANALYSIS

Overview of the Process

During our internship, we undertook the task of creating a detailed factory layout to better understand the production process and identify areas for potential improvement. This process involved an extensive on- site assessment of the factory's operations.

Steps in the Layout Creation

On-Site Observation and Measurement: We started by conducting an on-site survey of the factory floor. This included taking note of the placement and function of every machine, workbench, and storage area.

Dimensions were measured for each machine, workbench, and shop area using a measuring tape to ensure accuracy.

The positions of walkways, storage zones, and entrances/exits were carefully analyzed to map the flow of materials and workers.

Analysis of Placement & Positioning: The size & positioning of machinery & workbenches were assessed to determine their impact on workflow efficiency.

Existing layouts were evaluated to identify potential bottlenecks or inefficiencies in production.

DIGITAL LAYOUT CREATION

Using the data collected from the factory floor, we created a detailed digital layout using Microsoft Visio.

The layout incorporated all major areas, including:

ALCOP Main Office on the ground floor and Inventory Storage on the first floor. Fabrication Shop with workbenches, cutting machines, and assembly areas.
Powder Coating Shop, including exhaust systems and hanging equipment. Inventory and Packaging Area

Final Layout and Insights:

The final layout provided a comprehensive overview of the factory's structure and production methods.

It highlighted key areas for improvement, including potential rearrangements to streamline production flow and reduce material handling time.

This layout also served as a tool for identifying underutilized spaces and areas where safety and ergonomic adjustments were needed.

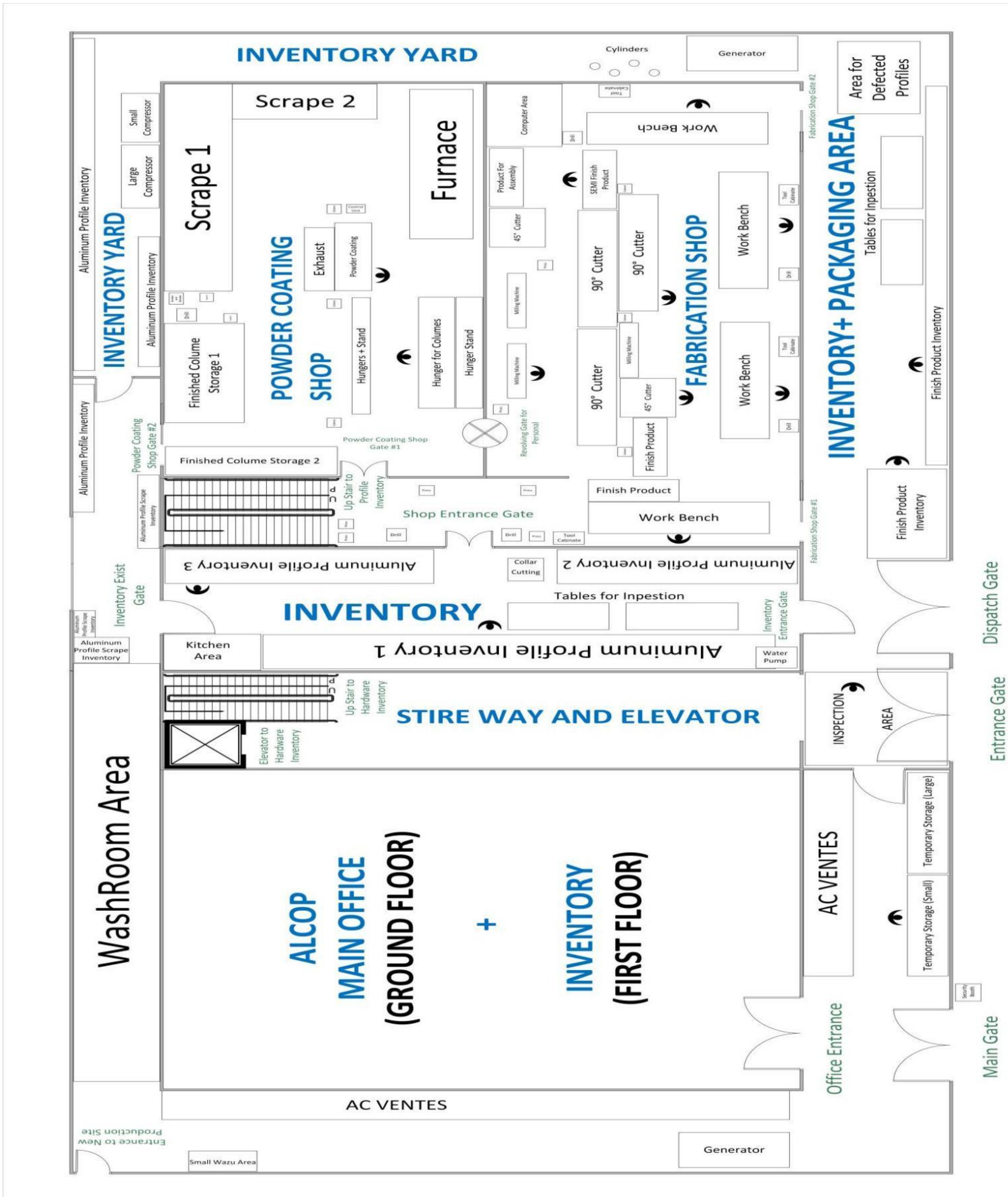
Purpose of the Layout:

The factory layout was created to:

Provide a macro and micro perspective of the factory's operations. Understand the interplay between various departments and processes. Identify existing challenges faced by the company in production, such as: Inefficient material flow.

Overcrowded or underutilized spaces.Ergonomic issues for workers due to improper placement of machinery or workbenches

PLANT LAYOUT



Impact and Benefits:

Improved Visualization: The layout helped visualize the factory's operations at a glance, making it easier to pinpoint inefficiencies.

Streamlined Production: Insights gained from the layout analysis can aid in redesigning workflows and enhancing production efficiency.

Problem Identification: The layout shed light on specific problems, such as congested workspaces and inefficient material flow, which could be addressed to improve overall productivity.

SUGGESTIONS FOR MACHINES

CUTTING SAW MACHINE

UCS350

Aluminum Single Head Arbitrary Angle Cutting Saw

Features:

1.This machine is mainly used for aluminum doors and Windows for the manual cutting equipment, so this machine is suitable for aluminum Windows and doors profiles (0 ° to 135 °) under arbitrary Angle of the cutting material.

2.This machine is mainly composed of parts: saw head part, working table, barpressing part, a manual lever, both material support (with positioning plates), spray. Saw head: composed of saw blade, the spindle box, table, motor, synchronous belt, linear guide part.

3.Note: saw head part workbench can arbitrarily in the 0-135 degree rotation and manual clamping and positioning.

MILLING MACHINE

EM200

Aluminium Window & Door End Milling Machine

Features:

1. End Milling Machine EM200 is used for end milling of transom and door frames in UPVC and aluminium profile.

2. Automatic feeding. Standard pneumatic cylinder. Optional hydro-pneumatic cylinder.

3. Various angle mullion milling for arch window or other special shape window.

4. Hand wheel for different height adjustment.

CRIMPING MACHINE

CCM120

Aluminum Window Corner Crimping Machine

Features:

1. Aluminum corner crimper mainly used for crimping the 90 corner of aluminum window and door

2. Adopt new mechanical linkage device ,realized complete synchronous corner combining

3. Adjustable locating device suitable for various sections and sizes processing

4. Left and right punching heads adopt hard synchronous feeding device ,thus avoided

useless deformation and made the connection more firmly.

5. Easy machine setting due to the synchronous feeding device.

ENGINEERING DRAWBACKS OF PLASTIC WINDOWS

1. Lower Structural Strength:
Plastic, such as PVC, has lower mechanical strength and stiffness compared to metals. This can lead to deformation or sagging over time, especially for large window frames.

2. Thermal Expansion:
Plastic materials have a higher coefficient of thermal expansion, making them prone to warping and expanding in extreme temperature fluctuations, which can affect the window's alignment and sealing.

3. **UV Degradation**:
Prolonged exposure to sunlight can degrade the material, causing discoloration, brittleness, and reduced lifespan unless UV stabilizers are used, which increases the cost.

4. Limited Temperature Resistance:
Plastic windows may soften or become brittle under extreme heat or cold conditions, which limits their use in extreme climates.

5. Recycling Challenge:
Although plastics can be recycled, the process is more complicated and less environmentally friendly compared to metals like aluminum.

6. Fire Hazard:
Plastics are more flammable than aluminum, which can be a safety concern in case of fire.

ENGINEERING ADVANTAGES OF ALUMINIUM WINDOWS

1. High Structural Strength:
Aluminum has excellent mechanical strength, making it ideal for large or heavy window frames that require robustness and durability.

2. Thermal Stability:
Aluminum is dimensionally stable and resists expansion and contraction under temperature changes, ensuring the window maintains its alignment and seal over time.

3. Corrosion Resistance:
Aluminum has a natural oxide layer that protects it from corrosion, especially when coated or anodized, making it suitable for humid or coastal environments.

4. Lightweight Yet Strong:
Despite its strength, aluminum is lightweight, which simplifies installation and reduces stress on building structures.

5. Design Flexibility:
Aluminum can be extruded into complex profiles, allowing for sleek and modern designs with narrow frames and larger glass areas.

6. Longevity:
Aluminum windows are highly durable and can last decades with minimal maintenance, making them a cost-effective option in the long term.

7. Eco-Friendliness:
Aluminum is highly recyclable and retains its properties through recycling processes, reducing environmental impact compared to plastics.

8. Fire Resistance:
Aluminum is non-combustible, making it a safer choice for fire-prone areas.

INVENTORY MANAGEMENT

Inventory management is the process of planning, organizing, and controlling the acquisition, storage, and distribution of inventory. Its primary goals are to minimize inventory costs, maximize inventory availability, and optimize inventory levels.

Effective inventory management involves:

Using techniques like JIT, EOQ, ABC Analysis, FIFO, and VMI.

Conducting regular inventory audits and tracking inventory movements.

Analyzing inventory data to identify trends and areas for improvement

Developing an inventory management policy and training inventory staff

INVENTORY MANAGEMENT AT ALCOP

As part of our internship at Alcop , we were entrusted with managing the inventory of aluminum rods, with a particular emphasis on the systematic return of materials. This involved identifying aluminum rods that were unsuitable for use, surplus to requirements, or mismatched in specification, and coordinating their return to the appropriate vendors or departments.

The following table highlights the aluminum rods categorized for return, including the respective recipients and reasons for return:

Our responsibilities included verifying the inventory, ensuring all returns were documented accurately, and maintaining communication with vendors and departments to facilitate timely returns.

This process not only helped in maintaining optimal inventory levels but also reinforced accountability in handling materials. By returning unusable or surplus stock, Alcop was able to reduce waste, optimize storage space, and improve overall inventory efficiency.

DATA OF RETURN ALUMINIUM RODS

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		S.no	Date	Profile name	Si	Qty	R	Total Running Fe	Colour	Side	Client N ne		
2	PO 182	1	2-Jan-25	1*4 pipe	16	2	32	32	light champagne	generator side	TGR RETURNED PROFILE		
3	PO 182	2	1/2/2025	1*4 pipe	14	5	70	102	light champagne	generator side	TGR RETURNED PROFILE		
4	PO 182	3	1/2/2025	D50	18	1	18	120	light champagne	generator side	TGR RETURNED PROFILE		
5	PO 182	4	1/2/2025	D50	16	5	80	200	light champagne	generator side	TGR RETURNED PROFILE		
6	PO 182	5	1/2/2025	D50	15	1	15	215	light champagne	generator side	TGR RETURNED PROFILE		
7	PO 182	6	1/2/2025	D50	14	2	28	243	light champagne	generator side	TGR RETURNED PROFILE		
8	PO 182	7	1/2/2025	D50	12	2	24	267	light champagne	generator side	TGR RETURNED PROFILE		
9	PO 182	8	1/2/2025	D50	14	3	42	309	light champagne	generator side	TGR RETURNED PROFILE		
10	PO 182	9	1/2/2025	D16 (1.6mm)	16	10	160	469	light champagne	generator side	TGR RETURNED PROFILE		
11	PO 182	10	1/2/2025	D16 (1.6mm)	14	8	112	581	light champagne	generator side	TGR RETURNED PROFILE		
12	PO 182	11	1/2/2025	D16 (1.6mm)	12	1	12	593	light champagne	generator side	TGR RETURNED PROFILE		
13	PO 182	12	1/2/2025	D16 (1.6mm)	10	1	10	603	light champagne	generator side	TGR RETURNED PROFILE		
14	PO 182	13	1/2/2025	D16 (2mm)	18	7	126	729	light champagne	generator side	TGR RETURNED PROFILE		
15	PO 182	14	1/2/2025	D16 (2mm)	14	1	14	743	light champagne	generator side	TGR RETURNED PROFILE		
16	PO 182	15	1/2/2025	D16 (2mm)	10	1	10	753	light champagne	generator side	TGR RETURNED PROFILE		
17	PO 182	16	1/2/2025	D14	20	3	60	813	light champagne	generator side	TGR RETURNED PROFILE		
18	PO 182	17	1/2/2025	D14	18	4	72	885	light champagne	generator side	TGR RETURNED PROFILE		
19	PO 182	18	1/2/2025	D14	14	3	42	927	light champagne	generator side	TGR RETURNED PROFILE		
20	PO 182	19	1/2/2025	D14	12	1	12	939	light champagne	generator side	TGR RETURNED PROFILE		
21	PO 182	20	1/2/2025	D14	18	2	36	975	light champagne	generator side	TGR RETURNED PROFILE		
22	PO 182	21	1/2/2025	D14	10	1	10	985	light champagne	generator side	TGR RETURNED PROFILE		
23	PO 182	22	1/2/2025	DG23 A	20	5	100	1085	light champagne	generator side	TGR RETURNED PROFILE		

INVENTORY COUNTING

During our internship, we conducted *cycle counting* for the inventory of MR hardware components, including hinges, handles, locks, and friction stays of various sizes. Cycle counting is a systematic inventory auditing method where a subset of inventory is physically counted to verify its accuracy against recorded data.

The process involved the following steps:

1- **Selection of Items:** We identified specific MR hardware items, such as hinges, handles, locks, and friction stays, for the cycle count. These items were selected based on their size, frequency of use, and importance in production.

2- **Physical Counting:** Each item in the inventory was manually counted, ensuring accuracy and attention to detail. The counting was performed in a structured manner to avoid duplication or omission of units.

3- **Comparison with Records:** The physical count was then cross- verified with the inventory data recorded on stock cards. This step ensured that the actual stock matched the documented quantities.

4- **Discrepancy Analysis:** In cases where discrepancies were identified, we analyzed possible causes, such as errors in data entry, misplaced items, or theft. Corrective actions were suggested to prevent futureinaccuracies.

5- **Validation of Accuracy:** Once the count and comparison were complete, we ensured that the inventory data was accurate and reflected the real- time stock levels.

By performing this cycle counting exercise, we not only validated the accuracy of the inventory records but also helped identify areas for improvement in inventory management processes. This practice is critical in maintaining operational efficiency and reducing errors in stock handling.

DATA OF CYCLE COUNTING

HARDWARE INVENTORY

S.NO	Name	ID#	Color	Record	Current	Difference
1	MR Removble Handle (Base)	9520	Black	687	677	10
2	MR Removble Handle (Top)	9520	Black	536	502	34
3	MR Double Box Roller	286.13	---	2163	2158	5
4	MR Single Box Roller	786.12	---	267	213	54
5	MR Sliding With Spring	4309	Black	387	326	61
6	Aguda Handle	4308	Black	336	348	-12
7	3 Part Hanges	5085	White	1335	1340	-5
8	MR Cremone Handle	9520	Black	469	486	-17
9	MR Window Hinges Handle	9560	Black	998	959	39
10	MR Sliding Lock	4309	White	62	50	12
11	Dorma Floor Hinge	---	---	25	25	0
12	Dorma door Closer	---	---	37	37	0
13	Dorma door Closer TS-83 EN3-6	---	---	8	8	0
14	Friction Stay (10 inch)	---	---	998	1177	-179
15	Friction Stay (12 inch)	---	---	140	138	2
16	Friction Stay (14 inch)	---	---	0	0	0
17	Friction Stay (16 inch)	---	---	1367	1350	17
18	Friction Stay (18 inch)	---	---	178	173	5
19	Friction Stay (20 inch)	---	---	117	117	0
20	Friction Stay (22 inch)	---	---	15	15	0
21	Friction Stay (24 inch)	---	---	45	45	0
22	Friction Stay (26 inch)	---	---	26	26	0

LEGEND:

RED = Indicates a decrease compared to the previous record.

PURPLE = Reflects an increase compared to the previous record.

GREEN = Denotes that the record remains unchanged and balanced.

MARKING & TAGGING

As part of the inventory management process, we implemented a structured method to ensure the accuracy of the inventory records for MR hardware items such as hinges, handles, locks, and friction stays of various sizes. This process involved marking, tagging

Steps Undertaken:

Marking and Tagging System:

To differentiate between items that were checked and those that were counted, we utilized color- coded tagging system:

Red Tags: Assigned to items that were physically **checked* for discrepancies.

Green Tags: Applied to items that were successfully **counted** and matched the records.

This tagging system provided a clear visual cue, simplifying the process of identifying the status of each inventory item.

Creation of an Inventory Banner:

We designed a comprehensive banner listing all MR hardware items present in the inventory.

The banner included a detailed list of items categorized by type (e.g., hinges, locks, handles, etc.).

Indications showing whether each item was *rechecked* or required further action.

A section for the *status legend* to explain the red and green tags, enhancing clarity for all personnel involved.

This banner was prominently displayed in the inventory area, serving as a reference point for team members and stakeholders.

Outcome:

By implementing the tagging system and creating a visual inventory banner, we enhanced the efficiency of the inventory management process. This approach not only ensured that all MR hardware items were accounted for and rechecked but also minimized errors and improved transparency in the inventory verification process.

BIN CARD HOLDER INTEGRATION

As part of the inventory management improvement initiative, we designed and fabricated custom aluminum pockets or holders to securely place inventory cards. These pockets ensured that cards were easily accessible and organized within the inventory, preventing misplacement and improving overall efficiency

Detailed Process:

Planning :

We identified the need of durable & visible holders to store inventory cards within the inventory area. Aluminum scrap was chosen as the material due to its availability, durability, and lightweight properties. Measurements were taken to ensure the holders could comfortably fit standard inventory cards.

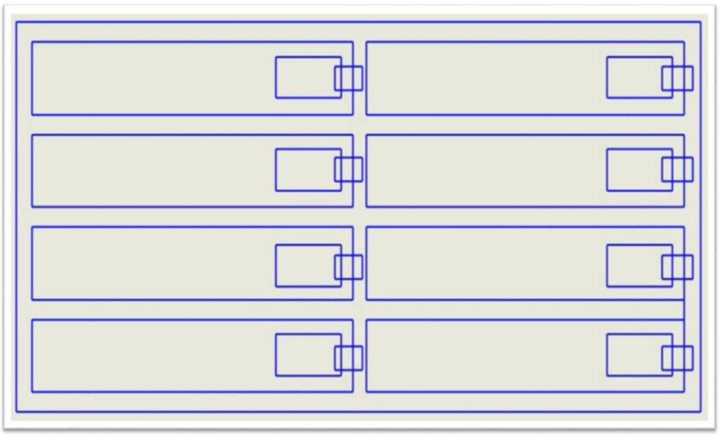
Prototyping :

A prototype was created to validate the design.

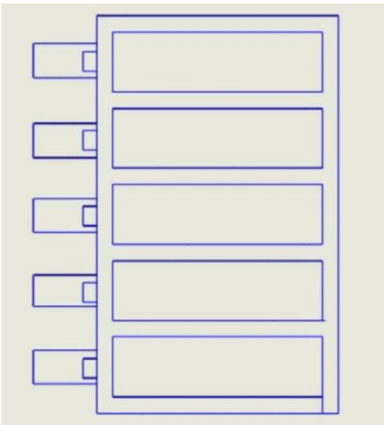
The prototype included:

A snug fit for the inventory cards.

An open design for easy card insertion and removal



Front view



Side view

Fabrication:

Using the finalized prototype as a reference, we fabricated the pockets from aluminum scrap. The process involved:

- Cutting the aluminum into the required dimensions using appropriate tools.
- Applied powder coating to enhance aesthetic appeal and ensured uniform coating for a professional finish
- Cut aluminum at a 45-degree angle to create pocket sand verified accuracy of angle cutting to ensure precise fitment

Attachment:

- Once the aluminum pockets were fabricated, they were securely attached to the inventory storage areas using riveting. This ensured a firm and long-lasting hold.
- The riveted holders were positioned strategically to align with the placement of specific inventory items for quick identification

Outcome

The implementation of aluminum pockets significantly improved the organization and accessibility of inventory cards. This sustainable approach not only utilized scrap material efficiently but also contributed to a more streamlined inventory management process. The secure placement of inventory cards reduced the risk of misplacement and enhanced the accuracy and speed of inventory operations.

SUGGESTION FOR CLEANING CURTAIN WALL

ROPE ACCESS SYSTEM

Equipment Costs

Rope access systems require specialized equipment for safety and efficiency. The approximate costs are:

Item	Cost (PKR)	Remarks
Full-Body Harness	10,000–25,000	Certified for industrial use.
Safety Helmet	5,000–10,000	Essential for head protection.
Ropes (Static & Dynamic)	20,000–40,000 (per 100m)	Quality ropes for working at height.
Descenders & Ascenders	15,000–30,000 each	For controlled descent and ascent.
Carabiners & Connectors	1,500–3,000 each	Multiple required for secure anchoring.
Lanyards & Shock Absorbers	3,000–8,000 each	For additional fall protection.
Anchoring System	20,000–50,000	Includes bolts, anchors, and slings.
Work Seats	20,000–40,000	For comfort during long-duration cleaning.
Rescue Kits	50,000–100,000	For emergency situations.

Total Equipment Cost (Per Team):

PKR 150,000–300,000 (one-time investment per team).

Labor Costs

Daily Wages (Skilled Rope Access Technicians):

PKR 5,000/person/day depending on experience and location.

Typically, a team of 3–5 technicians is required for high-rise cleaning.

Monthly Salaries (for Full-Time Teams):

PKR 80,000 per technician.

Maintenance Costs

Equipment must be inspected and maintained regularly to ensure safety:

Annual inspection and maintenance: PKR 20,000–50,000 per team.

Setup Costs (Anchoring System)

Anchors and rope installation on a skyscraper may cost:

PKR 50,000–100,000 for initial setup, depending on building height and complexity.

Total Estimated Costs for a Single Cleaning Project

Small Building (10–20 Floors):
PKR 50,000–100,000 (1–2 days of work).

Medium Building (20–40 Floors):
PKR 100,000–200,000 (2–4 days of work).

Tall Skyscraper (40+ Floors):

PKR 200,000–500,000(5+ days of work, depending on surface area and dirt level)

Cost Comparison to Other Methods

1.Rope Access vs. BMUs (Building Maintenance Units):

Rope access is 50–70% cheaper than installing permanent BMUs, making it ideal for low-budget operations.

2.Rope Access vs. Drones:

Rope access has higher labor costs than drones but can handle

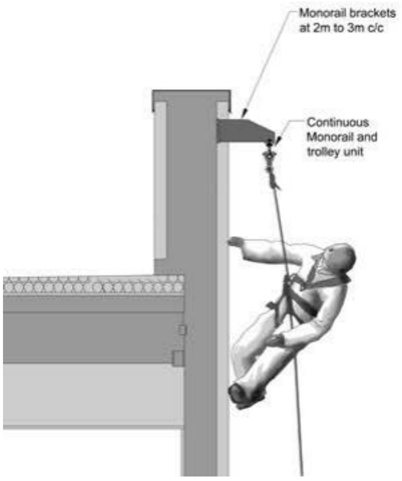
tough stains and detailed cleaning better.

Benefits of Rope Access Systems

□**Cost-Effective**: Requires minimal equipment compared to permanent systems like BMUs.

□**Versatile:** Technicians can access hard-to-reach areas.

☑**Scalable:** Can be used for buildings of varying heights


Monorail brackets at 2m to 3m c/c
Continuous Monorail and trolley unit

RISK ANALYSIS OF CUTTING MACHINES

INTRODUCTION

Risk assessment is the process of identifying, analyzing, and evaluating potential risks that could negatively impact people, assets, the environment, or business operations. It involves systematically examining workplace hazards, estimating the likelihood and consequences of incidents, and implementing control measures to reduce or eliminate risks.

Why is Risk Assessment Necessary for an Industry?

