University of Southern Indiana
Pott College of Science, Engineering, and Education
Engineering Department

8600 University Boulevard
Evansville, Indiana 47712

Space and Storage Optimization of Gribbins Scaffolding

Jackson Wendel
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ACKNOWLEDGEMENTS

- In this section, we would like to acknowledge the Gribbins Scaffolding team for all the insight and assistance with this Project. I also would like to thank Dr. Ely, Dr. Kuban, Jamie Curry and all my USI professors for all their hard work and guidance through my time here at USI. This project would not have been possible without everyone's help, thank you.

ABSTRACT

The project undertaken at Gribbins Insulation & Scaffolding aimed to enhance operational efficiency and resource utilization. Through a strategic redesign of the warehouse layout, including dedicated sections for material staging and lumber storage, the project sought to streamline processes. The meticulous planning involved a Failure Mode and Effects Analysis (FMEA) to anticipate and address potential issues.

While facing challenges such as interruptions due to other projects and the need to clean out the warehouse space, the implementation phase stayed on schedule. Leveraging existing resources minimized costs, contributing to an impressive return on investment. Gribbins Management estimates a 30% increase in material procurement speed and a threefold extension of lumber lifespan, translating to over $10,000 in quarterly savings.

Reflecting on the project, there is recognition of the need for a clearer scope definition from the project's outset. A recommendation is made for a formalized meeting with management during the initial stages to align expectations and establish a comprehensive understanding of the project's scope. This holistic approach to project management not only ensures operational improvements and financial benefits but also underscores the importance of proactive communication and strategic planning.

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SPACE AND STORAGE OPTIMIZATION OF GRIBBINS SCAFFOLDING

1 INTRODUCTION

The overarching objective of this endeavor is to maximize the utility of the existing storage space, enabling the accommodation of larger inventory volumes while concurrently improving organizational efficiency. It is imperative that the new system has to enhance the flow of inventory for Gribbins Insulation & Scaffolding.

In 2021, Gribbins Insulation launched a scaffolding division, and over the course of the past year, this division has exhibited exponential growth. This expansion has prompted an immediate requirement for the upgrading of the current storage facility. In response to this imperative, I have been tasked with collaborating alongside project managers to formulate innovative storage strategies and to reconfigure the layouts of both the warehouse and scaffolding yard.

The design I formulated had to follow design constraints set up by the Gribbins Scaffolding Team. My design also had to be compliant with all OSHA Regulations & Standards. It is these factors that truly shaped the entire process of not only designing the system, but also the implementation of said system. My design focuses on two main factors. Number one is storage optimization, and number two is space optimization. This means that not only does the system hold all parts but also works coherently with current business practices set by Gribbins Insulation and Scaffolding.

2 GRIBBINS BACKGROUND

Founded in 1985, Gribbins Insulation is a commercial and industrial mechanical insulation and scaffolding contractor serving the Midwestern United States. Since then, Gribbins Insulation has expanded into Gribbins Specialty Group with an array of different companies under its umbrella. The company I worked with is Gribbins Insulation & Scaffolding. This company deals with mechanical insulation on commercial and industrial systems.

After 36 years of offering only mechanical insulation services, Gribbins now offers scaffolding services. Due to customer requests, Gribbins decided to fully invest in scaffolding by purchasing scaffold, and industry-specific software used for inventory control, scaffold

design, and estimating. Since the addition of the scaffolding division the growth has well exceeded expectations.

I started a Construction Management Internship with Gribbins in November 2022. In that time, I not only learned the in's and out's of mechanical insulation, but also estimation, and management practices. Since then, I have accepted a full-time job offer to be a project manager/estimator for Gribbins Insulation & Scaffolding.

Figure 2.1: Gribbins Specialty Group Diagram

3 SYSTEM DESIGN

Being that this system required me to develop an overhead layout of the facility, I decided to use AutoCAD to build my design. I felt that this was the best choice, because the software offers a user-friendly yet flexible program that made making changes to the design simplistic. The layouts were created mostly using the block function which made it easy to move different parts around to find the best fit.

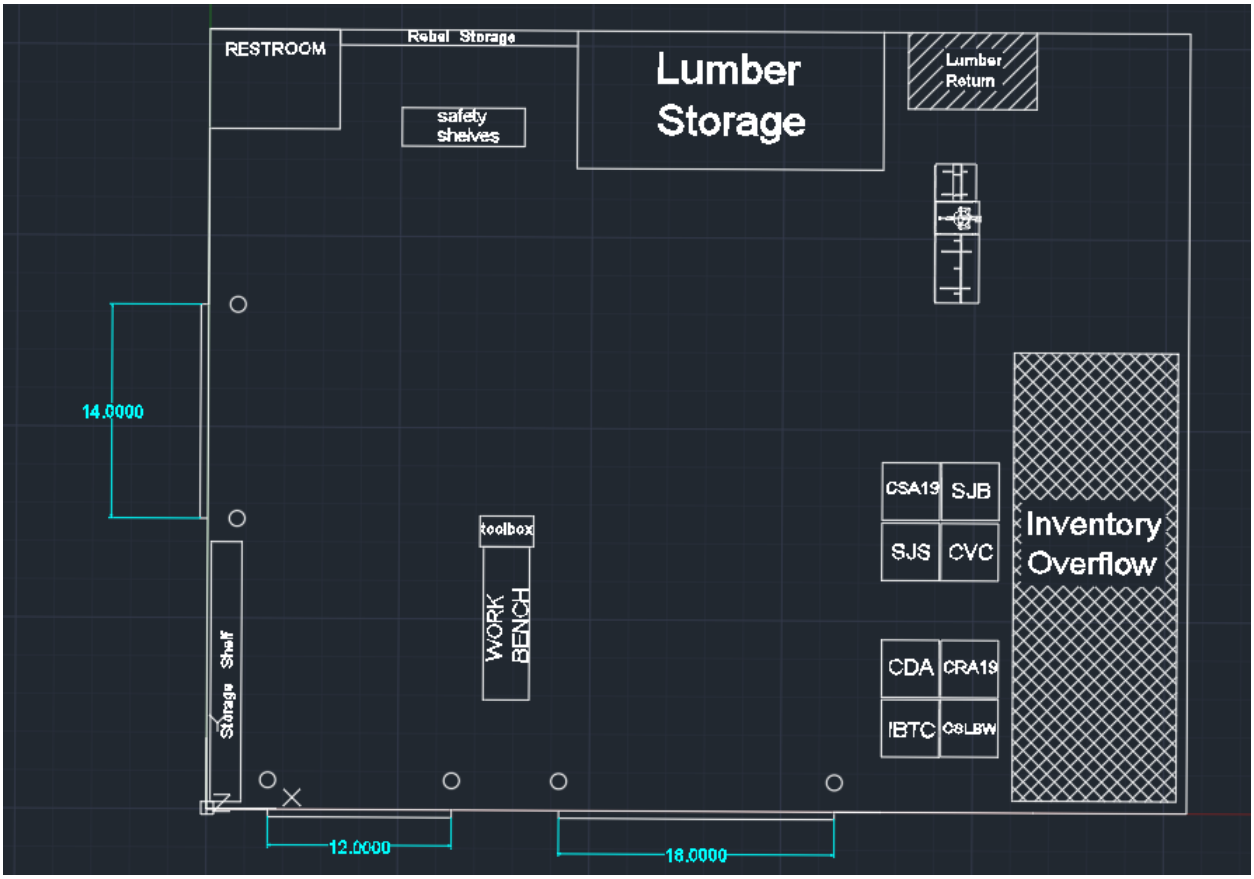

Figure 3.1: Warehouse Design