Risk assessment is essential for industries due to the following reasons:

1. **Ensures Workplace Safety**
2. **Legal Compliance**
3. **Reduces Financial Losses**
4. **Enhances Productivity**
5. **Protects the Environment**
6. **Improves Decision-Making**
7. **Prepares for Emergencies**

METHODOLOGY

A simple strategy is followed in this analysis in which two parameters are taken i.e. Frequency of accidents (in probabilities) and severity.

A data of accidents' history was taken from workers along with the frequency of usage of machines on daily basis approx. Now following are some values to be calculated:

Per day machine usage (As Alcop is a make-to-order company, hence there was no fixed frequency of machine usage, hence it was difficult to get daily frequency. One solution is considered for this problem i.e to take the approximate data of maximum usage of the machine in any day and same as that for minimum usage then taking the average of maximum and minimum to find an approximate value of daily usage)

Severity Criteria (Simple criteria is chosen i.e rating criteria in which a machine is rated out of 5 on the basis of severity of loss. Following are values assigned to each point:

Severity Level	Description	Potential Impact
1 - Negligible	Minor injury unlikely to require first aid	Small cuts or abrasions with no production downtime
2 – Minor	Injury requiring basic first aid (e.g., bandage) but no lost workdays	Shallow cuts, minor bruises, or slight irritation
3 - Moderate	Injury requiring medical attention and potential lost work time	Deep cuts requiring stitches, minor fractures, or short-term work restriction
4 – Major	Serious injury leading to long-term disability or hospitalization	Amputation of fingers, deep lacerations requiring surgery, or multiple fractures
5 - Catastrophic	Fatality or permanent disability	Loss of limb, severe blood loss, or life-threatening injury

CUTTING MACHINES

90* Cutting Machine A

90* Cutting Machine B

45* Cutting Machine

DATA:

No. of total cutting machines: 4.

No. of 90 degrees cutting machines:3

No. of 45 degrees cutting machines: 1

Maximum number of times ‘A’ 90 degrees machine used at a particular day: 224

Minimum number of times ‘A’ 90 degrees machine used at a particular day: 115

Average number of times ‘A’ 90 degrees machine used per2day: 224+115 = 169.5 = 170

Maximum number of times ‘B’ 90 degrees machine used at a particular day: 194

Minimum number of times ‘B’ 90 degrees machine used at a particular day: 95

Average number of times ‘B’ 90 degrees machine used pe2r day: 194+95 = 144.5 = 145

Maximum number of times ‘C’ 90 degrees machine used at a particular day: 156

Minimum number of times ‘C’ 90 degrees machine used at a particular day: 70

Average number of times ‘C’ 90 degrees machine used pe2r day: 156+70 = 113

Maximum number of times 45 degrees cutting machine used at a particular day: 240

Minimum number of times 45 degrees cutting machine used at a particular day: 110

Average number of times 45 degrees machine used per d2a y: 240+110 = 175

Overall accidents: 1

Duration of accident: 7 years ago

❖ CALCULATIONS:

PROBABILITY OF ACCIDENTS ON EACH USE:

1. **90 Degrees Cutting machine 'A':**

$$Probability = \frac{Number\ of\ accidents\ in\ history\ on\ the\ machine}{Average\ number\ of\ years\ between\ accidents * Number\ of\ uses\ per\ day * Number\ of\ working\ days\ in\ a\ year}$$

$$Probability = \frac{1}{7 * 170 * 288}$$

$$Probablity = 2.92 * 10^{-6}$$

2. **90 Degrees Cutting machine 'B':**

$$Probability = \frac{Number\ of\ accidents\ in\ history\ on\ the\ machine}{Average\ number\ of\ years\ between\ accidents * Number\ of\ uses\ per\ day * Number\ of\ working\ days\ in\ a\ year}$$

$$Probability = \frac{1}{7 * 145 * 288}$$

$$Probablity = 3.42 * 10^{-6}$$

3. **90 Degrees Cutting machine 'C':**

$$Probability = \frac{Number\ of\ accidents\ in\ history\ on\ the\ machine}{Average\ number\ of\ years\ between\ accidents * Number\ of\ uses\ per\ day * Number\ of\ working\ days\ in\ a\ year}$$

$$Probability = \frac{1}{7 * 113 * 288}$$

$$Probablity = 4.39 * 10^{-6}$$

4. **45 Degrees Cutting machine:**

$$Probability = \frac{Number\ of\ accidents\ in\ history\ on\ the\ machine}{Average\ number\ of\ years\ between\ accidents * Number\ of\ uses\ per\ day * Number\ of\ working\ days\ in\ a\ year}$$

$$Probability = \frac{1}{7 * 175 * 288}$$

$$Probablity = 2.83 * 10^{-6}$$

❖ COMPARATIVE ANALYSIS:

Cutting Machine	Severity	Probability of Accident at each use
90 degrees 'A'	5	$2.92 * 10^{-6}$
90 degrees 'B'	5	$3.42 * 10^{-6}$
90 degrees 'C'	5	$4.39 * 10^{-6}$
45 degrees	5	$2.83 * 10^{-6}$

COMMENTS

The severity for all cutting machines is same as all usually have same effects on an injured person in an accident and almost same injuring intensity.

- Analyzing the probability of accident during each use of all four machines it is observed that 90 degrees 'C' cutting machine has more probability of an accident, than remaining three (although difference is very minor), and probabilities' values are very small which are neglected normally in statistical analysis but in risk analysis it can not be neglected because severity of accident is maximum for each cutting machine.

RECOMMENDATIONS:

1. When the cutting machine is working, it is necessary to concentrate on it, not only to keep a clear mind, but also to operate the cutting machine attentively. It should be, strictly forbidden to operate the cutting machine after being tired or during sickness, as this can cause lack of attention and accident chances increases.

2. Normally it is observed that cutting machines blade is open to environment all the time and is not covered during no use. So, an adjustable safety bafle should be fitted with cutting blade so that the cutting blade could be covered by that safety bafle when the machine is not used.

3. Safety gloves, helmets and glasses should be used by the workers during cutting operations as it is observed that workers are not using these equipments.

4.Scheduled maintenance is one of the most necessary elements required to reduce accidental risks.

5.Number of uses per day should be recorded because this data is helpful for risk analysis in future, and also assumptions in risk analysis could be minimized and more authentic and realistic data would be available for risk analysis in future.

Risk analysis should be performed after a significant time for improvement in precautions

SUGGESTIONS FOR REDUCING NET WASTAGES

1- **Custom Roll Width:** Negotiate with the suppliers to provide custom roll width like 4.5 ft or other frequently used size.

2- **Optimize Cutting Patterns:** Use nesting software or manual planning to ensure maximum utilization of net rolls for varying window sizes,

3- **Recycle Wastage:** A possibility of arranging aluminium nets instead of steel. They can be recycled with other aluminium scrap.

4- **Use Adjustable Materials:** Switch to adjustable fiber nets or stretchable materials that can with fit varying window sizes with minimal wastage. Other such material can be explored to replace current nets.

5- **Training Workers:** Training workers involved in installing net, and handling the semi-finished inventory

6- **Repurpose Waste:** Use leftover nets for small screens, ventilation covers, or other product if possible.

7- **Managing inventory safely:** Net rolls should be kept safely in inventory to avoid possible damage during storage.

8- **Audit:** Inspection is needed for root cause of excess net wastages.

PRACTICAL PROBLEM SOLVING

GROUP MEMBERS:
KHIZER JAMALI
MUHAMMMAD OSAMA SAJID

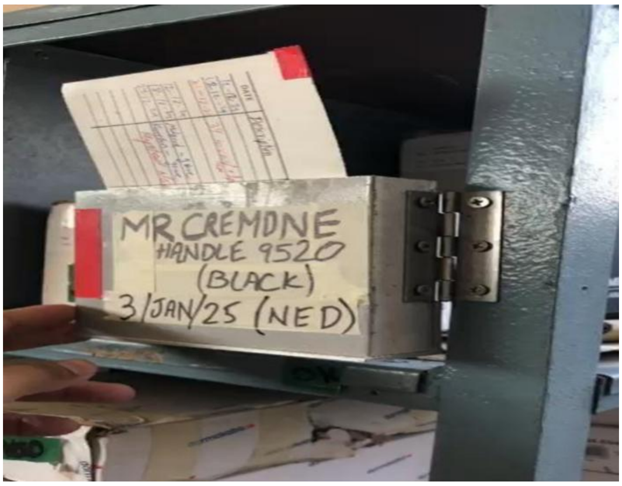
PROBLEMS:

HARDWARE INVENTORY:

There was no designated place for components in the hardware inventory and lack of accuracy in counting records, records were not updated on time.

LENGTHS' INVENTORY:

The aluminum profile lengths were not organized, also there was no criteria for organizing lengths.



SOLUTIONS IMPLEMENTED:

Moveable Aluminum pockets for inventory cards so that it could be visible from a distance too. One card at a specified section designated for a specific component. Tick marks with red pen could indicate that inventory is checked, even to a person viewing the shelf from a significant distance, and the green indicator on each hardware box indicates the inventory is counted.

RECOMMENDATIONS FOR FUTURE

A Digital device before the exit gate of inventory which would have basic following features:

- Asking the worker, the code of the component he has taken (every category of components should have specific codes, like for screws there will be a separate code, for door handles there will be a different code.
- Asking the quantity of components taken by the worker from the inventory.
- After the above two things are entered, the worker can then exit and the details are automatically saved into excel sheet etc. and time to time the data is updated on backend.

This will eliminate the need of counting inventory manually and could save much time, hence an efficient inventory counts plus records

Members Name Namira

Umme Hani

PRACTICAL PROBLEM SOLUTION

1`PROBLEM STATEMENT:

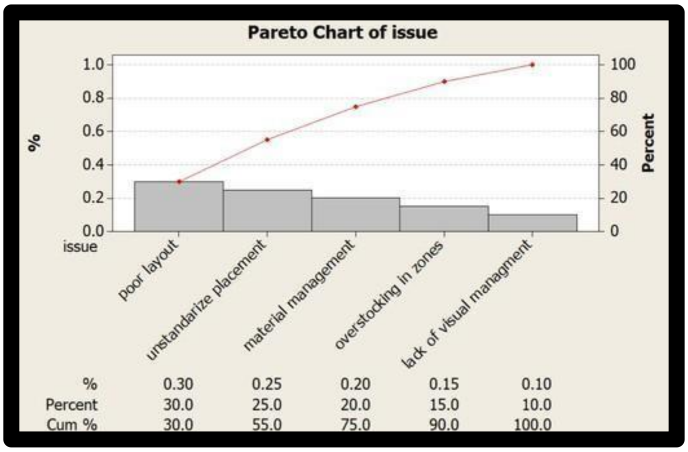
“Semi- finished products are placed far apart, causing unnecessary movement.

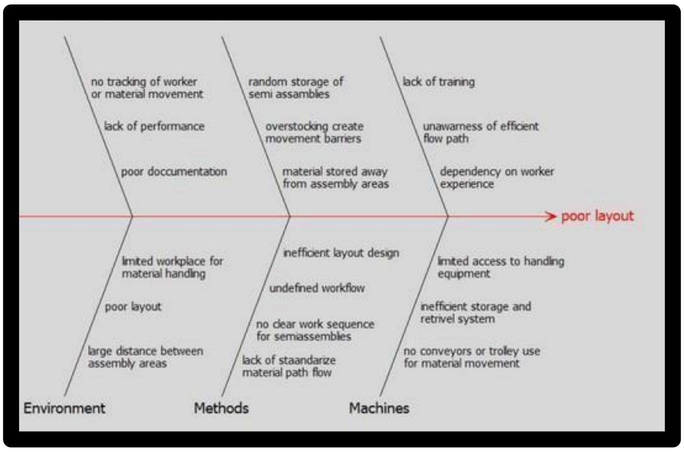
Lack of a standard material and process flow path, resulting in inefficiencies”

2 TEMPORARY FIXTURE:

- Assign temporary zones for specific assemblies and materials
- .Use signs to direct workers and reduce movement

3 PROBLEM ANALYSIS AND BREAKDOWN





4 TARGET SETTING:

- Reduce unnecessary movement by 50%.
- Establish a standardized material and process flow path to streamline operations

5 ROOT CAUSE:

- Inefficient workplace layout design.
- No standard operating procedure for material placement.

6 COUNTER EASURE/ PLAN:

- Redesign layout to place semi finished products closer to their respective processes.
- Implement a standard material flow path and designate specific areas for materials. • Provide training to workers on the new process and flow.
- Conduct regular audits to ensure compliance with the new system.

PRACTICAL PROBLEM SOLVING

alcop

CONDUCT BY: HASSAN ALI & NABEEL SIDDIQ

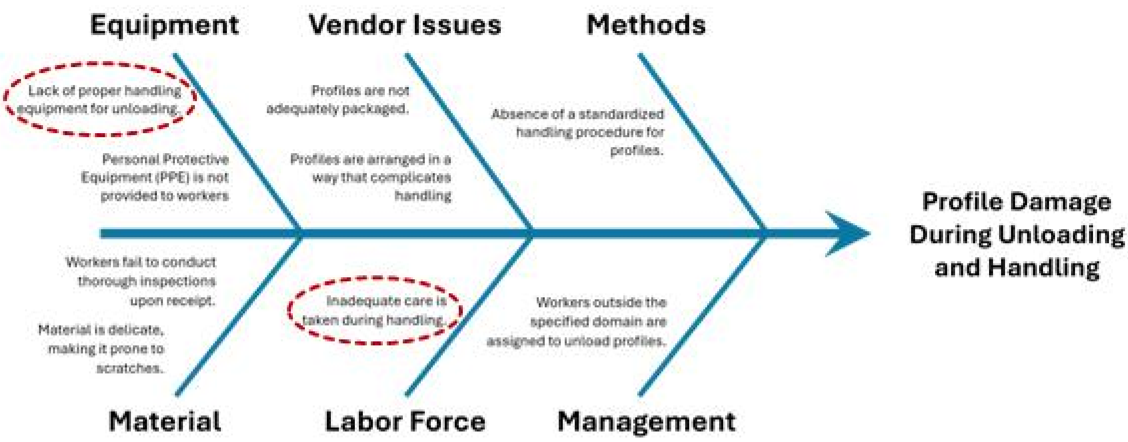
STEP 1: PROBLEM CLARIFICATION

- Profiles are prone to scratches and dents due to improper handling during the initial loading and unloading phase.
- Manual unloading is time-consuming and inefficient.

STEP 2: FURTHER PROBLEMS IDENTIFIED

- Scratches on profiles present a need for reorder the damaged is considered as wastage
- Manual handling of heavy profiles raises the likelihood of accidents, safety hazards and disturbing ergonomics.

STEP 3: PROBLEM ANALYSIS & BREAKDOWN



STEP 4: TARGET SETTING

- Ensure proper care and handling of profiles.
- Minimize effort and cost.
- Reduce process time.
- Enhance safety standards.
- Boost productivity through streamlined processes.

STEP 5: COUNTERMEASURES / PLAN

1. Introduce specialized handling equipment such as side loaders reach truck (Forklift) to streamline unloading operations and protect profiles.
2. Establish clear handling guidelines and train workers on best practices.
3. Communicate packaging and arrangement standards to vendors to reduce handling complications.
4. Allocate experienced personnel to the unloading process and provide them with proper training and PPE.
5. Ensure consistent use of PPE and enforce adherence to safety protocols to mitigate risks.

Optimizing Angle Preparation in Fabrication of Windows and Doors

Prepared By:

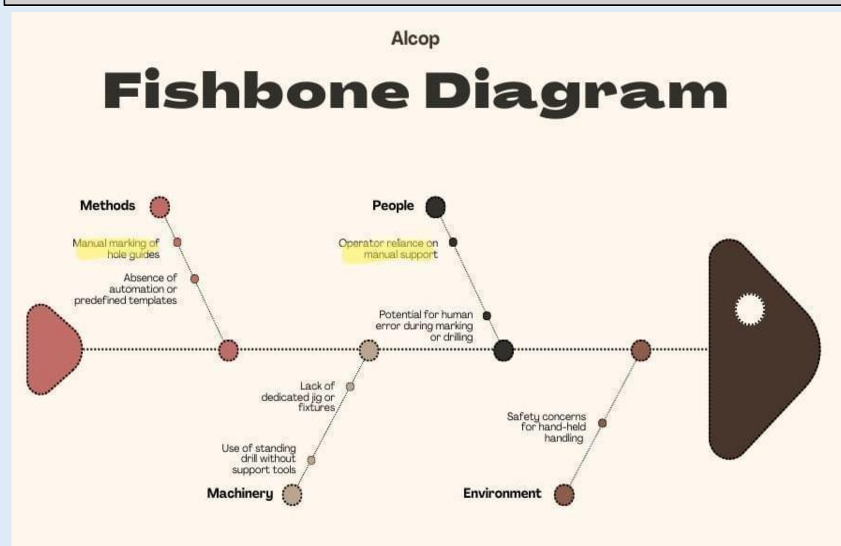
Syed Uzair Ali

Maviya Wadood

Date: 10/January/2025

Problem Statement

Workstation responsible for preparing angles, including drilling holes and manually drawing hole-guides according to project specifications. This process is time-intensive, requiring the angle to be manually supported by hand during drilling. The preparation work consumes valuable time that could otherwise be allocated to fabricating windows and doors, thereby reducing overall productivity and efficiency.



Proposed Solution

To address the identified root cause, the following solution is proposed:

- - Implement a Jig or Fixture:
- - A jig would eliminate the need for manual marking by integrating hole-guide templates.
- - A fixture would securely hold the angle, ensuring precision and operator safety.
- - Both solutions would reduce setup time

Additional Suggestions

1. **Operator Training**: Provide training for staff to familiarize themselves with using fixtures or jigs effectively.
2. **Workspace Optimization**: Reorganize the workstation to streamline processes and improve workflow.

ALCOP×NED INNOVATORS 2024 | January 10,2025

PRACTICAL PROBLEM SOLVING (PPS)

Conducted By: Arisha Fazal and Faiza


Model	Premium Series
Part Name	Doors, Windows
Dimensions	Custom Defined
Origin	ALCOP

Step#1 Problem Clarification

1. The main issue arises due to delayed **quality checks**, which are conducted only at the final stage before packaging.
2. If defects are identified during the final quality checks, earlier steps need to be revisited to rectify the problem, causing:

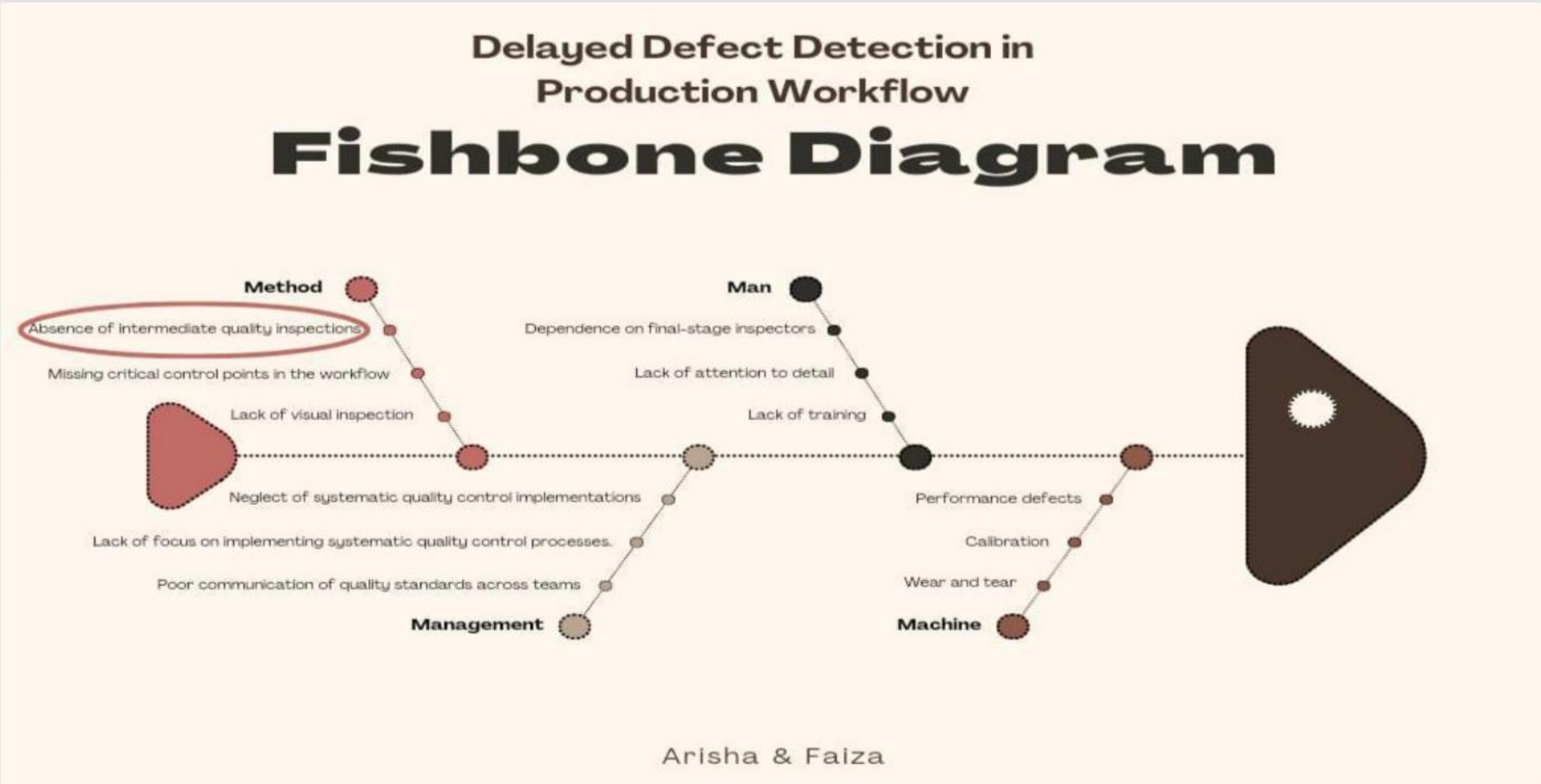
- Increased cycle time.
- Additional labor effort.
- Non-value-added activities like disassembly, rework, and repetition of steps.

For example, if a defect such as improper lock slot drilling is detected just before packaging, the frame must be disassembled, corrected, and then reassembled.

Step#2 Temporary Fixing

- Conduct manual quality checks at critical stages (e.g., drilling, assembly) until a standardized intermediate inspection system is established.
- Assign dedicated personnel to perform these manual checks.
- Document detected defects and inform upstream operators immediately to prevent recurrence of similar issues during subsequent steps.

Step#3 Problem Analysis and Breakdown



Step#4 Target Setting

To reduce the extra labor for correcting the end detected problems and non-value-added activities by introducing quality checks at earlier stages of fabrication, ensuring defects are identified and rectified as soon as possible.

This approach minimizes the likelihood of repeating earlier steps and reduces unnecessary rework while preparing for a more robust long-term solution.

Step#5 Root Cause

- Lack of intermediate quality checks during production.
- Final quality checks only at the packaging stage.
- Lack of proper Quality Control and Quality Assurance team.

Step#6 Counter Measures / Plan

- **Introduce intermediate quality checks:** Place quality inspection steps after critical operations (e.g., after drilling, assembly).
- **Improve operator accountability:** Train operators to self-check their work at each stage.
- **Standardize inspection procedures:** Develop and implement standard operating procedures (SOPs) for quality checks (e.g., visual inspection, etc.)
- **Proactive maintenance:** Regularly calibrate and maintain machines to minimize defects.
- **Optimize material handling.** Ensure material is inspected for defects at the start of production.

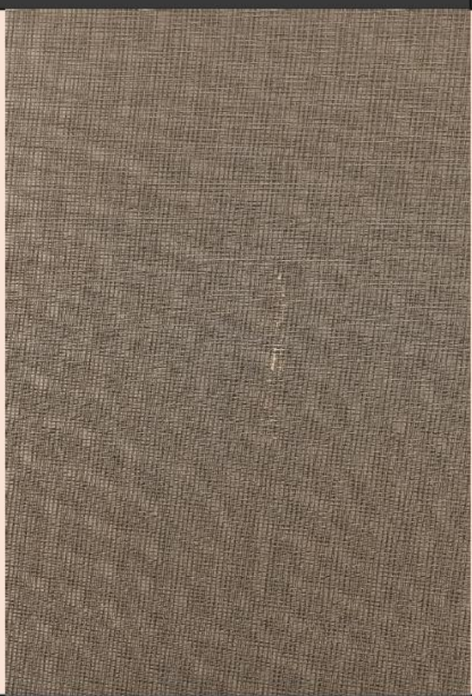
ALCOP×NED Innovators 2024 **January**

PRACTICAL PROBLEM SOLVING (PPS) — Conducted By: Arisha Gulfam

Model	**Premium Series**
Part Name	**Finished Assemblies**
Dimensions	**Custom Defined**
Origin	**ALCOP**

Step#1 Problem Clarification

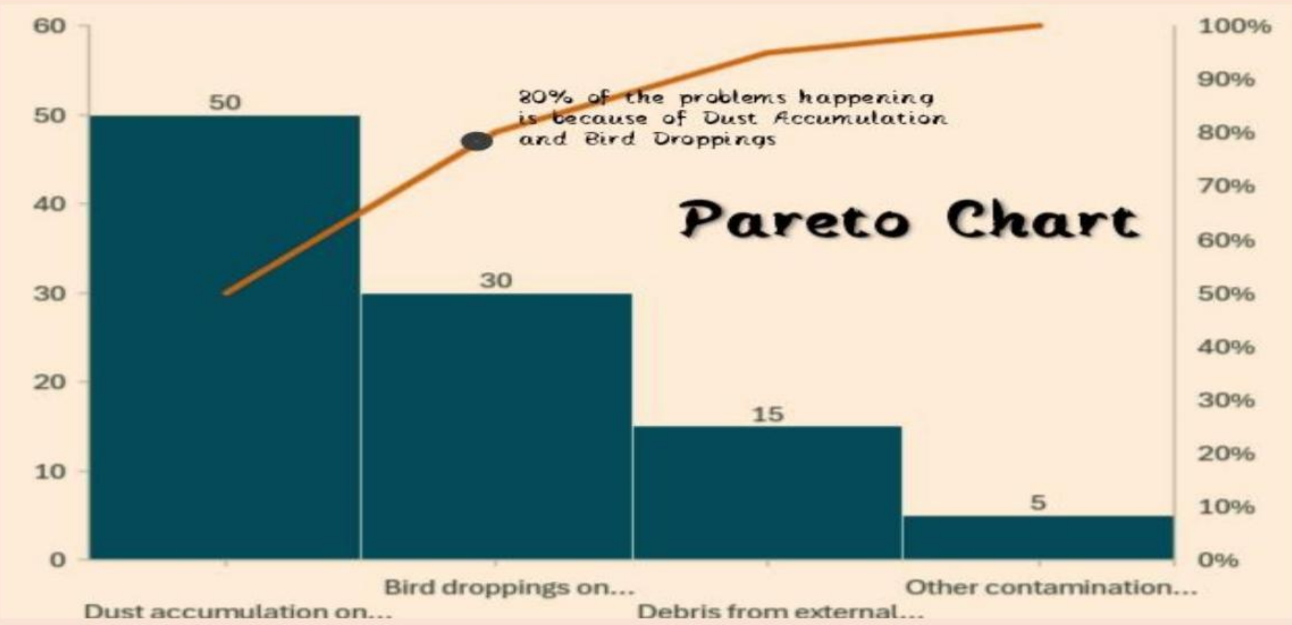
- ***The packaging area is open*** from the top, exposing finished assemblies to dust and dirt.
- Birds entering the packaging area cause contamination, leaving droppings or debris on finished assemblies.
- These factors compromise the cleanliness and quality of the finished products, ***requiring additional cleaning or rework*** before packaging.
- The ***contamination risks delay the packaging process*** and impact customer satisfaction due to compromised product hygiene.



Step#2 Temporary Fixing

- ***Cover finished assemblies with protective sheets or temporary covers*** while they remain in the packaging area.
- Assign personnel to regularly clean and monitor the area to minimize dust and dirt accumulation.
- ***Use portable barriers*** or enclosures to reduce open exposure ***until a permanent solution is implemented.***

Step#3 Problem Analysis and Breakdown



A Pareto Chart has been used to analyze and prioritize the main causes of contamination in the packaging area.

Key Findings:

- Dust accumulation and bird droppings account for 80% of the contamination issues.
- Addressing these top two issues will significantly reduce contamination risks.

Step#4 Target Setting

- To prevent contamination of finished assemblies in the packaging area ***by minimizing exposure to dust, dirt, and birds, ensuring cleaner products and faster packaging processes.***

Step#5 Root Cause

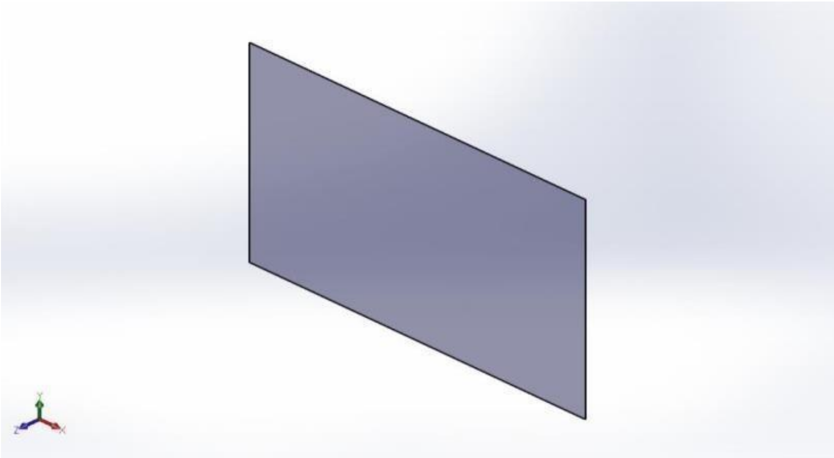
- The packaging area is open from the top, allowing dust and birds to enter.
- Finished assemblies are not adequately protected before packaging.

Step#6 Counter Measures / Plan

- ***Cover the packaging area*** to prevent exposure to dust and birds.
- Provide dustproof covers for finished assemblies awaiting packaging.
- ***Assign a team to regularly clean the area*** and monitor for contamination risks.
- Use bird deterrent systems like nets or ultrasonic devices to prevent birds from entering the area.

STRESS ANALYSIS

Simulation of Seamless Glass Panel

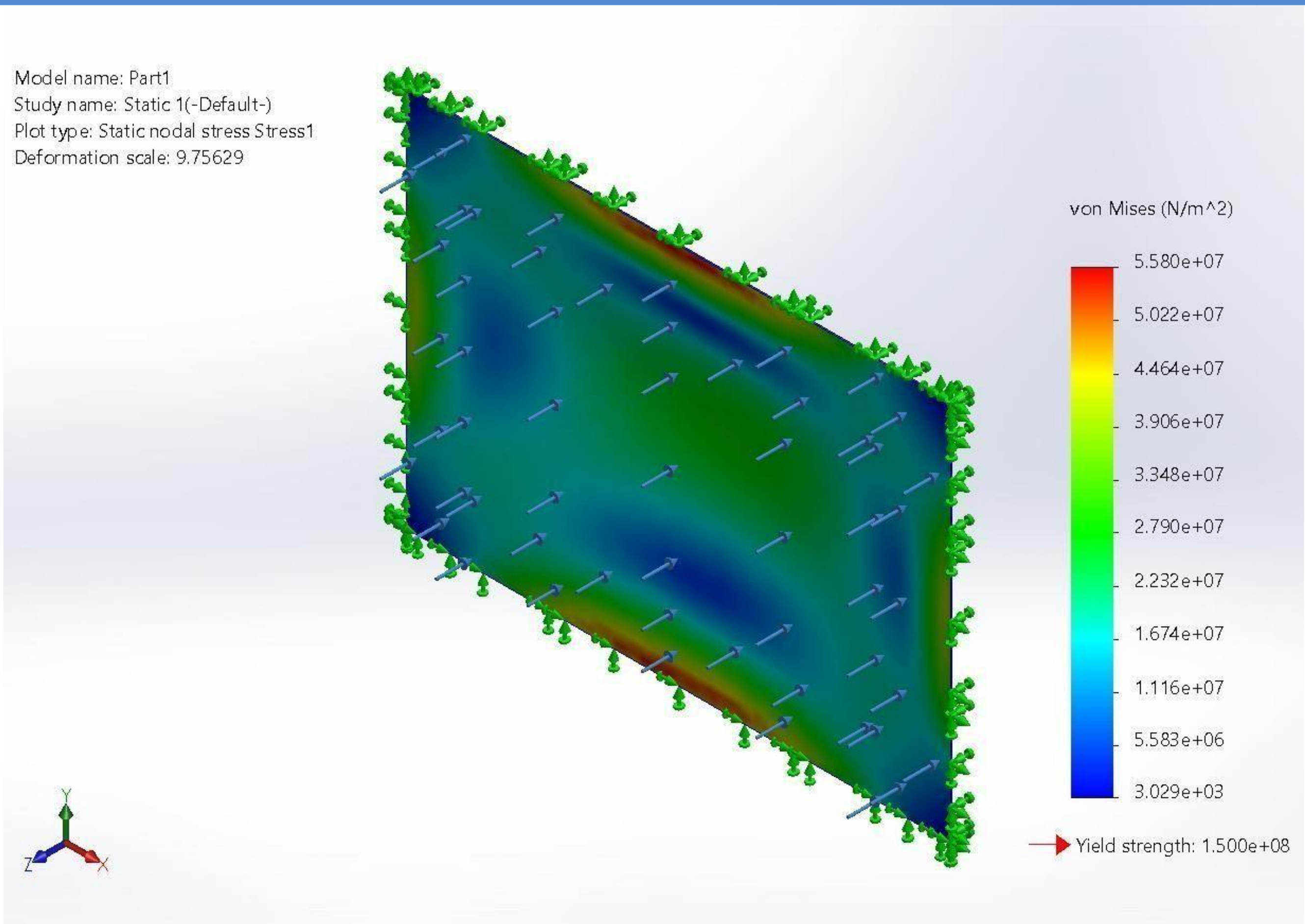


Description

This simulation analyzes the structural behavior of a tempered glass panel measuring 10 feet in length, 7 feet in width, and 8 mm in thickness under a static pressure load of 2,250 N/m^2. The material properties for glass, including an elastic modulus of 6.8935×10^{10} N/m^2 and a yield strength of 1.5×10^8 N/m^2, were used to evaluate stress, strain, displacement, and the factor of safety. The analysis was conducted using SolidWorks Static Simulation with a high-quality solid mesh, assuming linear elastic and isotropic behavior. The panel's edges were fixed, and the study aimed to determine its performance and safety under the specified conditions.

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	3.029e+03N/m^2 Node: 13752	5.580e+07N/m^2 Node: 15741

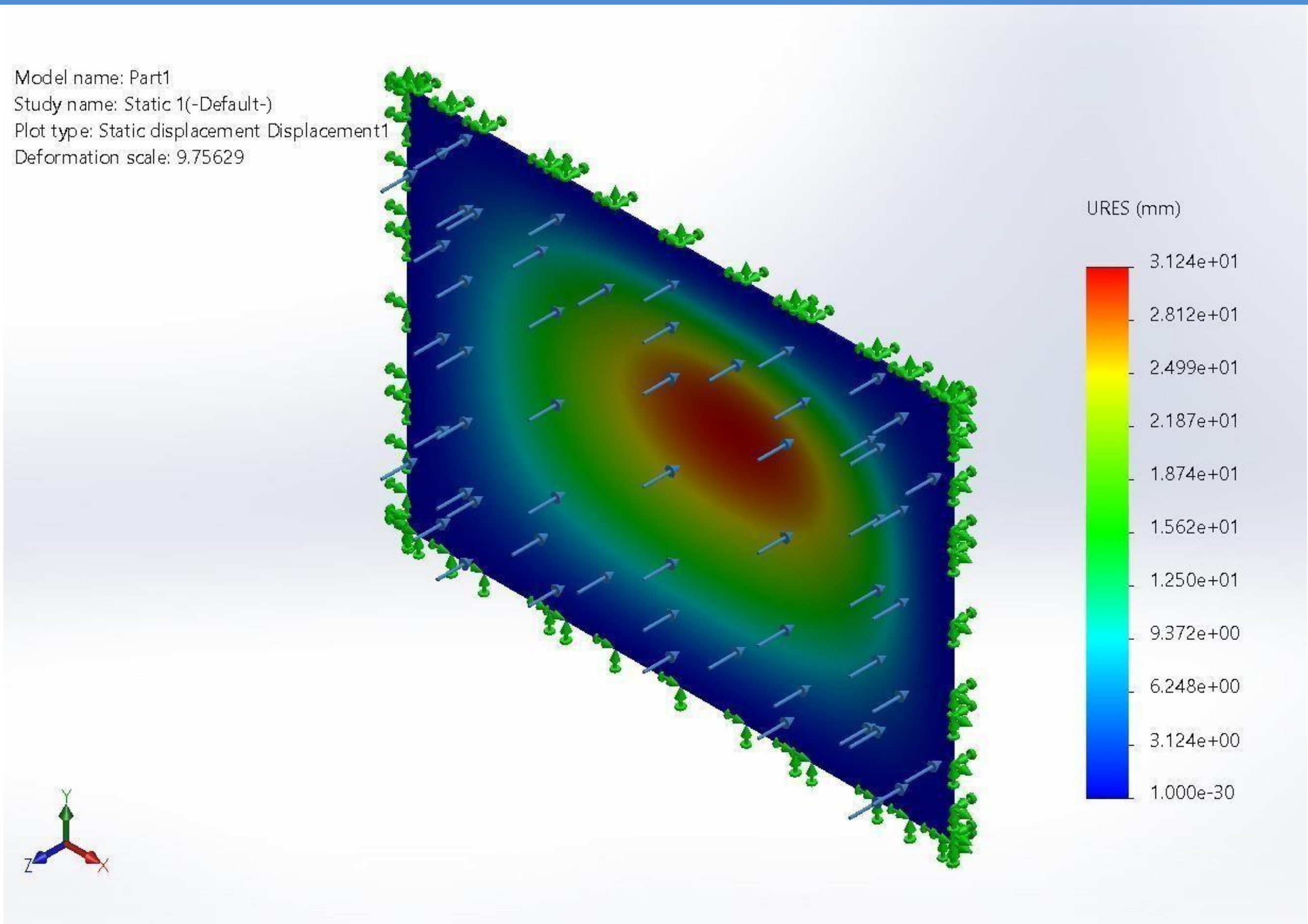


Part1-Static 1-Stress-Stress1

Minimum: 3,029 N/m²
Maximum: 5.580×10^7 N/m²

The maximum stress is well below the yield strength of the material (1.5×10^8 N/m²), indicating the material remains in the elastic range.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 1	3.124e+01mm Node: 13752



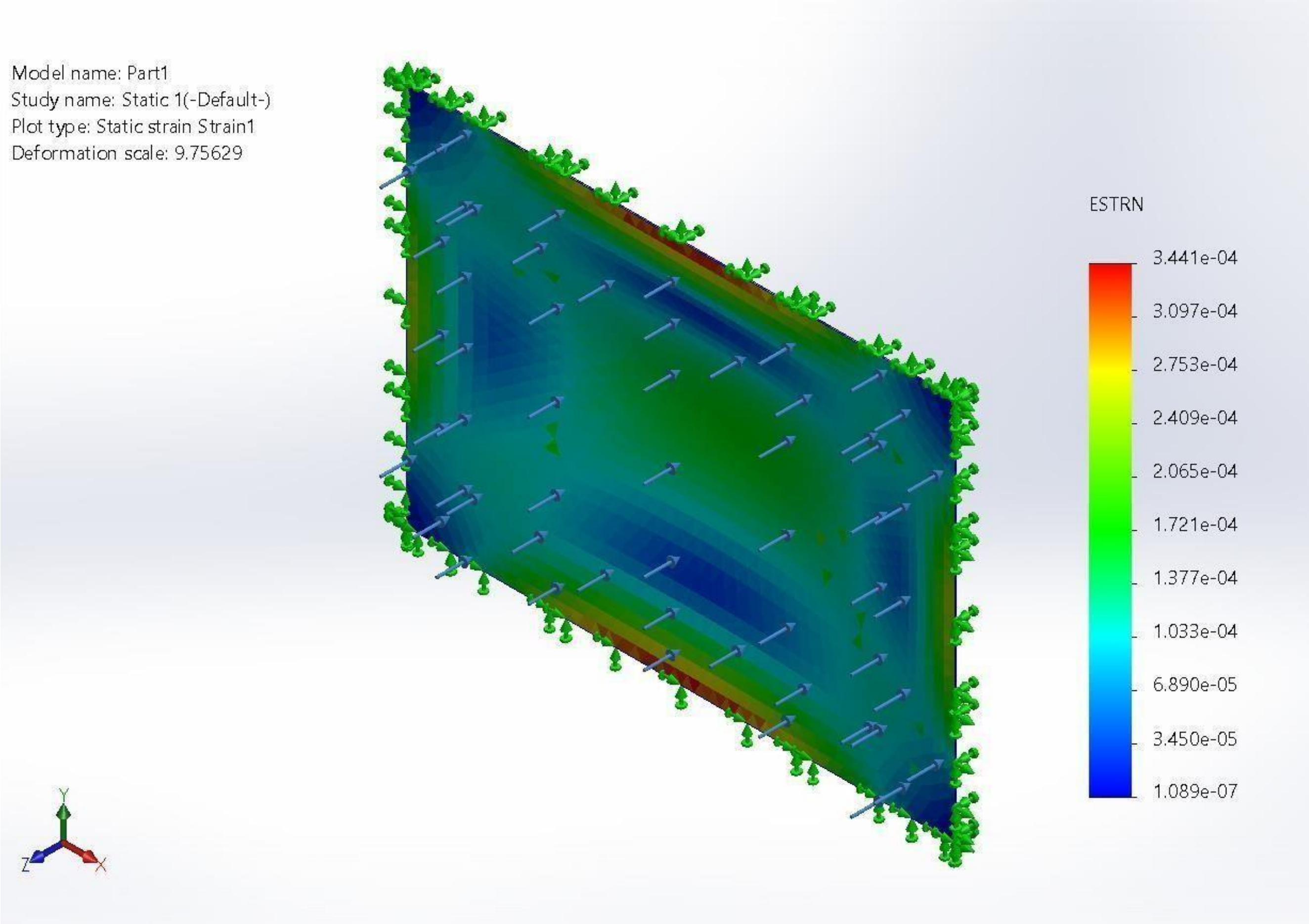
Part1-Static 1-Displacement-Displacement1

Minimum: 0 mm

Maximum: 31.24 mm

The maximum displacement is localized, likely at the center or unsupported regions of the glass.

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.089e-07 Element: 875	3.441e-04 Element: 5753

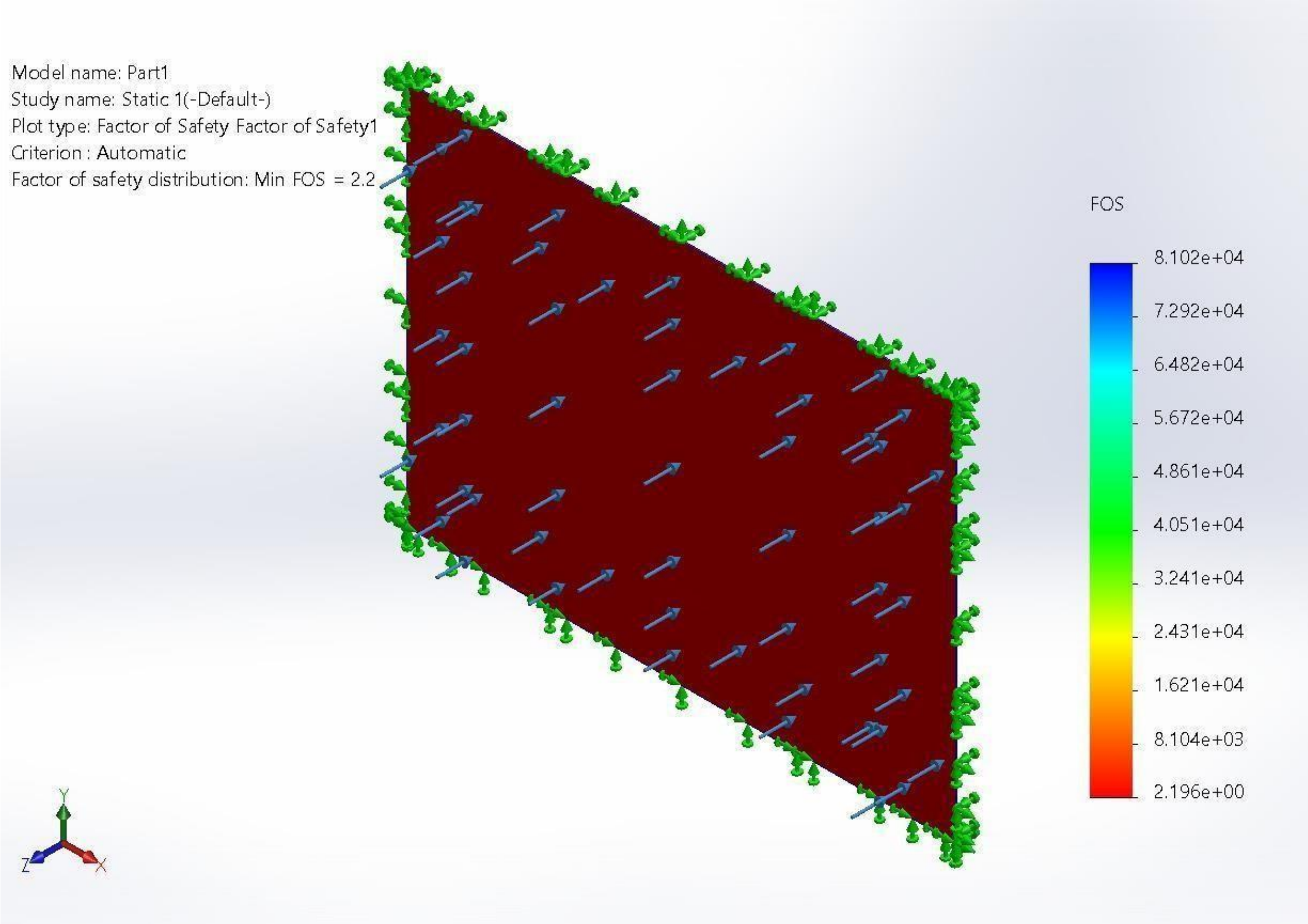


Part1-Static 1-Strain-Strain1

Minimum: 1.089×10^{-7}
Maximum: 3.441×10^{-4}

These values show minimal deformation under the applied pressure.

Name	Type	Min	Max
Factor of Safety1	Automatic	2.196e+00 Node: 9186	8.102e+04 Node: 13752



Part1-Static 1-Factor of Safety-Factor of Safety1

Minimum: 2.196

Maximum: 81,020

The lowest FOS is greater than 1, confirming the design's safety under the given loading conditions.

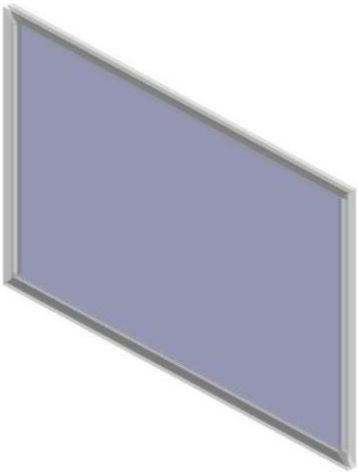
Conclusion

The static simulation of the tempered glass panel under a uniform pressure of 2,250 N/m^2 confirms its structural integrity. The maximum stress of 5.580×10^7 N/m^2 is well below the material's yield strength of 1.5×10^8 N/m^2, ensuring elastic behavior. The maximum resultant displacement of 31.24 mm is within acceptable limits for the application, and the minimum factor of safety of 2.196 demonstrates a sufficient margin against failure. Overall, the tempered glass panel is safe and reliable for the defined operating conditions.

Key Takeaways:

- The tempered glass is structurally sound under the defined pressure, with stress, strain, and displacement values within acceptable limits.
- The safety margin is high, with the minimum FOS exceeding 2, ensuring durability under normal operating conditions.
- The results align with the material's strength and elastic properties, demonstrating reliable performance in this application.

Simulation of Fixed Glass Panel



Description

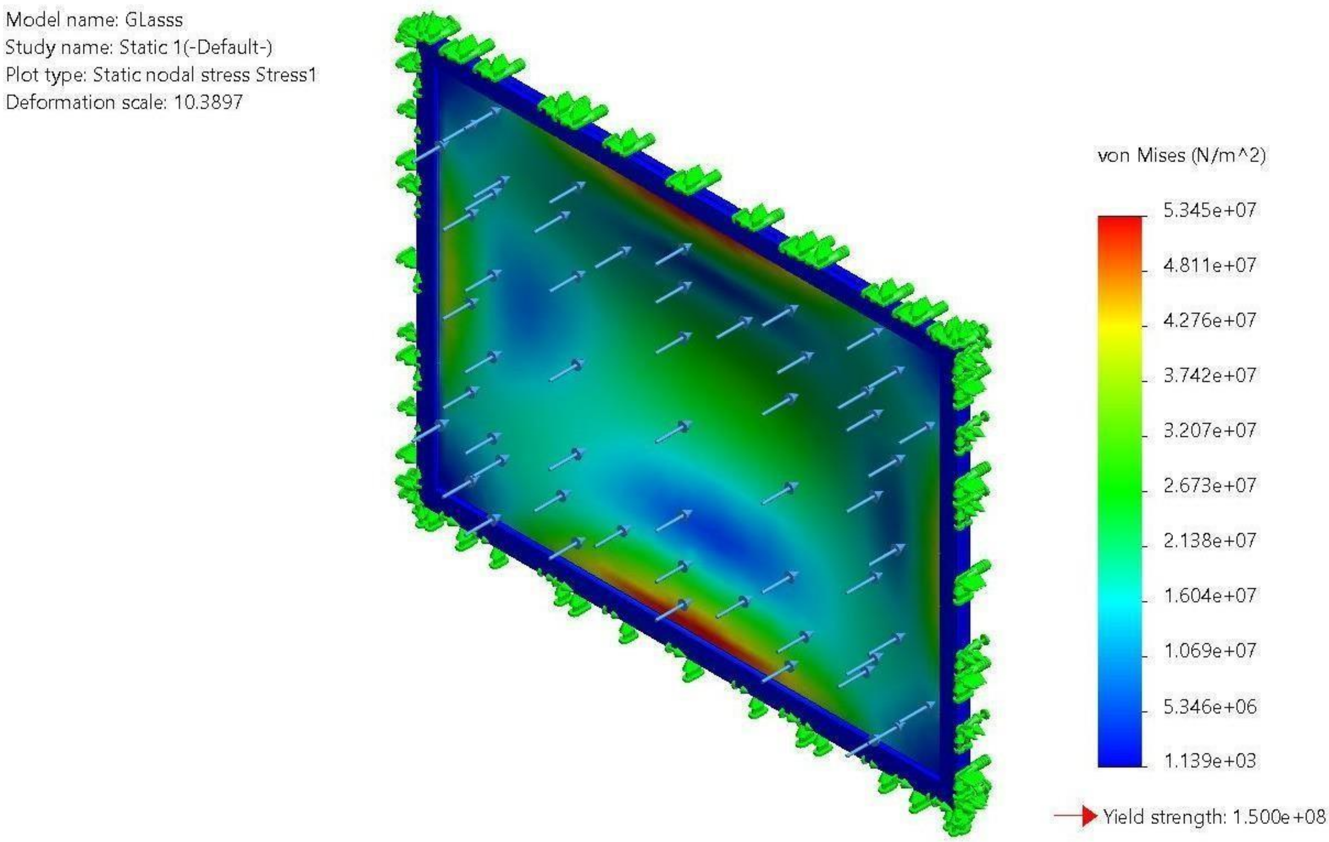
This report presents the results of a static structural analysis performed on a glass panel with dimensions of 10 ft × 7 ft and a thickness of 8 mm, fixed on all four sides with aluminum profiles. The analysis evaluates the panel's stress, strain, displacement, and factor of safety under an applied pressure load of 2,250 N/m². The study aims to assess the structural performance of the glass and its interaction with the fixed supports to ensure safety and functionality under the given conditions. Recommendations for design optimization and further validation are provided based on the findings.

Prepared By

- Faiza (Solid Works Design)
- Arisha (Interpretation)

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.139e+03N/m^2 Node: 19443	5.345e+07N/m^2 Node: 12901

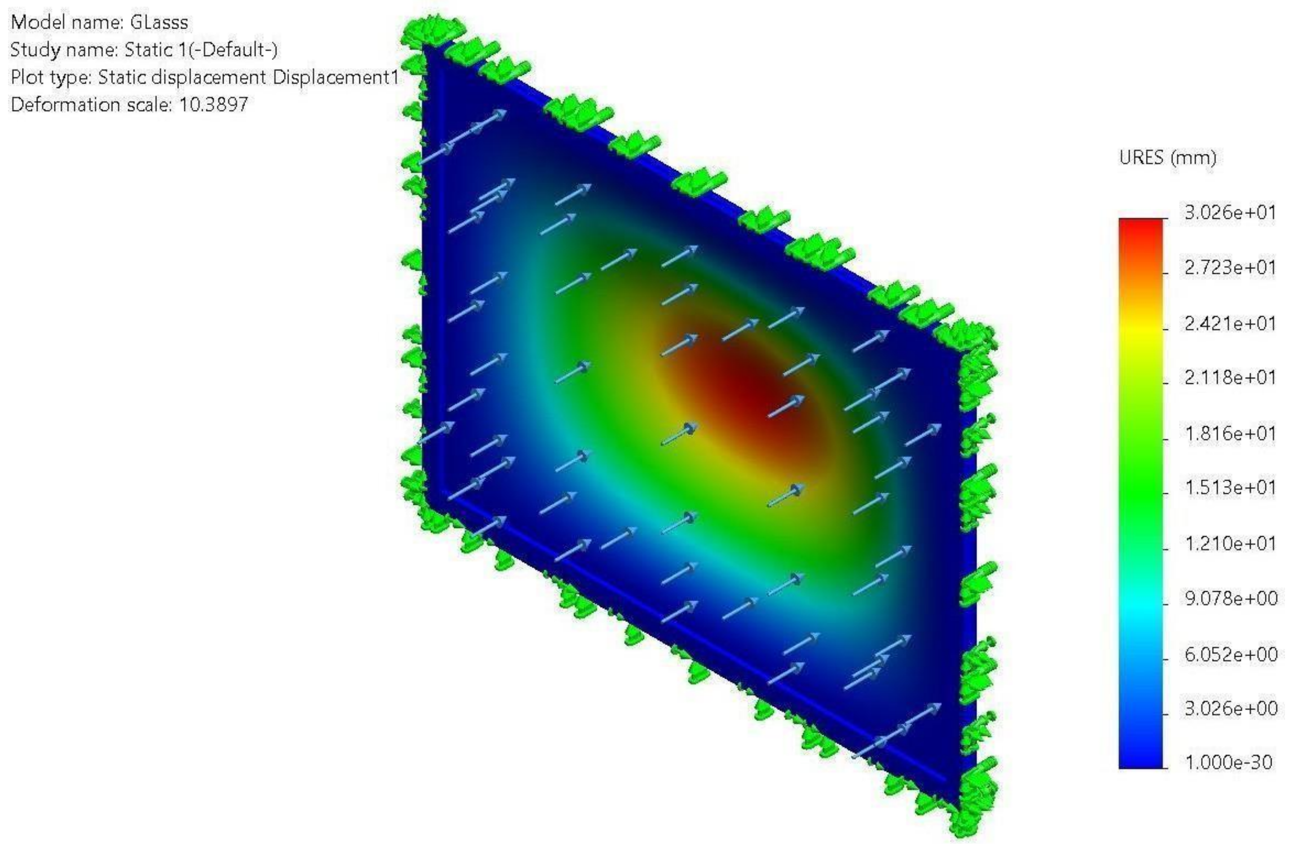


GLasss-Static 1-Stress-Stress1

The von Mises stress ranges between 3,029 N/m² and 55.8 MPa.

The maximum stress is below the material's yield strength of 150 MPa, indicating that the glass part operates safely under the applied load.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 2	3.026e+01mm Node: 7243

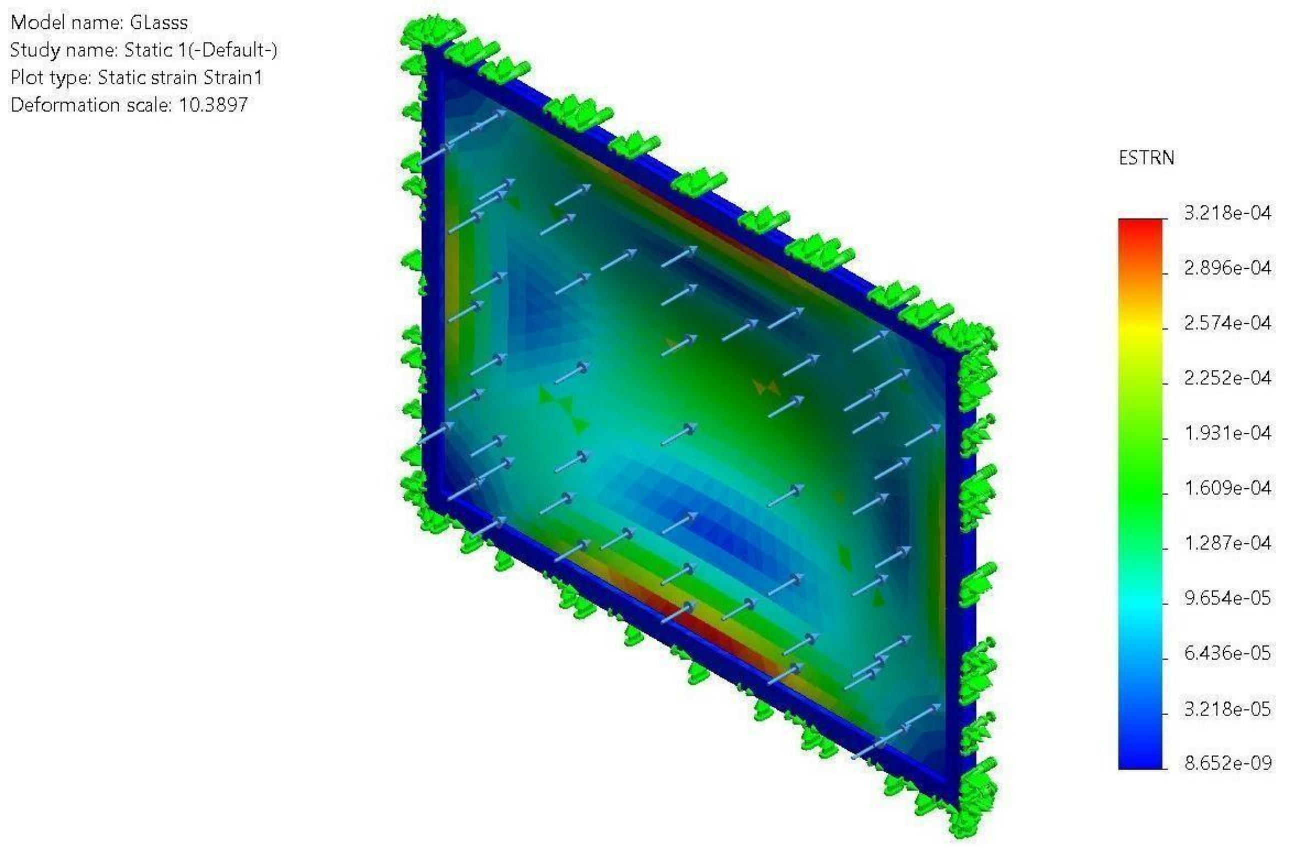


GLasss-Static 1-Displacement-Displacement1

The equivalent strain ranges between 1.089e-07 and 3.441e-04.

These low strain values suggest minimal deformation, which is expected for a rigid material like glass.

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	8.652e-09 Element: 1623	3.218e-04 Element: 4350

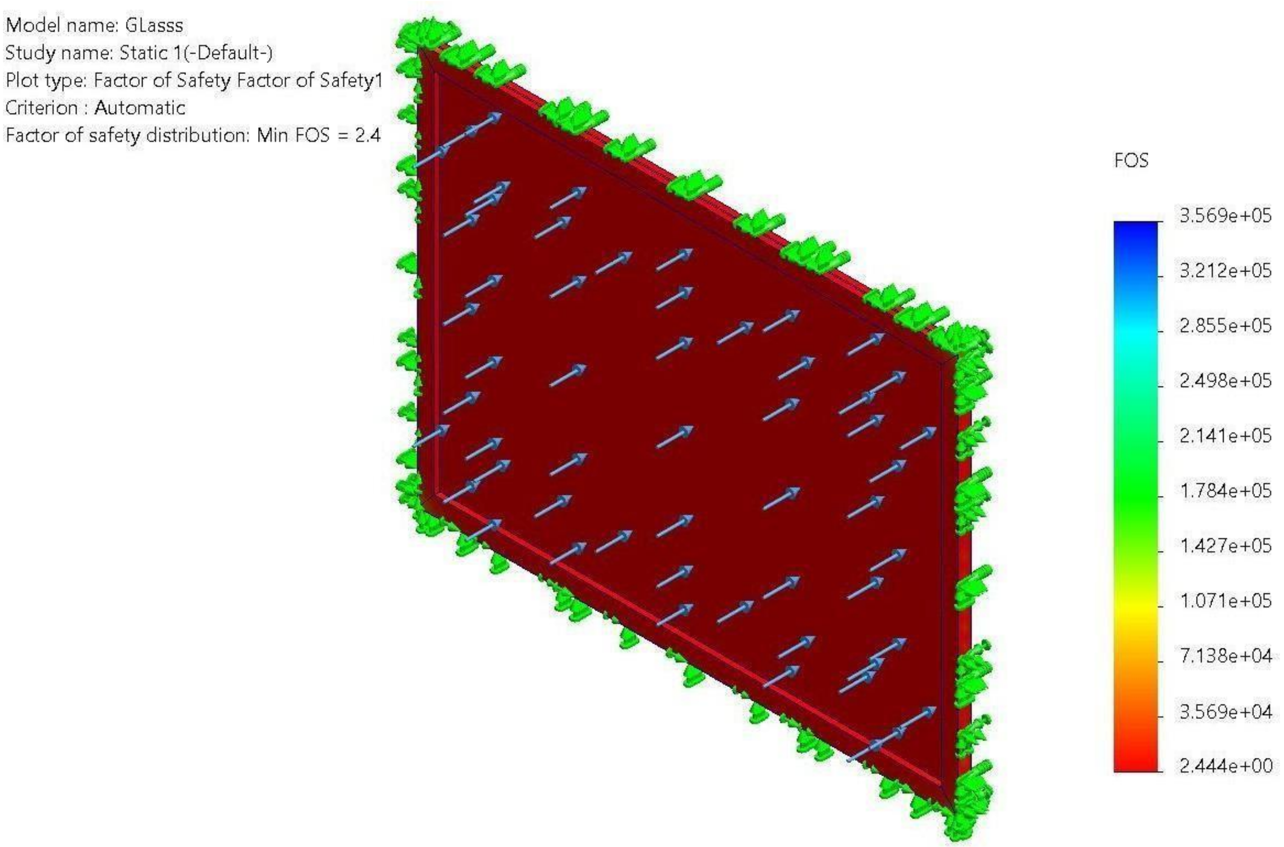


GLasss-Static 1-Strain-Strain1

The resultant displacement ranges between 0.0 mm and 31.24 mm.

Maximum displacement at specific nodes indicates areas of concern where deformation might be more noticeable. However, for glass, such a value might necessitate validation of structural stability.

Name	Type	Min	Max
Factor of Safety1	Automatic	2.444e+00 Node: 10259	3.569e+05 Node: 19443



GLasss-Static 1-Factor of Safety-Factor of Safety1

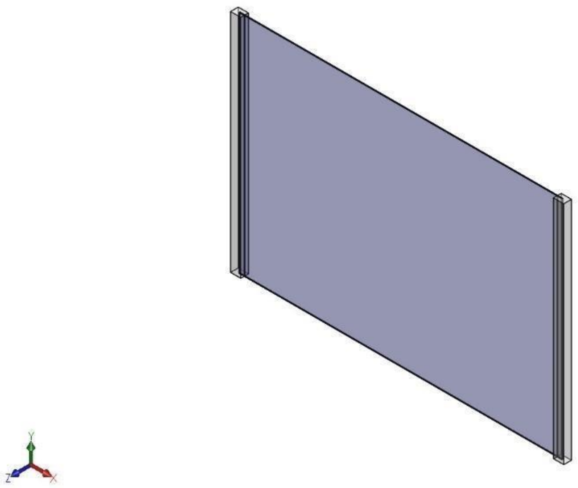
The factor of safety ranges from 2.196 to 81,020.

The minimum FoS of 2.196 suggests the design is safe under normal operating conditions but could be close to critical limits under extreme loading.

Conclusion

The static analysis of the glass panel (10 ft × 7 ft × 8 mm) fixed within aluminum profiles confirms its structural integrity under the applied pressure of 2,250 N/m^2. The maximum stress (55.8 MPa) is well below the material's yield strength (150 MPa), and the minimum factor of safety (2.196) ensures adequate safety margins. The low strain values indicate negligible deformation, but the maximum displacement of 31.24 mm at certain points warrants further review to ensure functionality. The design is robust, with potential for optimization to reduce material use or costs while maintaining safety and performance. Validation through experimental testing is recommended.

Simulation of Two-sided Glass Panel



Description

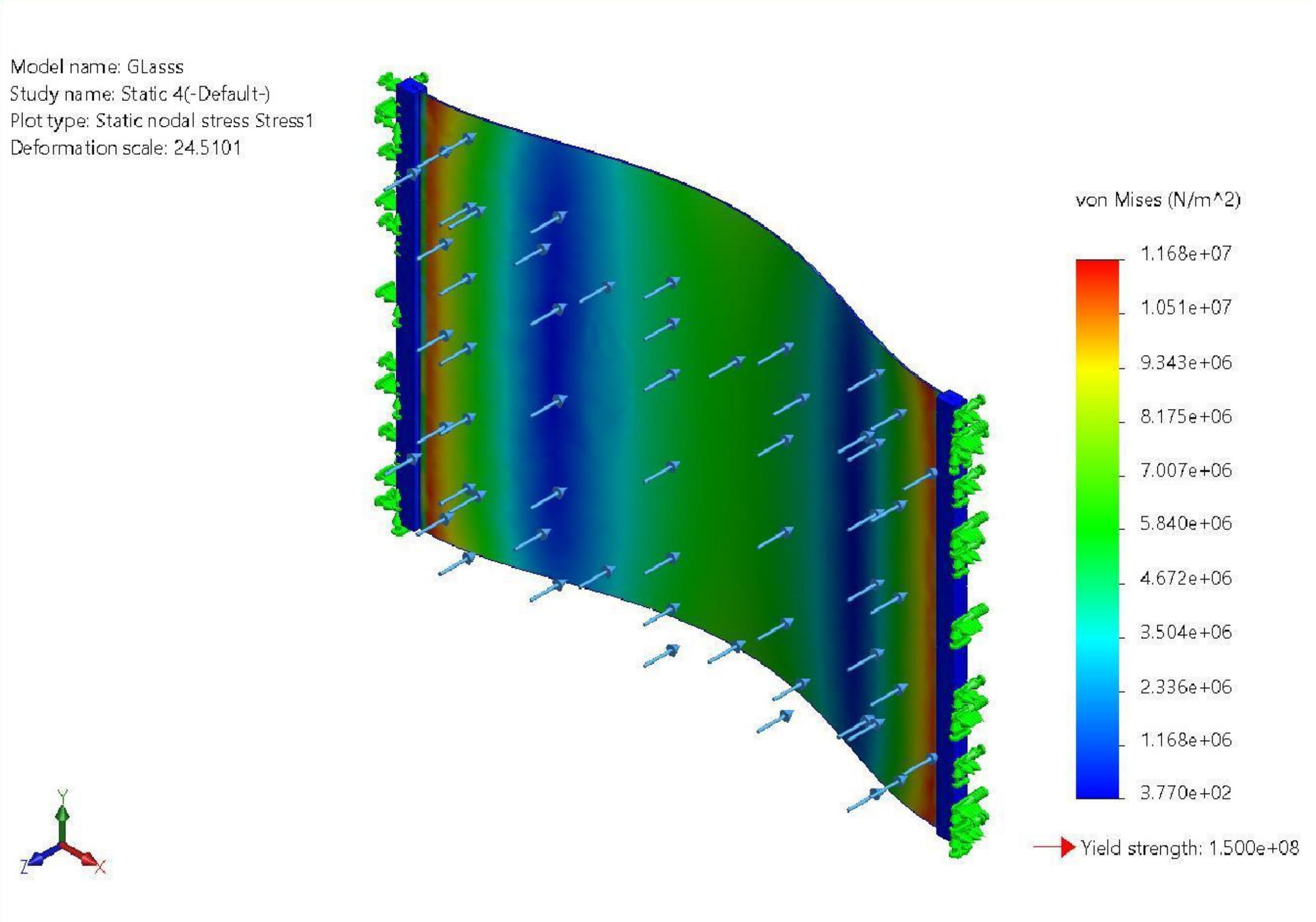
This simulation analyzes the structural performance of a single-glazed tempered glass panel subjected to an air pressure of 65 km/h. The panel has the following specifications:

Thickness: 8 mm
Length: 10 feet (3048 mm)
Breadth: 7 feet (2134 mm) Material: Tempered glass
Support: Two sides fixed with an aluminum profile.

The applied air pressure was converted to a simple pressure value of 199.7 N/m². Results include stress, strain, displacement, and factor of safety.

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	3.770e+02N/m^2 Node: 11872	1.168e+07N/m^2 Node: 10352

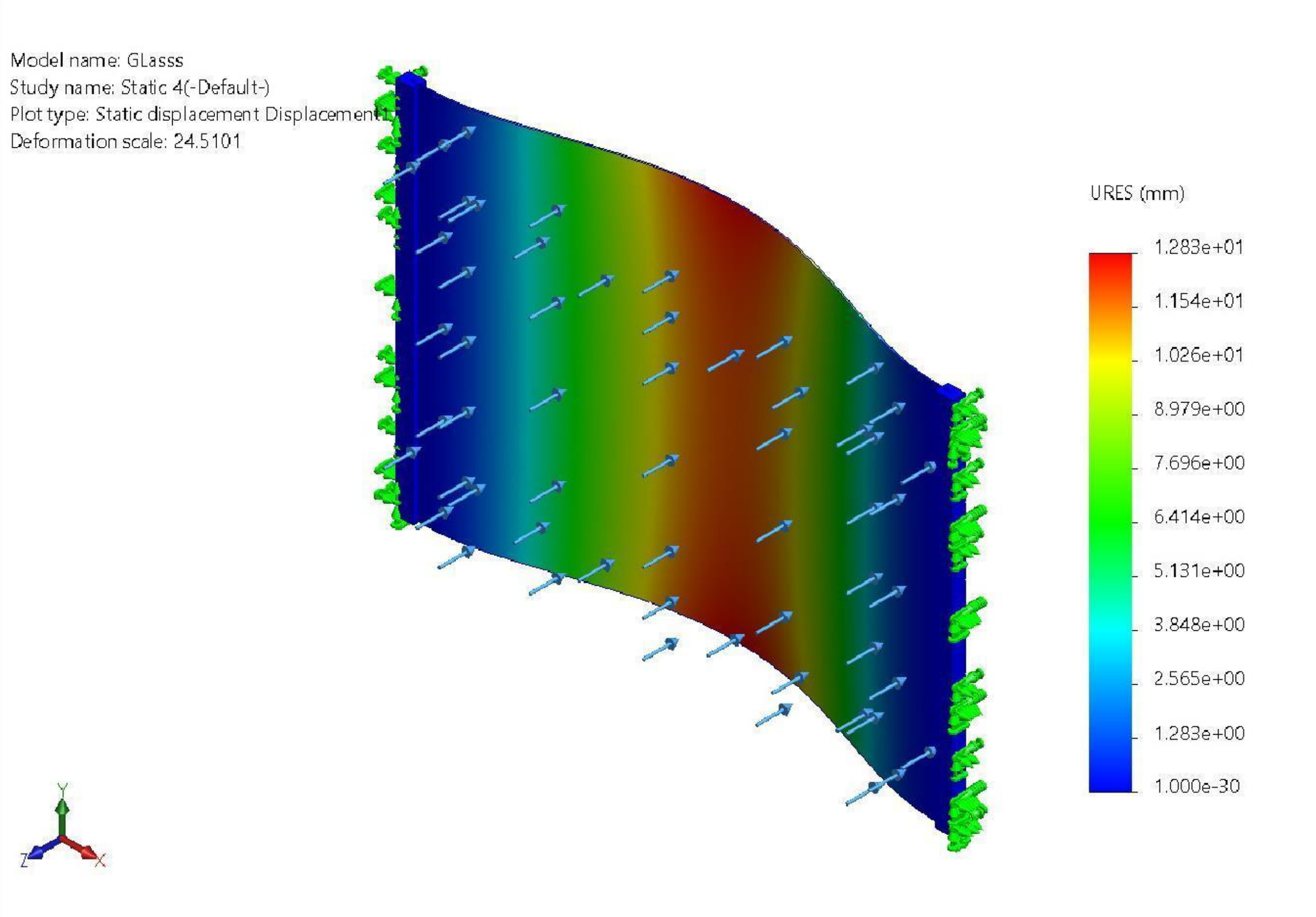


GLasss-Static 4-Stress-Stress1

Maximum: 11.68 MPa (Node 10352).

This stress is well below the yield strength of tempered glass (150 MPa), indicating no risk of material failure under the applied load.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 5	1.283e+01mm Node: 8587

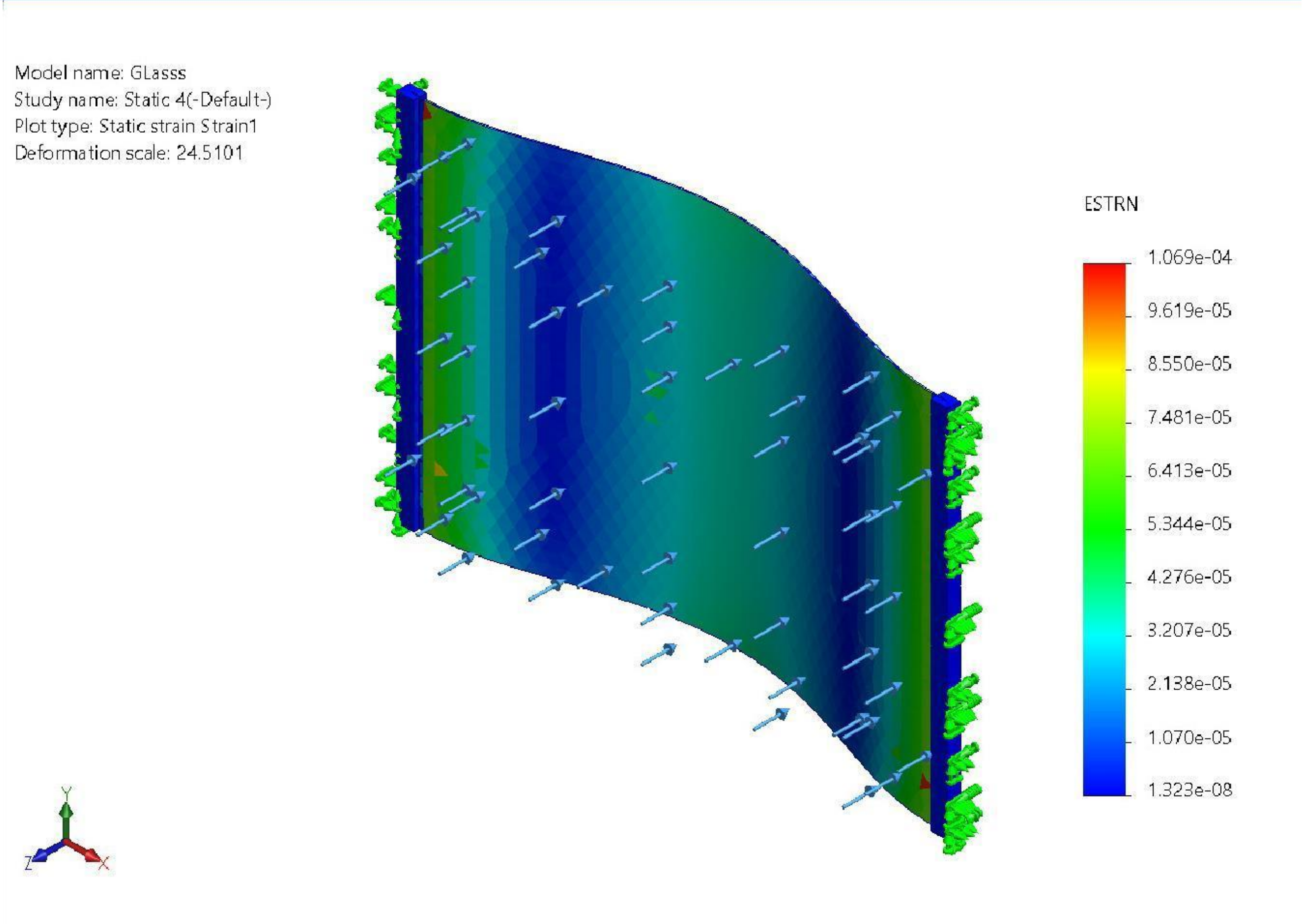


GLasss-Static 4-Displacement-Displacement1

Maximum: 12.83 mm (Node 38587).

This value reflects the glass's flexibility under pressure but remains within acceptable deflection limits for structural integrity.

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.323e-08 Element: 8219	1.069e-04 Element: 3071

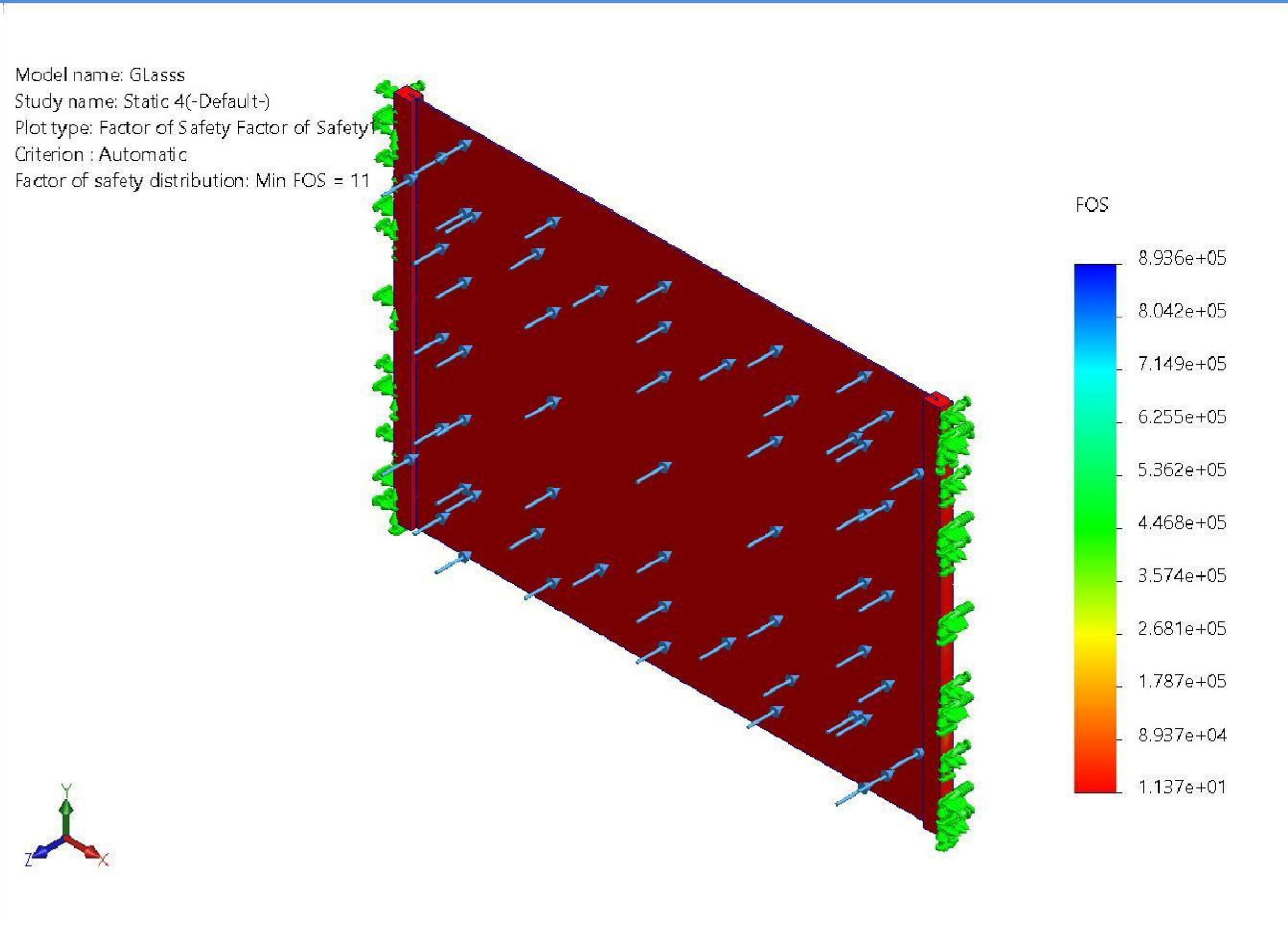


GLasss-Static 4-Strain-Strain1

Maximum: 1.069×10^{-4} (Element 3071).

The strain values confirm minimal deformation, consistent with the material's elastic properties.

Name	Type	Min	Max
Factor of Safety1	Automatic	1.137e+01 Node: 10119	8.936e+05 Node: 11872



GLasss-Static 4-Factor of Safety-Factor of Safety1

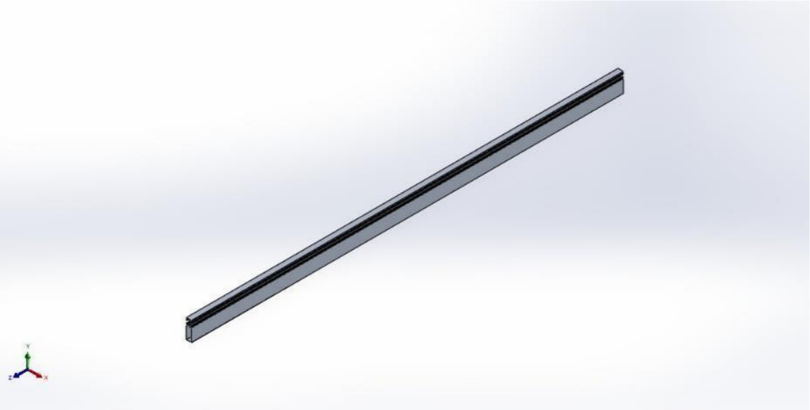
Minimum: 11.37 (Node 10119).

The high FOS indicates the glass's capability to withstand loads significantly higher than the applied pressure, ensuring a robust design.

Conclusion

The simulation verifies the adequacy of the tempered glass panel under a wind pressure of 65 km/h. The results demonstrate that the panel operates within safe limits for stress, displacement, strain, and factor of safety. The design is deemed reliable for the specified conditions. Further optimization or reinforcement may be unnecessary unless higher loads are anticipated.

CURTAIN WALL (TRANSOM) FEA



Simulation of Transom Assembly (New Project)

Date: Sunday, January 12, 2025
Designer: HASSAN ALI SHAHID
Study name: Static 1
Analysis type: Static

Description

Curtain Wall (Transom) Analysis to Evaluate Stress, Displacement, Strain and Factor of Safety

Table of Contents

Interpretation:

The simulation report on the transom assembly evaluates its structural integrity under static loading conditions. The analysis focuses on stress, displacement, strain, and factor of safety, using SolidWorks Simulation. Key takeaways include:

1. **Stress Analysis:**

- Maximum von Mises stress recorded was 3.703×108 N/m23.703 \times 10^8 \, \text{N/m}^23.703×108N/m2, which is critical for determining the material's resistance to deformation.

2. **Displacement:**

- Maximum displacement observed was 69.45 mm. This highlights the deformation under applied forces, which could impact the assembly's performance.

3. **Strain:**

- Equivalent strain peaked at 2.857×10−12.857 \times 10^{-1}2.857×10−1, indicating the intensity of deformation.

4. **Factor of Safety (FoS):**

- The minimum recorded FoS was 0.3916, suggesting potential failure zones and necessitating design optimization.

5. **Load Conditions:**

- Total force applied was approximately 10,929 N, distributed among three sections, each experiencing 3,643 N.

Assumptions

The total Force applied is based on the weight of Double Glaze Glass Panel

1. A single glass panel and has a thickness of about 0.6in.
2. The Thickness of Spacer is considered to be 0.6in.
3. The Gas use in Spacer is Argon with density of 1.78kg/m^3.
4. The Height of the Panel is 12ft.
5. The Width of the Panel is 4m.
6. Force is divided into three sections

Formulas (For Glass weight Calculation)

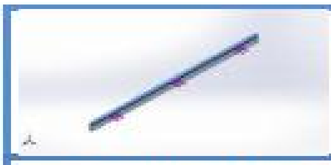
1. Area (m^2) = Height (m) * Width (m)
2. Glass Weight (kg) = Area (m^2) * Glass Thickness (m) * 2500 kg/m^3
3. Gas Weight(kg) = Area (m^2) * Spacers Thickness (m) * Gas Density

Weight Calculation:

1. Area = 3.6576m * 4m = 14.6304 m^2
2. Glass Weight = 14.6304 m^2 * 0.01524 m * 2500 kg/m^3 = 557.41824 kg
3. Gas Weight = 14.6304 m^2 * 0.01524 m * 1.78 kg/m^3 = 0.396 kg
4. Total Weight = 557.41824 + 0.396 + 557.41824 = 1115.2248 kg
5. Total Force = 1115.2248 * 9.8 = 10929.278304 N
6. Force on One section = 10929.278304/3 = 3643 N

Model name: Transom Assembly (New Project)
Current Configuration: Default

Solid Bodies			
Document Name and Reference	**Treated As**	**Volumetric Properties**	**Document Path/Date Modified**
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Left (Transom 4m).SLDPRT Jan 10 00:32:22 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Right (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.80928 kg Volume:0.00080928 m^3 Density:1,000 kg/m^3 Weight:7.93094 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Main Gasket (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1	Solid Body	Mass:1.67484 kg Volume:0.000620311 m^3 Density:2,700 kg/m^3 Weight:16.4134 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Pressure Plate (Transom 4m).SLDPRT

			Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:1.17235 kg Volume:0.000434203 m^3 Density:2,700 kg/m^3 Weight:11.489 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Snap Cover (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Split Line1 	Solid Body	Mass:8.39992 kg Volume:0.00311108 m^3 Density:2,700 kg/m^3 Weight:82.3193 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Transom 4m.SLDPRT Jan 12 17:54:44 2025

Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	Automatic
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project)

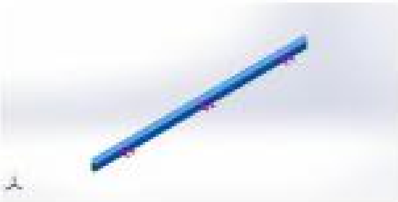
Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

CURTAIN WALL (TRANSOM) FEA

HASSAN ALI SHAHID
1/12/2025

Material Properties

Model Reference	Properties	Components
	**Name:** Rubber **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 9.23737e+06 N/m^2 **Tensile strength:** 1.37871e+07 N/m^2 **Elastic modulus:** 6.1e+06 N/m^2 **Poisson's ratio:** 0.49 **Mass density:** 1,000 kg/m^3 **Shear modulus:** 2.9e+06 N/m^2 **Thermal expansion coefficient:** 0.00067 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Left (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Right (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Main Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-2)
Curve Data:N/A		
	**Name:** 6063-T5 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 1.45e+08 N/m^2 **Tensile strength:** 1.85e+08 N/m^2 **Elastic modulus:** 6.9e+10 N/m^2 **Poisson's ratio:** 0.33 **Mass density:** 2,700 kg/m^3 **Shear modulus:** 2.58e+10 N/m^2 **Thermal expansion coefficient:** 2.34e-05 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Pressure Plate (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Snap Cover (Transom 4m)-1), SolidBody 1(Split Line1)(Transom 4m-1)
Curve Data:N/A		

CURTAIN WALL (TRANSOM) FEA

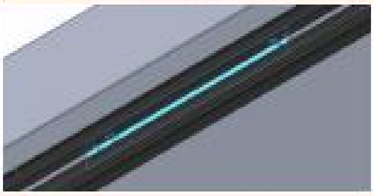
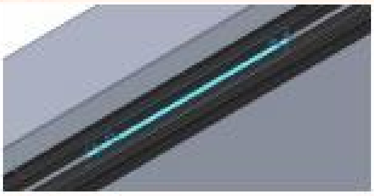
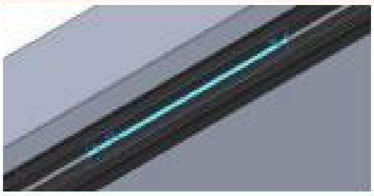
HASSAN ALI SHAHID
1/12/2025

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		Entities: 2 face(s) Type: Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	10,928.9	-0.864648	-1.32045	10,928.9
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details
Force-2		Entities: 1 face(s) Type: Apply normal force Value: 3,643 N
Force-3		Entities: 1 face(s) Type: Apply normal force Value: 3,643 N
Force-4		Entities: 1 face(s) Type: Apply normal force Value: 3,643 N

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	4.1585 in
Minimum element size	0.207925 in
Mesh Quality	High
Remesh failed parts independently	Off

Mesh information – Details

Total Nodes	2228770
Total Elements	1180426
Maximum Aspect Ratio	6,114.1
% of elements with Aspect Ratio < 3	7.26
Percentage of elements with Aspect Ratio > 10	38.3
Percentage of distorted elements	1.49
Time to complete mesh(hh;mm;ss):	00:11:39
Computer name:	

Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	10,928.9	-0.864648	-1.32045	10,928.9

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	127.538	108.487	-113.3	202.169

Free body moments

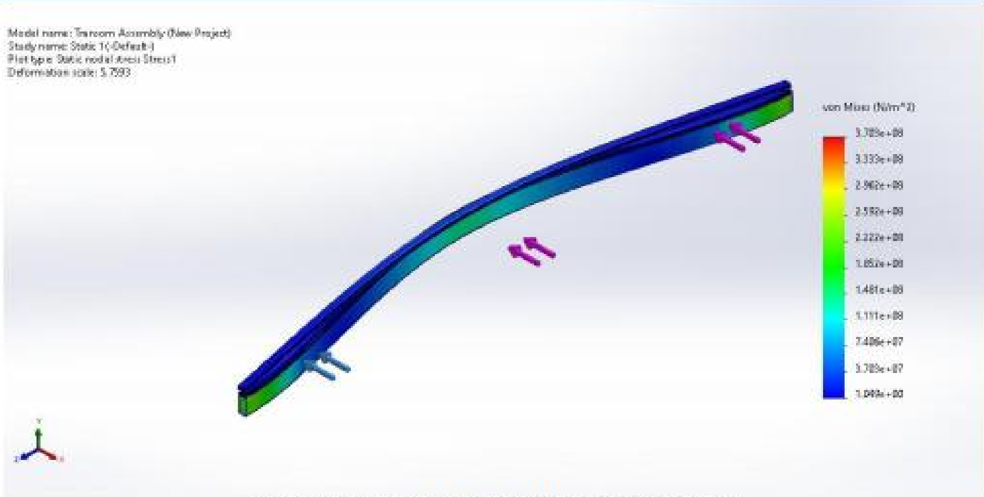
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

CURTAIN WALL (TRANSOM) FEA

HASSAN ALI SHAHID
1/12/2025

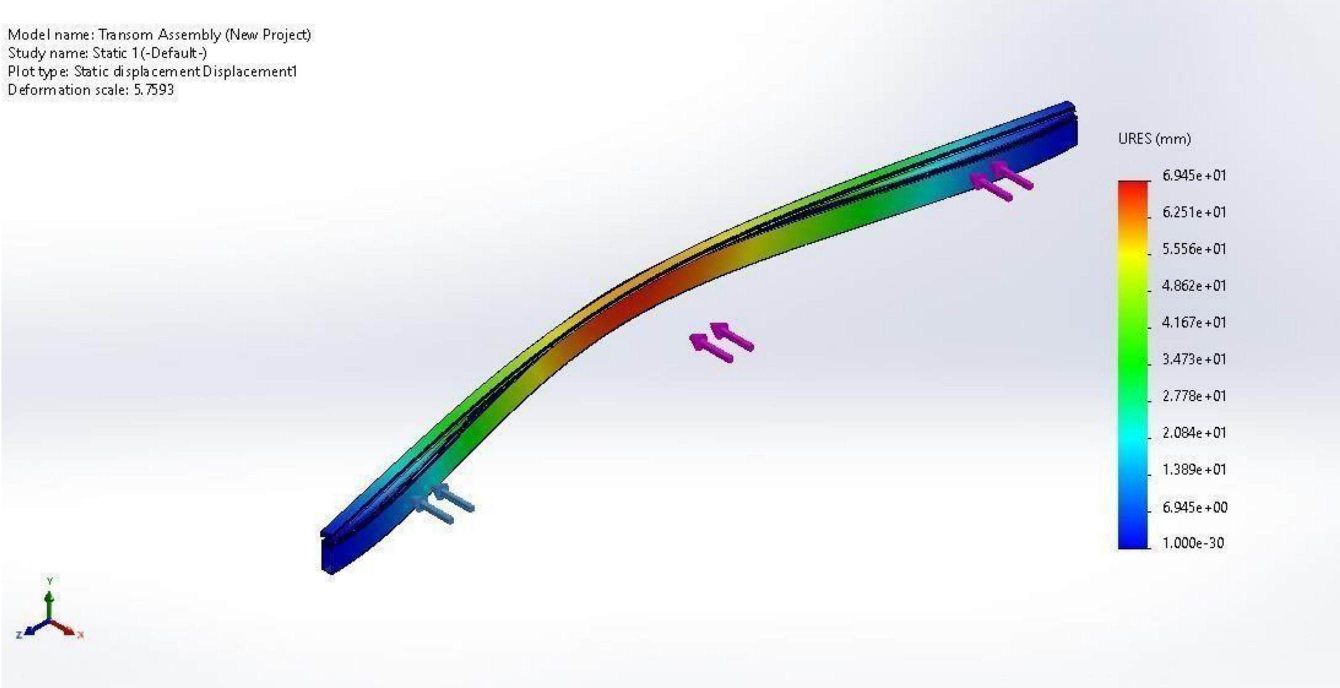
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.049e+00N/m^2 Node: 75351	3.703e+08N/m^2 Node: 1776788



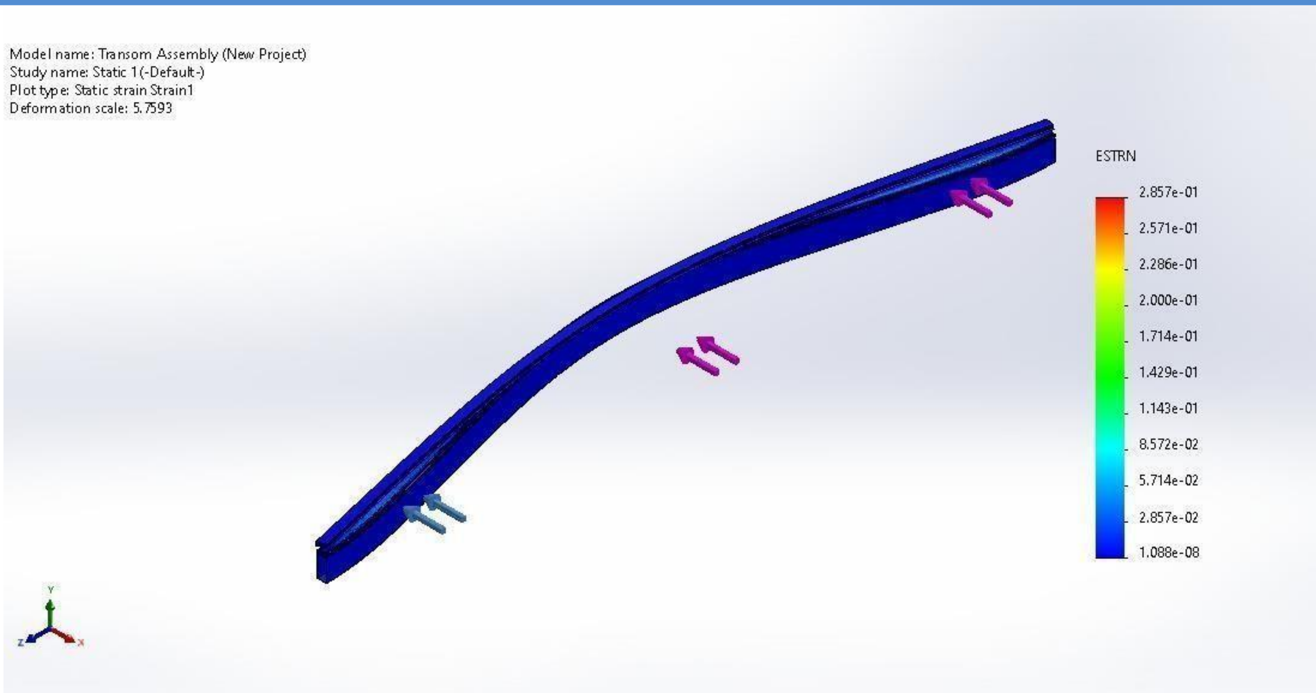
Transom Assembly (New Project)-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 1776675	6.945e+01mm Node: 463140



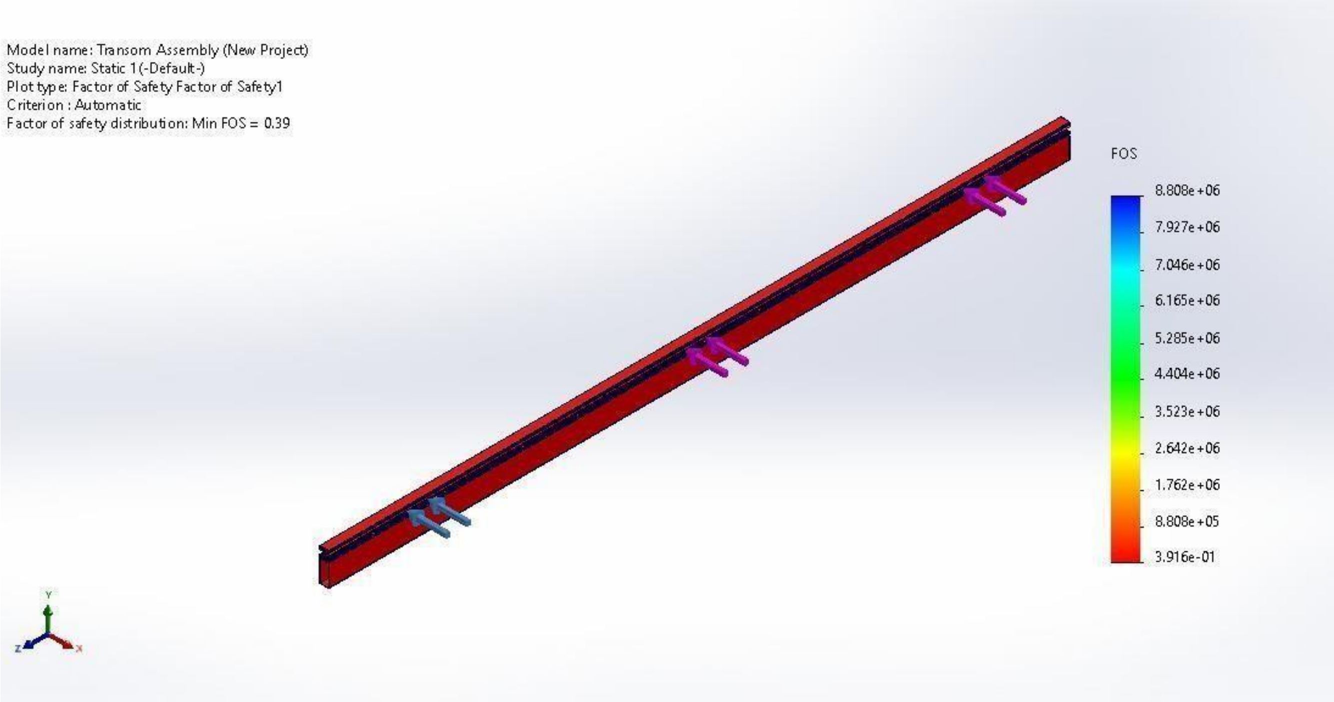
Transom Assembly (New Project)-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.088e-08 Element: 485003	2.857e-01 Element: 310192

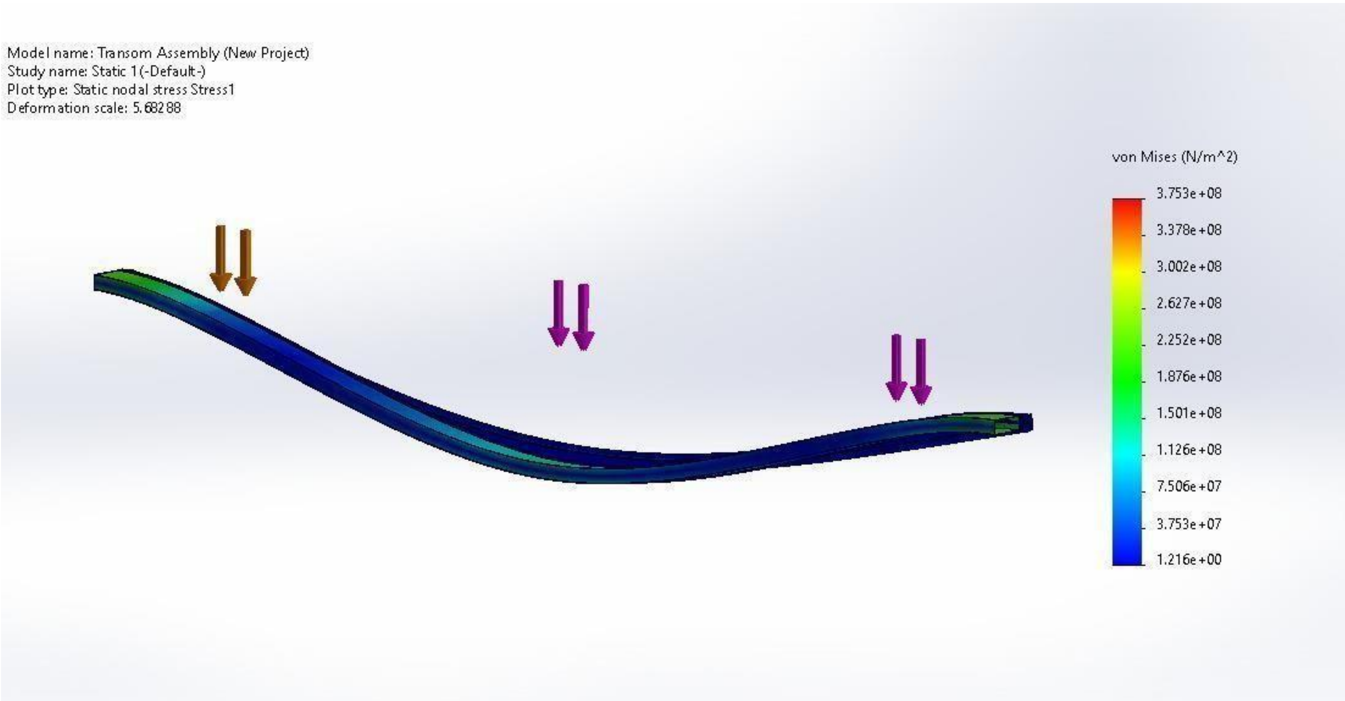


Transom Assembly (New Project)-Static 1-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	3.916e-01 Node: 1776788	8.808e+06 Node: 75351



Transom Assembly (New Project)-Static 1-Factor of Safety-Factor of Safety1



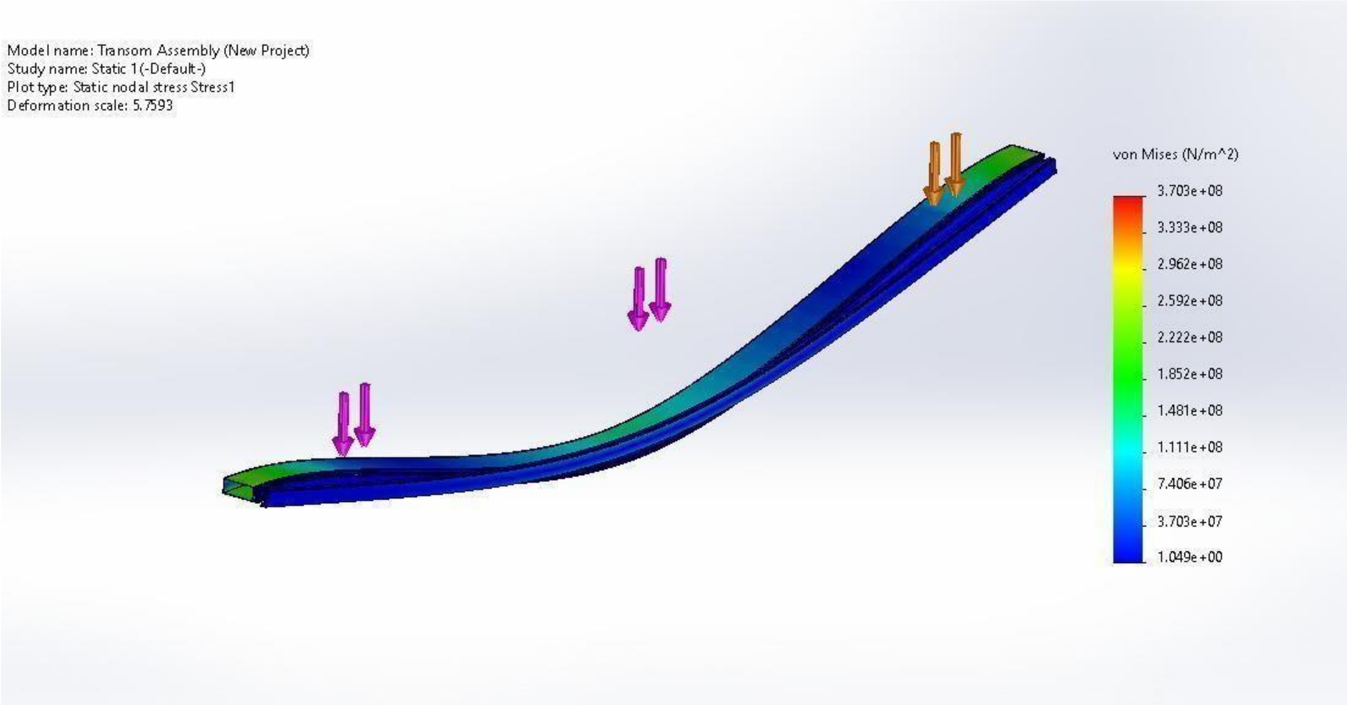


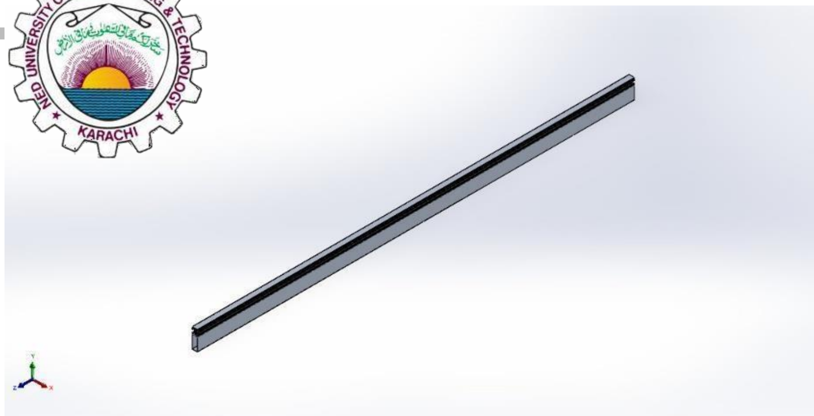
Image-2

Conclusion

The simulation results identify critical areas of concern:

- High stress and strain concentrations indicate regions prone to failure.
- The minimum factor of safety is below acceptable thresholds for most engineering applications, requiring immediate design improvements.
- Displacement values suggest possible deformation affecting functionality, emphasizing the need for structural reinforcement.

Further steps could include redesigning the high-stress zones, using materials with higher strength, or redistributing loads to enhance overall performance and safety.



Simulation of Transom Assembly (New Project)

Date: Wednesday, January 15, 2025
Designer: HASSAN ALI SHAHID
Study name: Static 2
Analysis type: Static

Description

The simulation aimed to analyze the structural integrity of a transom assembly under a uniform pressure load of 2250 Pa applied to simulate the weight of a glass panel.

Interpretation

1. **Stress Distribution**:

- Maximum Von Mises Stress: 4.98 MPa.
- This stress is significantly lower than the yield strength of aluminum, indicating that the material remains well within its elastic limits.

2. **Displacement**:

- Maximum deformation: 0.999 mm, localized at specific nodes.
- Minimal displacement ensures the assembly maintains its structural integrity without noticeable deformation under load.

3. **Strain**:

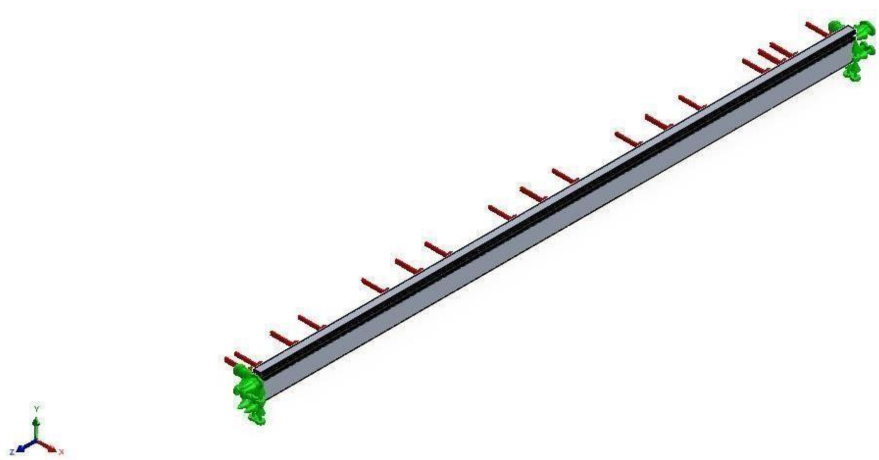
- Maximum strain: 0.00459 (dimensionless).
- Strain values indicate minimal elongation or compression within the assembly.

4. **Factor of Safety (FoS)**:

- Minimum FoS: 29.11.
- The high FoS indicates a conservative design with significant safety margins, ensuring reliability under operational conditions.

Assumptions

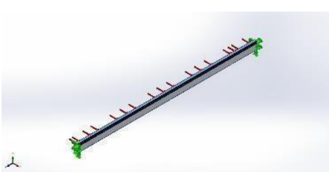
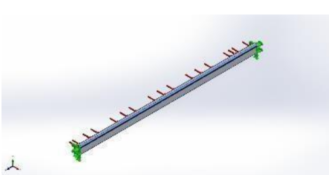
A Pressure of 2250 Pa is applied on the Face of the Transom where the Weight of the Glass Panel would be placed.

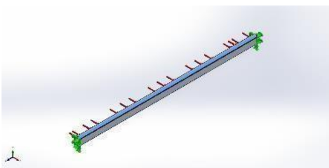


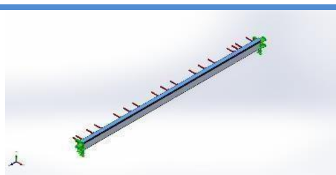
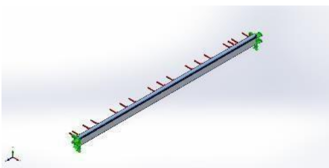
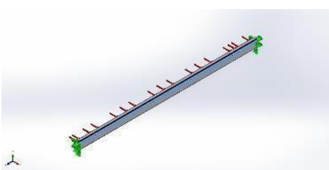
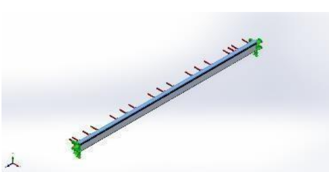
Model name: Transom Assembly (New Project)

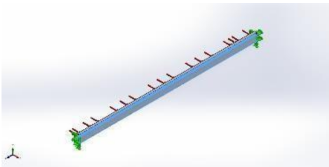
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Left (Transom 4m).SLDPRT** Jan 10 00:32:22 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Right**

			(Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.80928 kg Volume:0.00080928 m^3 Density:1,000 kg/m^3 Weight:7.93094 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Main Gasket (Transom 4m).SLDPRT** Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1	Solid Body	**Mass:1.67484 kg Volume:0.000620311 m^3**	**D:\Ali Data\Ali University Data\Intership**

		Density:2,700 kg/m^3 Weight:16.4134 N	(ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Pressure Plate (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	Mass:1.17235 kg Volume:0.000434203 m^3 Density:2,700 kg/m^3 Weight:11.489 N	D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Snap Cover (Transom 4m).SLDPRT Jan 10 00:32:23 2025

Split Line2 	Solid Body	**Mass:8.39992 kg Volume:0.00311108 m^3 Density:2,700 kg/m^3 Weight:82.3193 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Transom 4m.SLDPRT** Jan 15 15:29:49 2025

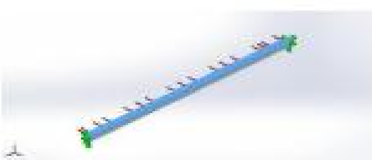
Study Properties

Study name	Static 2
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	Automatic
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project)

Units

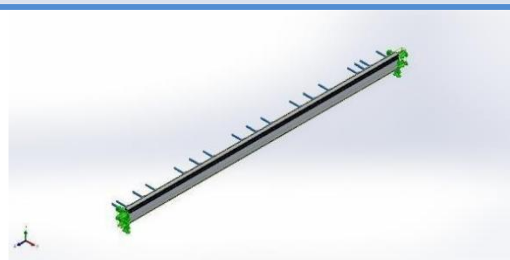
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

Model Reference	Properties	Components
	Name: Rubber Model type: Linear Elastic Isotropic Default failure criterion: Unknown Yield strength: 9.23737e+06 N/m^2 Tensile strength: 1.37871e+07 N/m^2 Elastic modulus: 6.1e+06 N/m^2 Poisson's ratio: 0.49 Mass density: 1,000 kg/m^3 Shear modulus: 2.9e+06 N/m^2 Thermal expansion coefficient: 0.00067 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Left (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Right (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Main Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-2)
Curve Data:N/A		
	Name: 6063-T5 Model type: Linear Elastic Isotropic Default failure criterion: Unknown Yield strength: 1.45e+08 N/m^2 Tensile strength: 1.85e+08 N/m^2 Elastic modulus: 6.9e+10 N/m^2 Poisson's ratio: 0.33 Mass density: 2,700 kg/m^3 Shear modulus: 2.58e+10 N/m^2 Thermal expansion coefficient: 2.34e-05 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Pressure Plate (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Snap Cover (Transom 4m)-1), SolidBody 1(Split Line2)(Transom 4m-1)
Curve Data:N/A		

Analyzed with SOLIDWORKS Simulation Simulation of Transom Assembly (New Project)

Interaction Information

Interaction	Interaction Image	Interaction Properties
Global Interaction		**Type:** Bonded **Components:** 1 component(s) **Options:** Independent mesh

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	4.13742 in
Minimum element size	0.206871 in
Mesh Quality	High

Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-138.576	-0.0521941	-0.00414228	138.576

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	3.41882	-0.909691	-1.09779	3.70419

Free body moments

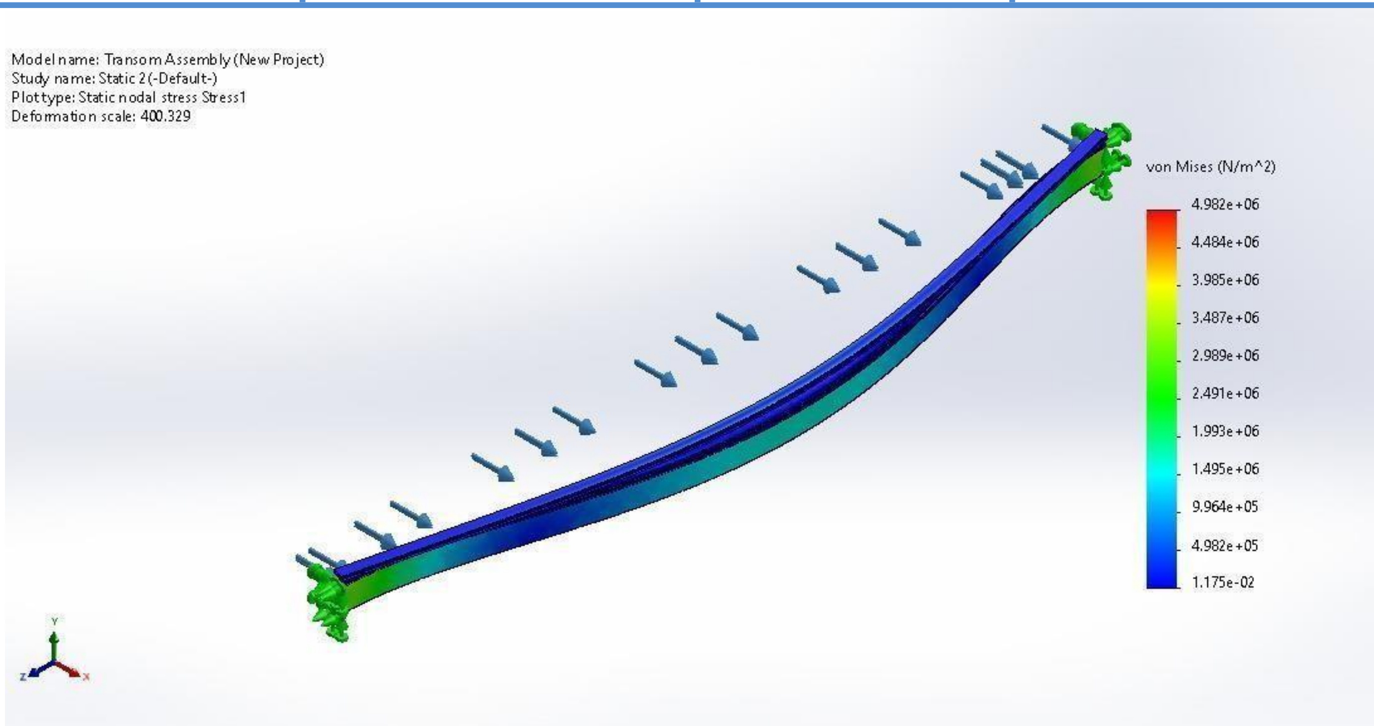
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

Beams

No Data

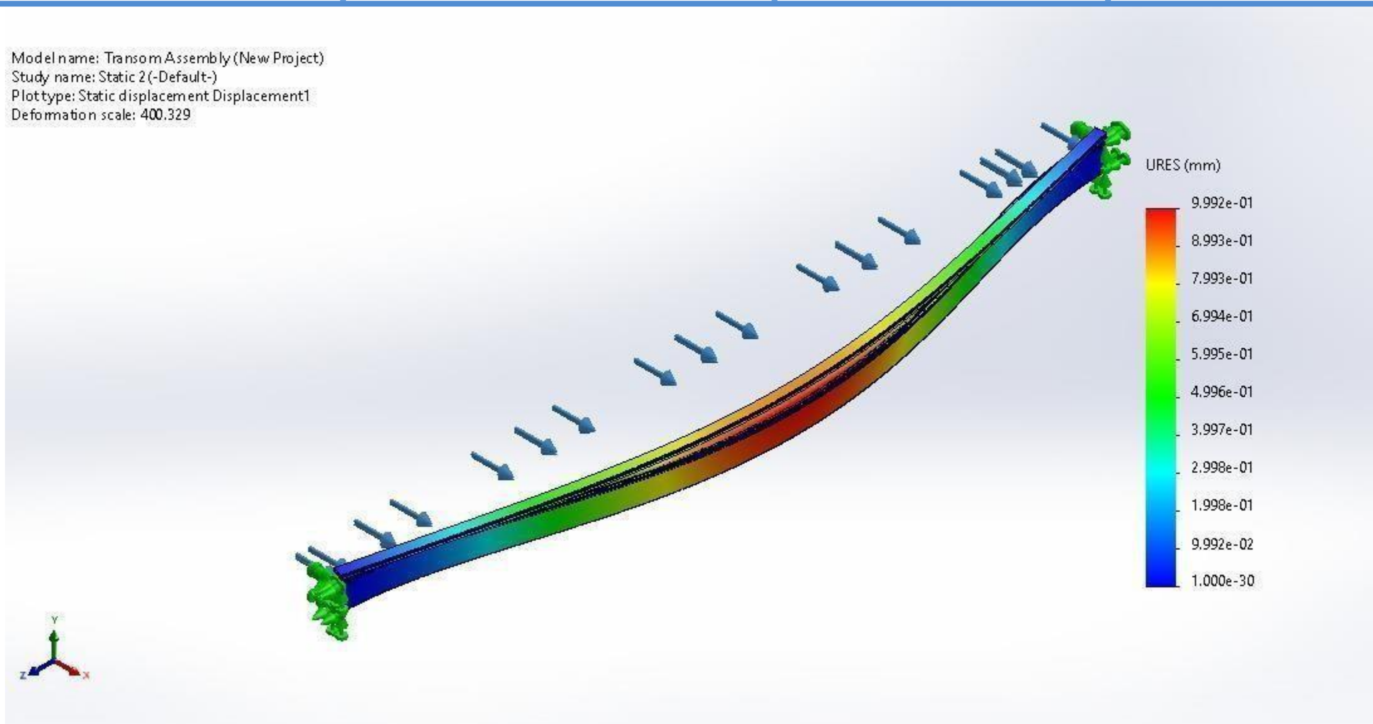
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.175e-02N/m^2 Node: 105015	4.982e+06N/m^2 Node: 1868843



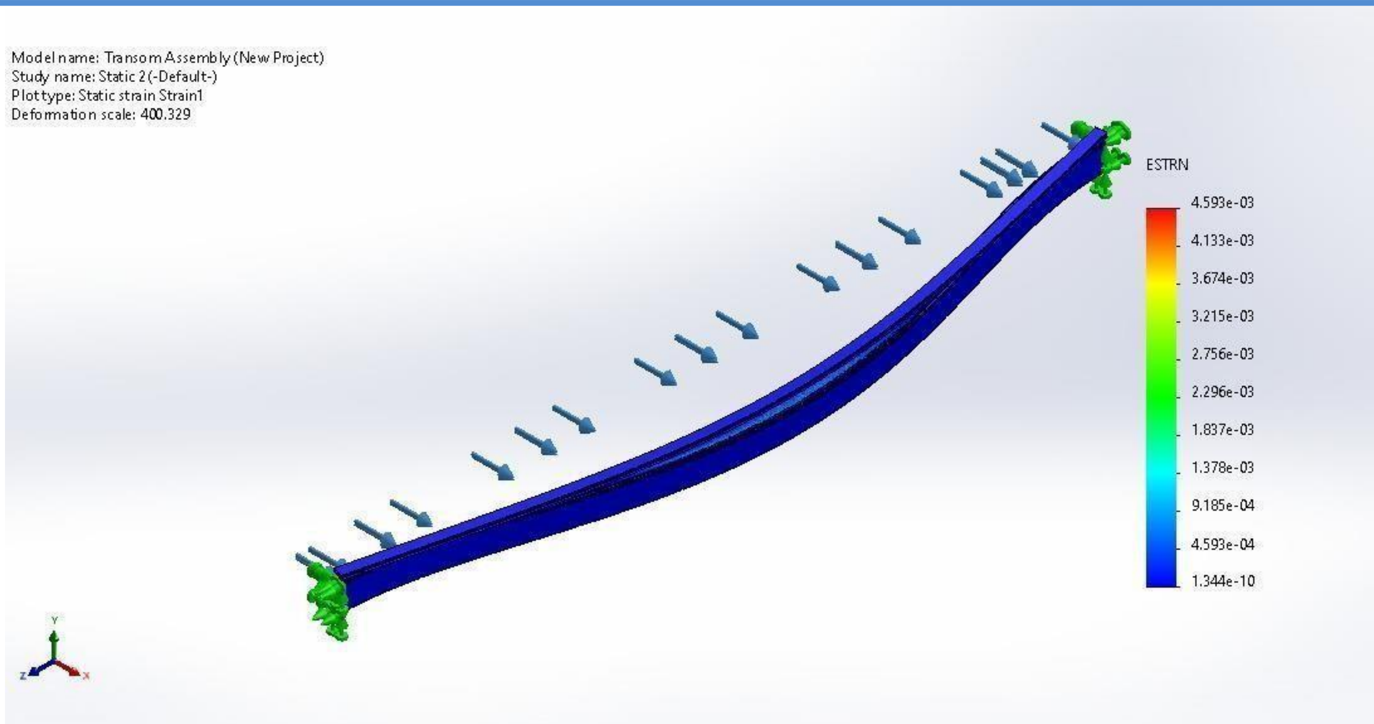
Transom Assembly (New Project)-Static 2-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 1868730	9.992e-01mm Node: 667486



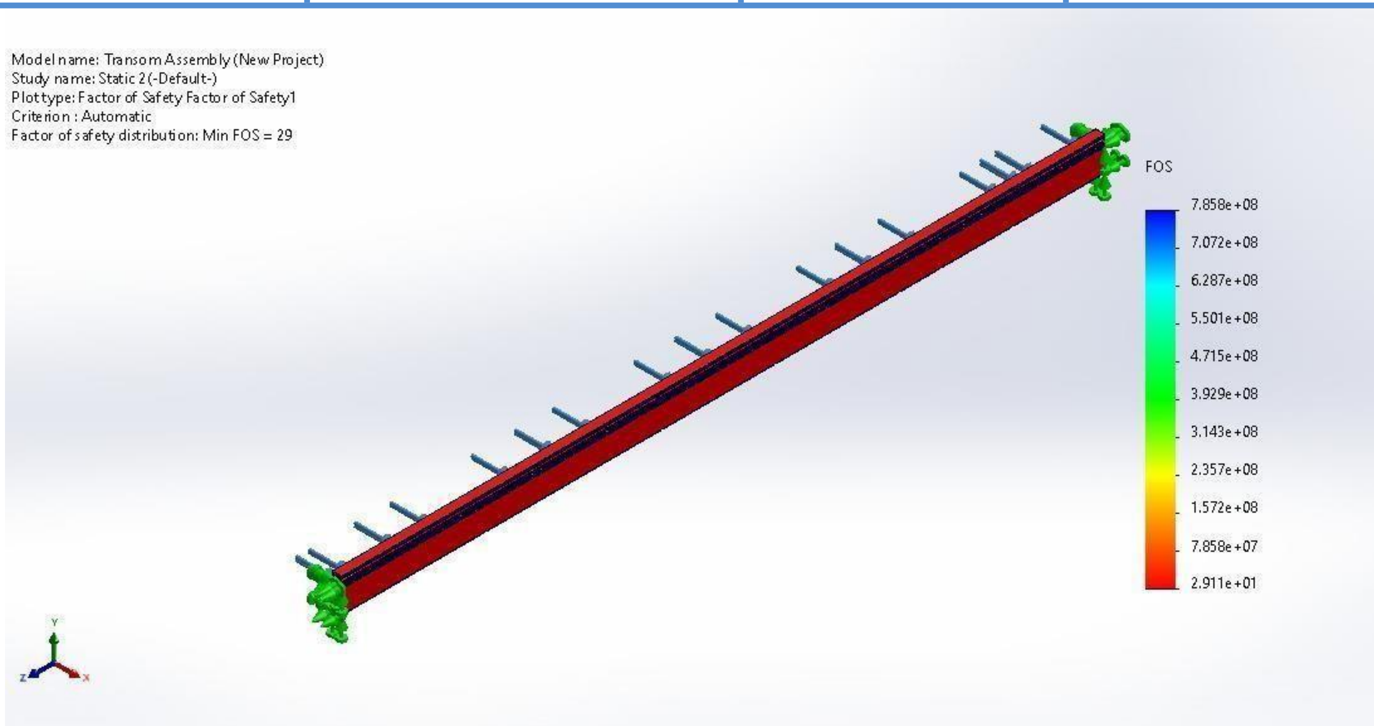
Transom Assembly (New Project)-Static 2-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.344e-10 Element: 464306	4.593e-03 Element: 299912

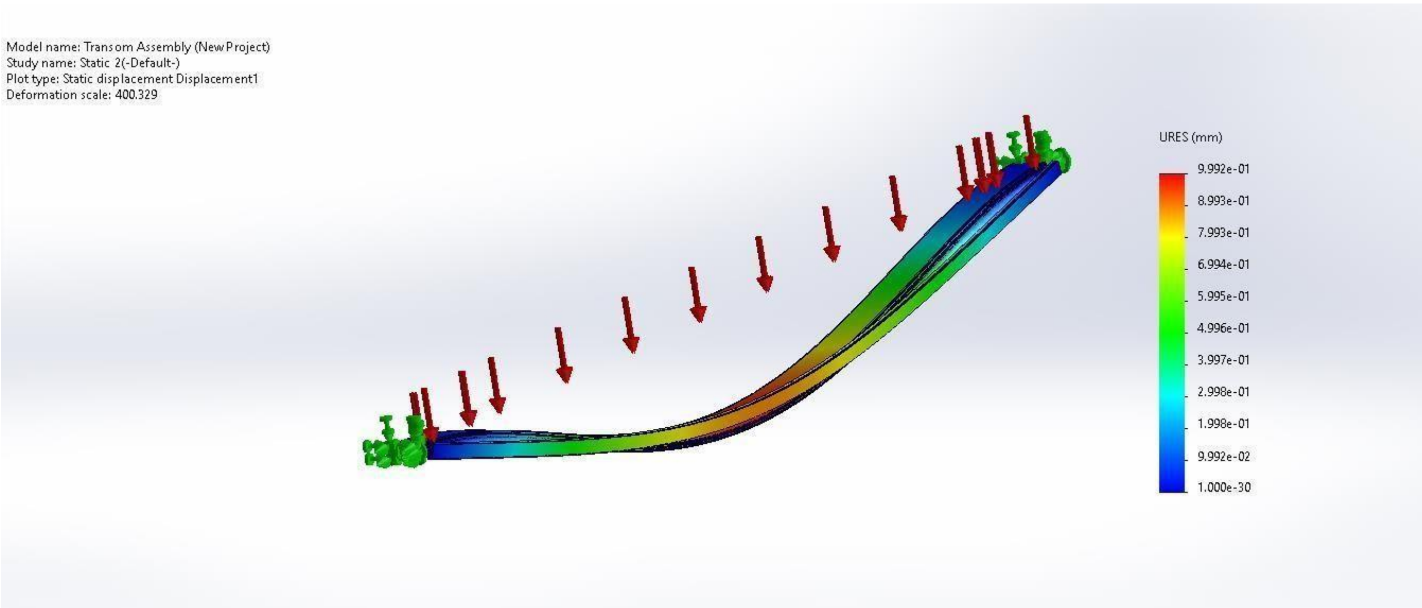


Transom Assembly (New Project)-Static 2-Strain-Strain1

Name	**Type**	**Min**	**Max**
Factor of Safety1	Automatic	2.911e+01 Node: 1868843	7.858e+08 Node: 105015



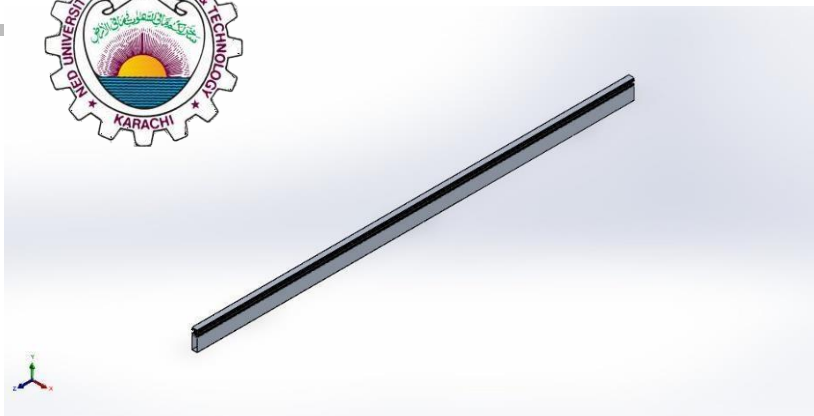
Transom Assembly (New Project)-Static 2-Factor of Safety-Factor of Safety1



Conclusion

The transom assembly demonstrates exceptional structural performance under the applied load. Key observations include:

1. The maximum stress is well within the material's allowable limits, ensuring no risk of failure.
2. Displacement is minimal, signifying high rigidity and maintaining the alignment of the glass panel.
3. The observed strain is negligible, reinforcing the stability and durability of the design.
4. With a minimum factor of safety of 29.11, the design is highly conservative and far exceeds
5. typical safety requirements, making it suitable for demanding real-world applications.



Simulation of Transom Assembly (5in 3 Brackets)

Date: Wednesday, January 15, 2025
Designer: HASSAN ALI SHAHID
Study name: Static 3 with Bracket
Analysis type: Static

Description

The analysis aimed to evaluate the stress, displacement, strain, and factor of safety for a transom assembly supported by three brackets under applied loads from double-glazed glass panels.

INTERPRTATION

1. **Applied Forces**:

- A total force of approximately 10,929 N was distributed evenly across three brackets, each bearing a load of 3,643 N.

2. **Von Mises Stress**:

- Ranged from 0.0472 N/m^2 to 171.5 MPa, indicating the stress distribution under the applied load.

3. **Displacement**:

- Maximum displacement observed was 0.588 mm, which is within acceptable deformation limits for structural integrity.

4. **Strain**:

- The strain values were minimal, with a maximum of 0.0758, demonstrating the material's capacity to handle applied loads.

5. **Factor of Safety (FoS)**:

- The minimum observed FoS was 0.8457, indicating that some regions are close to the failure threshold under the given loading conditions.

ASSUMPTIONS

The total Force applied is based on the weight of Double Glaze Glass Panel

1. A single glass panel and has a thickness of about 0.6in.
2. The Thickness of Spacer is considered to be 0.6in.
3. The Gas use in Spacer is Argon with density of 1.78kg/ ^{3}.
4. The Height of the Panel is 12ft.
5. The Width of the Panel is 4m.
6. Force is divided into three sections
7. Three Brackets of 5in is used to provide extra support to the Transom
8. The Brackets are placed perpendicular the force section.

Formulas (For Glass weight Calculation)

1. Area (^{2}) = Height (m) * Width (m)
2. Glass Weight (kg) = Area (^{2}) * Glass Thickness (m) * 2500 kg/ ^{3}
3. Gas Weight(kg) = Area (^{2}) * Spacers Thickness (m) * Gas Density

Weight Calculation:

576m * 4m = 14.6304 ^{2}

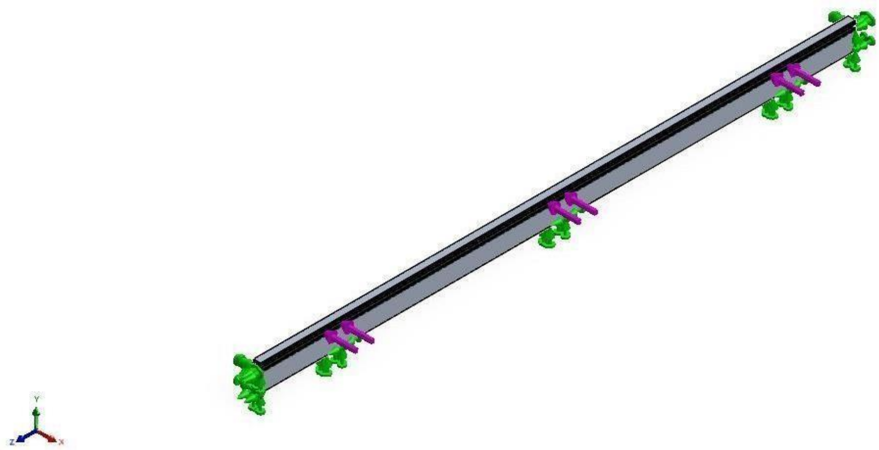
ht = 14.6304 ^{2} * 0.01524 m * 2500 kg/ ^{3} = 557.41824 kg

t = 14.6304 ^{2} * 0.01524 m * 1.78 kg/ ^{3} = 0.396 kg

ht = 557.41824 + 0.396 + 557.41824 = 1115.2248 kg

e = 1115.2248 * 9.8 = 10929.278304 N

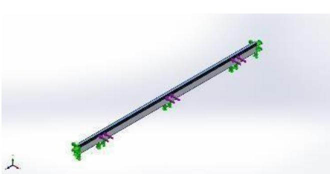
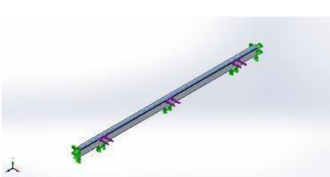
ne section = 10929.278304/3 = 3643 N

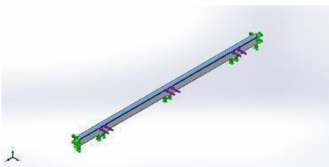


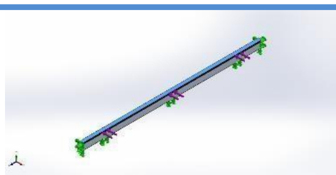
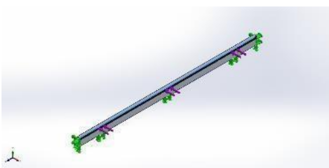
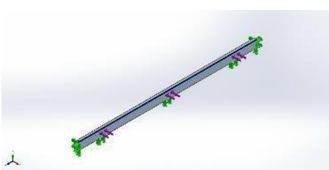
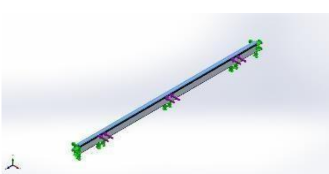
Model name: Transom Assembly (New Project)

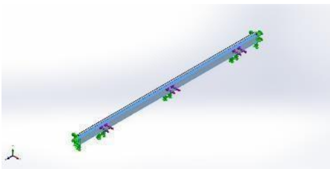
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Left (Transom 4m).SLDPRT** Jan 10 00:32:22 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.216371 kg Volume:0.000216371 m^3 Density:1,000 kg/m^3 Weight:2.12044 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Glass Grade Right**

			(Transom 4m).SLDPRT Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.80928 kg Volume:0.00080928 m^3 Density:1,000 kg/m^3 Weight:7.93094 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Main Gasket (Transom 4m).SLDPRT** Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1	Solid Body	**Mass:1.67484 kg Volume:0.000620311 m^3**	**D:\Ali Data\Ali University Data\Intership**

		**Density:2,700 kg/m^3 Weight:16.4134 N**	**(ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Pressure Plate (Transom 4m).SLDPRT** Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT** Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:0.308812 kg Volume:0.000308812 m^3 Density:1,000 kg/m^3 Weight:3.02636 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Side Gasket (Transom 4m).SLDPRT** Jan 10 00:32:23 2025
Stock-New Project Transom 4m-1 	Solid Body	**Mass:1.17235 kg Volume:0.000434203 m^3 Density:2,700 kg/m^3 Weight:11.489 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Snap Cover (Transom 4m).SLDPRT** Jan 10 00:32:23 2025

Split Line2 	Solid Body	**Mass:8.39992 kg Volume:0.00311108 m^3 Density:2,700 kg/m^3 Weight:82.3193 N**	**D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project\Transom Assembly Part Files\Transom 4m.SLDPRT** Jan 15 15:29:49 2025

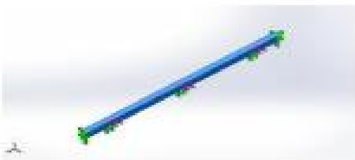
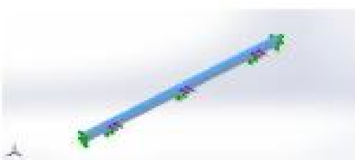
Study Properties

Study name	Static 3 with Barkets
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	Automatic
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (D:\Ali Data\Ali University Data\Intership (ALCOP)\Curtain Wall New Project)

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

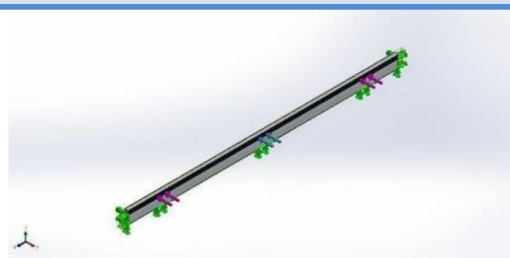
Material Properties

Model Reference	Properties	Components
	**Name:** Rubber **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 9.23737e+06 N/m^2 **Tensile strength:** 1.37871e+07 N/m^2 **Elastic modulus:** 6.1e+06 N/m^2 **Poisson's ratio:** 0.49 **Mass density:** 1,000 kg/m^3 **Shear modulus:** 2.9e+06 N/m^2 **Thermal expansion coefficient:** 0.00067 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Left (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Glass Grade Right (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Main Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Side Gasket (Transom 4m)-2)
Curve Data:N/A		
	**Name:** 6063-T5 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 1.45e+08 N/m^2 **Tensile strength:** 1.85e+08 N/m^2 **Elastic modulus:** 6.9e+10 N/m^2 **Poisson's ratio:** 0.33 **Mass density:** 2,700 kg/m^3 **Shear modulus:** 2.58e+10 N/m^2 **Thermal expansion coefficient:** 2.34e-05 /Kelvin	SolidBody 1(Stock-New Project Transom 4m-1)(Pressure Plate (Transom 4m)-1), SolidBody 1(Stock-New Project Transom 4m-1)(Snap Cover (Transom 4m)-1), SolidBody 1(Split Line2)(Transom 4m-1)
Curve Data:N/A		

Connector Definitions

No Data

Interaction Information

Interaction	Interaction Image	Interaction Properties
Global Interaction		**Type:** Bonded **Components:** 1 component(s) **Options:** Independent mesh

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points for High quality mesh	16 Points
Maximum element size	4.13742 in
Minimum element size	0.206871 in
Mesh Quality	High
Remesh failed parts independently	Off

Mesh information - Details

Total Nodes	2315877
Total Elements	1243417
Maximum Aspect Ratio	3,543.6
% of elements with Aspect Ratio < 3	7.41
Percentage of elements with Aspect Ratio > 10	37.6
Percentage of distorted elements	1.53
Time to complete mesh(hh;mm;ss):	00:06:59
Computer name:	

Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	10,929.1	0.0348377	0.255363	10,929.1

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

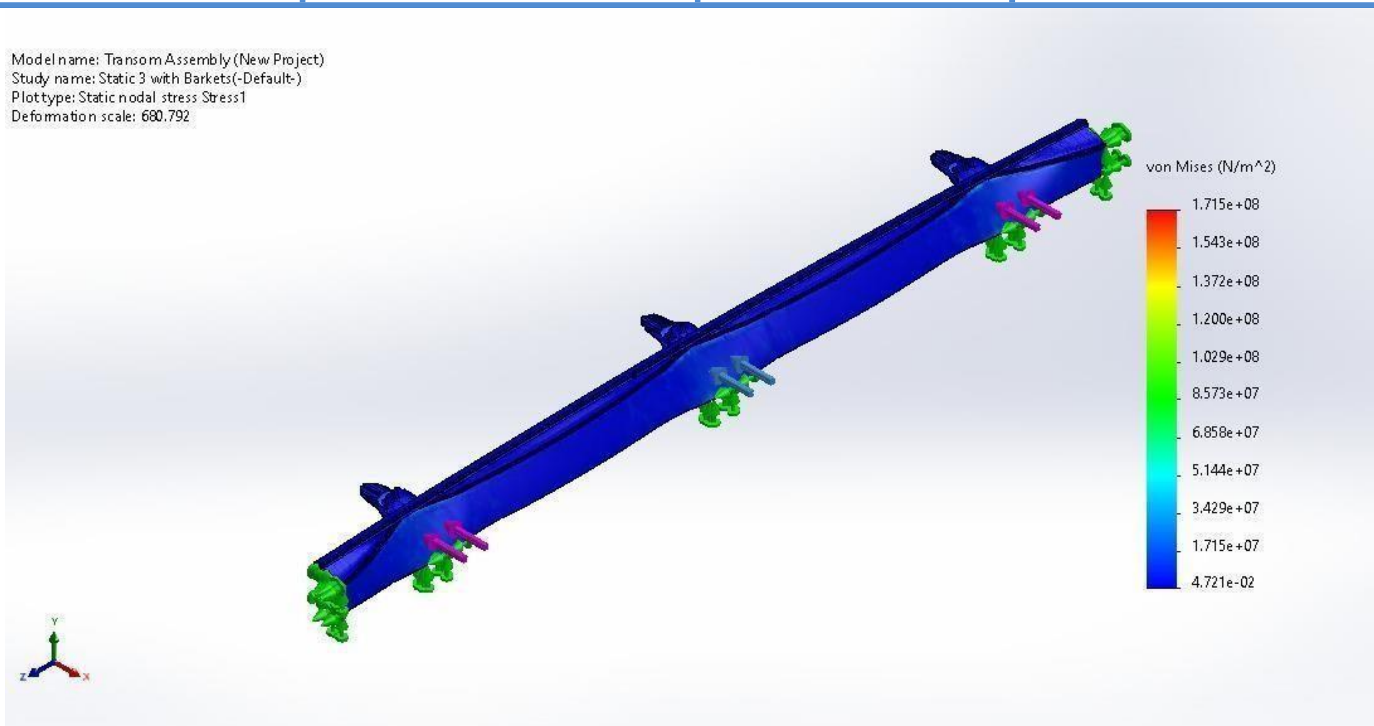
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-1.38001	3.56769	-0.876359	3.92439

Free body moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

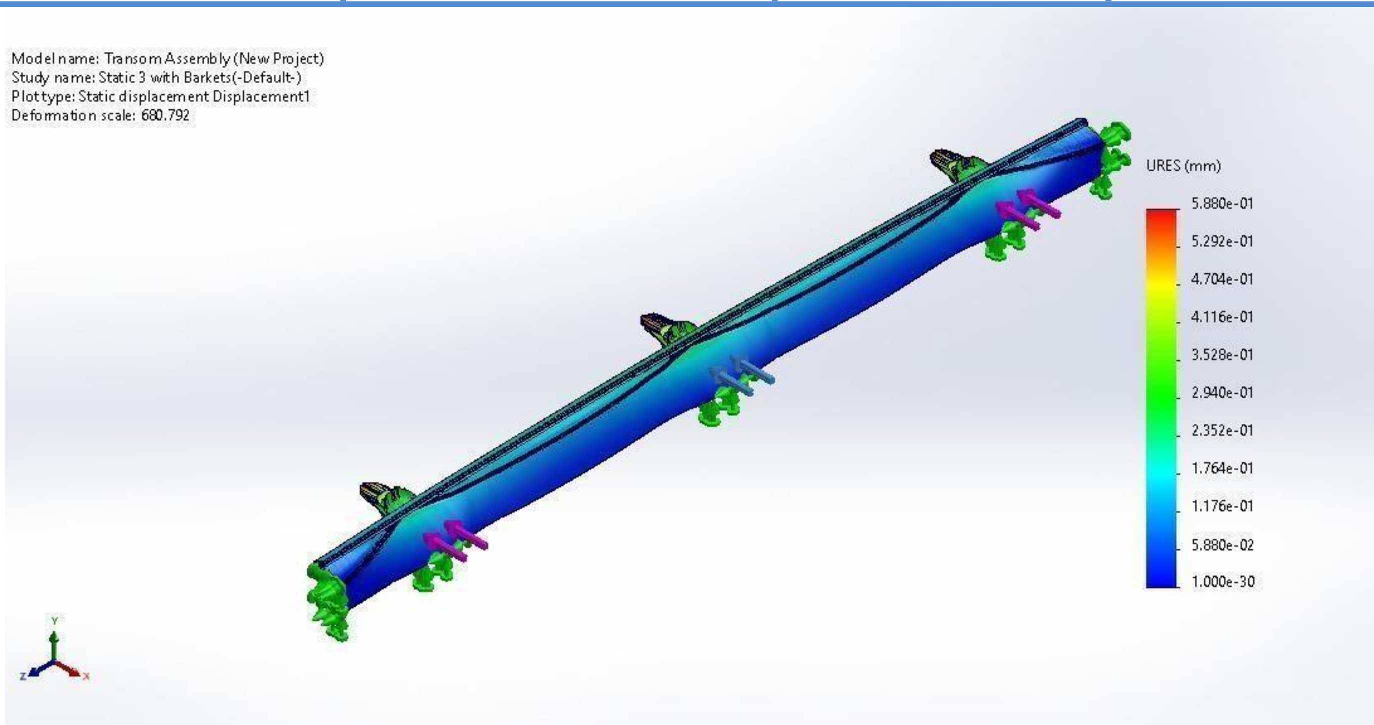
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	4.721e-02N/m^2 Node: 351585	1.715e+08N/m^2 Node: 2293711



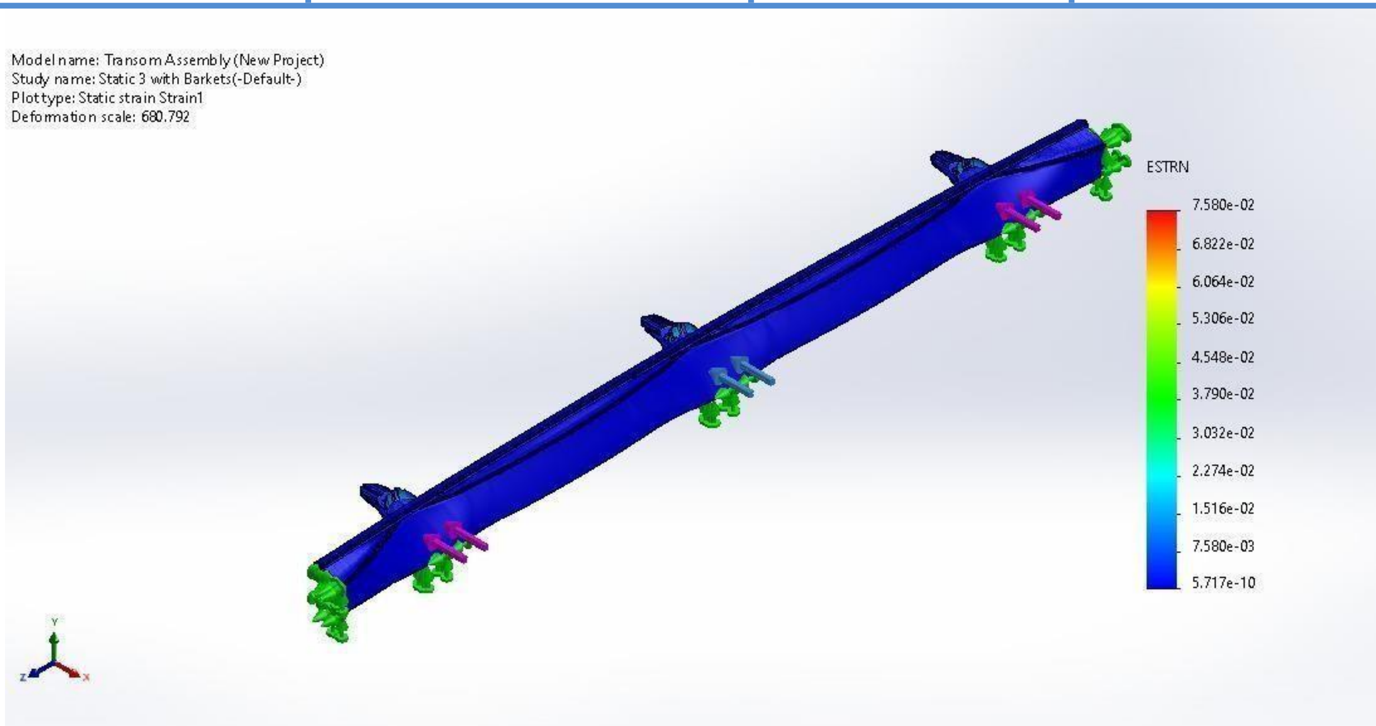
Transom Assembly (New Project)-Static 3 with Barkets-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 1868728	5.880e-01mm Node: 667486



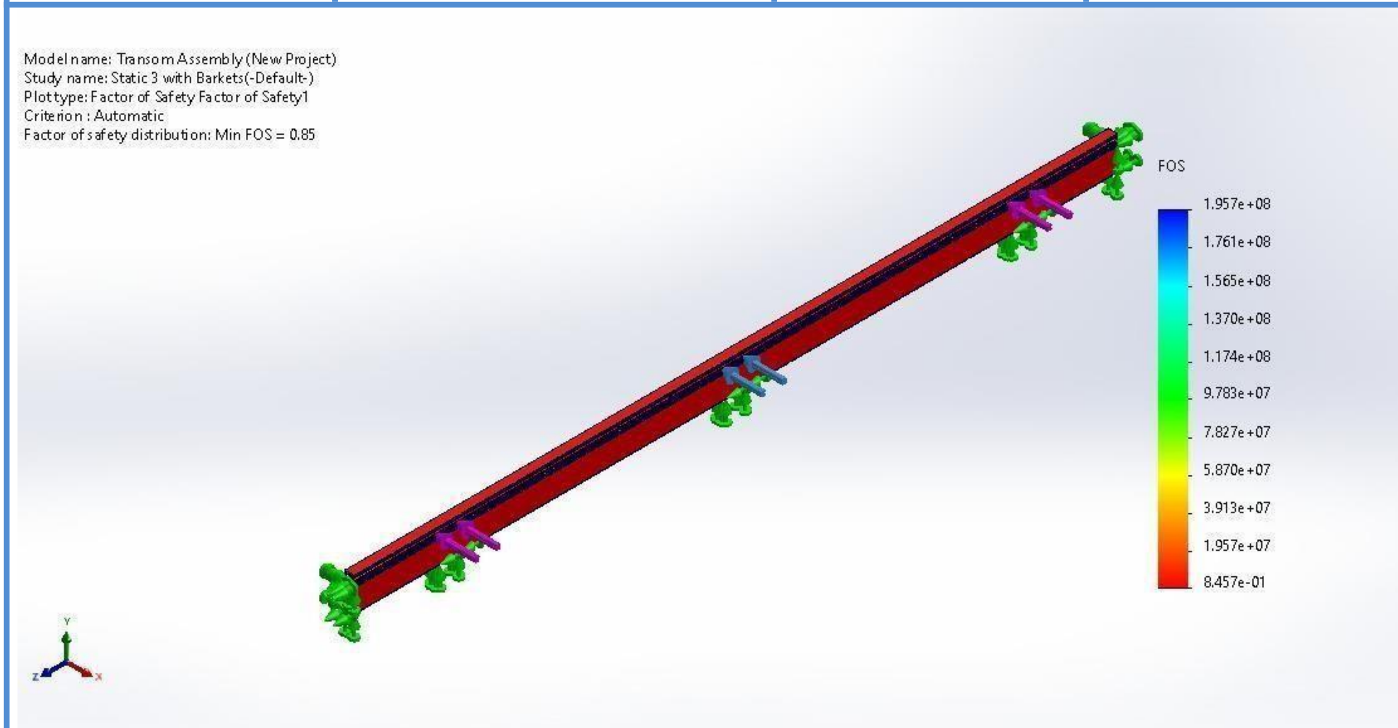
Transom Assembly (New Project)-Static 3 with Barkets-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	5.717e-10 Element: 355657	7.580e-02 Element: 286554

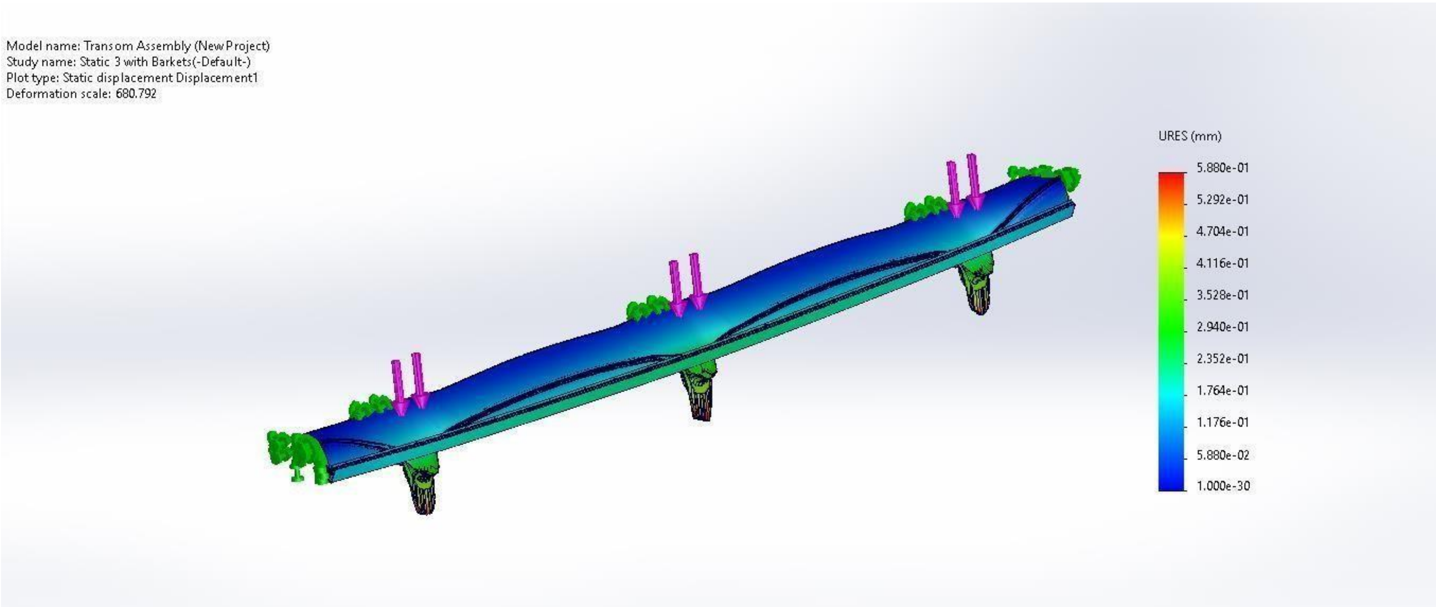


Transom Assembly (New Project)-Static 3 with Barkets-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	8.457e-01 Node: 2293711	1.957e+08 Node: 351585



Transom Assembly (New Project)-Static 3 with Barkets-Factor of Safety-Factor of Safety1



Conclusion

The transom assembly design provides sufficient structural integrity under the specified loading conditions. However, the observed minimum factor of safety (0.8457) suggests that certain regions might require reinforcement to prevent potential failure, especially if subjected to higher-than-expected forces or dynamic loads.

To improve the design:

1. Reinforce critical areas where the stress approaches or exceeds the material's yield strength.
2. Consider using materials with higher yield strength for critical components.
3. Perform further analysis for dynamic loading conditions or varying environmental impacts.

5S METHODOLOGY

The 5S methodology is a systematic approach to workplace organization aimed at improving efficiency, productivity, and safety. It involves five key steps:

1. Sort (Seiri):

Unnecessary items are identified and removed from the workspace, leaving only essential materials. This reduces clutter and ensures efficient use of space.

2. Set in Order (Seiton):

Tools, equipment, and materials are organized systematically, with everything assigned a designated place for easy access. This step minimizes time spent searching for items and streamlines workflows.

3. Shine (Seiso):

The workplace is thoroughly cleaned and regularly maintained. This not only ensures a safe and healthy environment but also helps identify potential issues early, such as equipment malfunctions.

4. Standardize (Seiketsu):

Clear procedures and guidelines are established to maintain the first three steps. This standardization fosters consistency and ensures smooth operations across teams.

5. Sustain (Shitsuke):

Continuous discipline is developed to embed the 5S practices into the workplace culture. Regular audits and employee training help sustain improvements over time.

Significance of 5S in Operations

By implementing the 5S methodology, organizations benefit from increased productivity, improved safety, reduced waste, and streamlined processes. It encourages a culture of continuous improvement and ensures that workspaces remain efficient and organized.

LEAN WASTAGES

Lean manufacturing identifies seven types of waste (Muda) that hinder efficiency, increase costs, and reduce value for customers. These wastes are as follows:

1. Transportation Waste:

Unnecessary movement of materials, products, or tools between processes or locations. For example, excessive handling of raw materials due to poor facility layout leads to delays, increased costs, and potential damage. Reducing transportation waste involves streamlining workflows and improving layouts to ensure materials are where they are needed.

2. Inventory Waste:

This involves keeping excess raw materials, work-in-progress, or finished goods that are not immediately required. Overstocking due to poor demand forecasting or fear of shortages ties up capital and consumes storage space, risking damage or obsolescence. Just-in-Time (JIT) systems help reduce inventory waste.

3. Motion Waste:

Unnecessary movements by workers, such as walking, bending, or searching for tools, consume time and increase fatigue. For instance, if workers must walk long distances to access tools or materials, it slows productivity. This waste can be minimized through ergonomic workspace design and better tool placement.

.4-**Waiting Waste:**

This refers to idle time when workers or machines are not actively engaged due to delays, such as material shortages, bottlenecks, or unbalanced workloads. For example, workers waiting for approvals or machine repairs impacts overall productivity. This waste can be reduced by improving scheduling, maintenance, and resource planning.

4. Overproduction Waste:

Producing more than is needed or manufacturing too early creates surplus inventory and increases storage costs. For example, making products without confirmed orders leads to unnecessary resource usage.
Implementing pull-based systems and producing based on actual demand reduces this waste.

5. Over-processing Waste:
Performing more work or using higher-quality materials than necessary. For example, over-polishing a surface or using unnecessary finishing processes that do not add value for the customer leads to over processing waste. Identifying customer requirements and eliminating redundant processes can address this issue.

6. Defects Waste:
Errors in products that require rework, repairs, or scrapping. Poor-quality control or improper procedures often cause defects. For example, a defect in aluminum frames during gasket installation may lead to material wastage and production delays. Robust quality assurance and poka-yoke (error- proofing) mechanisms help reduce defect waste.

7. Non-Utilized Talent (Skills Waste):

Failing to utilize the full potential of employees is a significant form of waste. For example, assigning skilled workers to repetitive tasks that do not use their expertise or failing to involve employees in problem-solving processes under utilizes their abilities. Encouraging employee participation, providing training, and delegating tasks aligned with their skills can mitigate this waste.

Importance of lean wastages

By systematically identifying and addressing these eight wastes, organizations can optimize processes, reduce costs, improve productivity, and enhance employee engagement. During my internship at ALCOP, we observed and tackled these wastes in various processes. For example, we reduced transportation waste by improving layout design and addressed defects waste by ensuring proper quality checks during gasket installation. Additionally, we identified skills waste by recommending better task alignment to utilize the expertise of skilled workers effectively. These efforts contributed to a leaner, more efficient manufacturing process.

IMPLEMENTATION OF 5S METHODOLOGY TO OVERCOME LEAN WASTAGES & BOTTLE NECKS IN ALCOP INDUSTRY

Problems Identified:

- Excess material and scrap occupying space.
- Disorganized storage of tools , equipment and raw materials
- Equipment and hardware delivered early or late, causing unnecessary storage space and delays.

5S Implementation

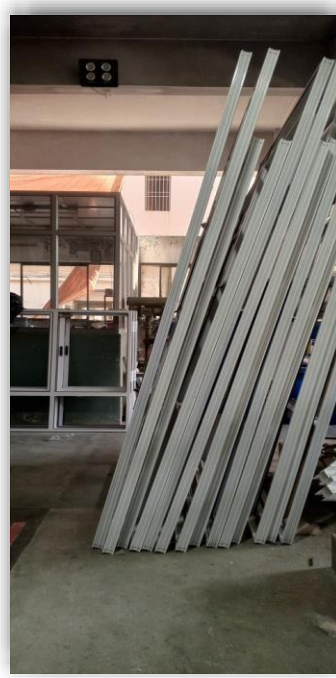
1. **Sort (Seiri):** Remove unnecessary materials, dispose of scrap, and purge excess inventory.
2. **Set in Order (Seiton):** Designate storage areas, label, and organize materials and tools for easy access.
3. **Shine (Seiso):** Clean and maintain inventory areas, and perform regular equipment maintenance.
4. **Standardize (Seiketsu):** Implement SOPs, use visual management, and standardize storage and inventory practices.
5. **Sustain (Shitsuke)**: Regularly review and maintain practices, and train staff on 5S principles.

MOTION AND TRANSPORATION

Problems Identified:

Assemblies and semi-assemblies placed far apart, causing unnecessary movement.

Lack of a standard material and process flow path.



5S Implementation

1. **Sort (Seiri):** Eliminate unnecessary movements by streamlining workspace layout.
2. **Set in Order (Seiton):** Arrange workstations and materials to minimize distance and optimize material flow.
3. **Shine (Seiso):** Clean and organize walkways and aisles, and keep the workspace tidy.
4. **Standardize (Seiketsu):** Implement standardized layout and visual cues for optimal paths and routes.
5. **Sustain (Shitsuke):** Conduct regular audits and reinforce motion efficiency in training and communications.

EXTRA PROCESS

Problems Identified:

- Repeated measurements of the same dimensions.
- Use of improper equipment for measurements.
- Excessively running machines and measuring simultaneously, wasting time.

5S Implementation

1. **Sort (Seiri):** Eliminate unnecessary movements by streamlining workspace layout.
2. **Set in Order (Seiton):** Arrange workstations and materials to minimize distance and optimize material flow.
3. **Shine (Seiso):** Clean and organize walkways and aisles, and keep the workspace tidy.
4. **Standardize (Seiketsu):** Implement standardized layout and visual cues for optimal paths and routes.
5. **Sustain (Shitsuke):** Conduct regular audits and reinforce motion efficiency in training and communications**.**

WAITING

Problems Identified:

- Workers waiting for equipment and materials.
- Excessive idle time due to absent workers or inefficiencies especially in packing and fabrication.

5S Implementation

1- Sort (Sealth)

1. Identify areas with waiting times
2. Analyze root causes (equipment, materials, labor)
3. Eliminate unnecessary delays and Waste

2- Set in Order (Seiton)

1. Implement just-in-time delivery of materials and equipment
2. Organize workstations for efficient workflow
3. Designate areas for inventory and supplies

1- Shine (Seiso)

1. Regularly clean and maintain equipment and workstations
2. Perform routine checks on tools and materials
3. Ensure all necessary items are readily available

2- Standardize (Seiketsu)

1. Develop standardized inventory management processes
2. Implement reliable tracking systems for materials and equipment
3. Establish worker scheduling to ensure adequate coverage

3- Sustain (Shitsuke)

1. Regularly review waiting times to ensure improvements
2. Continuously monitor workflows to identify bottlenecks
3. Provide ongoing training and feedback to maintain efficiency gains

DEFECTS

Problems Identified:

- Measurements not taken properly, leading to defects.
- Lack of an inspection process, leading to unchecked defects in the product.

5S Implementation

1- Sort (Seiri)

1. Remove defective materials/components from production area
2. Eliminate steps increasing defect likelihood in production process
3. Identify and purge unnecessary inventory to reduce waste
4. Separate essential from non-essential items

2. Set in Order (Seiton)

1. Organize inspection areas and tools for efficient use
2. Ensure easy access to quality control tools and documentation
3. Designate areas for inspection, testing, and storage
4. Label and sign inspection areas for clarity

3. Shine (Seiso)

1. Clean inspection tools regularly to prevent contamination
2. Prevent contamination at workstations through cleaning and organization

3. Maintain equipment calibration to ensure accuracy

4. Schedule regular maintenance for inspection equipment

4. Standardize (Seiketsu)

1. Develop clear inspection criteria and procedures

2. Implement visual quality indicators (e.g., color-coded tags)

3. Establish quality control checklists for inspections

4. Develop standardized documentation for inspection results

5. **Sustain (Shitsuke)**

1. Conduct regular audits and training for quality control

2. Foster a culture of quality and defect prevention

OVERPRODUCTION

Problems Identified:

Excess products in inventory due to improper measurement

Repeated assembly due to inaccurate or poorly measured parts

5S Implementation

1- Sort (Seiri)

Define production requirements based on actual demand
Identify and remove redundant processes causing overproduction

2- Set in Order (Seiton)

1. Align production schedules with real-time demand

2- Designate the areas for finished goods to prevents inventory overflow

3- Shine (Seiso)

1. Maintain a clean production area
2. Regularly maintain equipment to prevent defects

4-Standardize (Seiketsu)

3. Establish standardized production processes based on demand forecasts
4. Implement Kanban or pull-based systems to control production flow

5-Sustain (Shitsuke)

5. Conduct regular reviews to ensure production aligns with demand
6. Foster a lean thinking culture, training workers to produce only what's needed

CONCLUSION

Our internship at ALCOP was a transformative experience that provided us with in-depth exposure to aluminum manufacturing and window production. It enabled us to bridge the gap between theoretical learning and real-world industrial applications, significantly enhancing our technical, analytical, and managerial skills.

A key highlight of our internship was the comprehensive involvement in inventory management processes. We conducted cycle counting to ensure inventory accuracy and reliability, a critical step in maintaining smooth operations and minimizing discrepancies. We performed detailed data entry for returned materials, ensuring precise record-keeping to streamline re-usability and stock management.

Additionally, we undertook marking and tagging of inventory items, which enhanced traceability and improved organization within the warehouse. Another innovative task we executed was attaching pockets for identification cards on inventory items, simplifying tracking and access while promoting efficiency in handling materials. These activities gave us a hands-on understanding of inventory control systems, emphasizing accuracy, traceability, and cost-effectiveness.

Beyond inventory management, we gained valuable practical experience in various manufacturing processes. Tasks such as drilling, riveting, gasket installation, and packing enabled us to develop essential technical skills while contributing to production workflows.

Conducting stress analyses on aluminum frames and glass panels further honed our problem-solving and analytical capabilities. We also had the opportunity to propose innovative solutions, such as advanced cleaning methods for curtain walls and strategies for reducing net wastage, which aligned with lean manufacturing principles.

The application of methodologies like 5S workplace organization, production layout optimization, and the analysis of lean waste strengthened our understanding of process improvement and industrial efficiency. Collaborating with industry professionals provided us with critical insights into the challenges and dynamics of real-world manufacturing operations, sharpening our communication and teamwork abilities.

Overall, this internship equipped us with both theoretical insights and practical expertise in a dynamic industrial environment. It not only broadened our knowledge of aluminum manufacturing but also instilled a deep appreciation for efficiency, sustainability, and innovation. The skills and experiences we gained will undoubtedly serve as a strong foundation for our future endeavors in manufacturing, process optimization, and industrial management.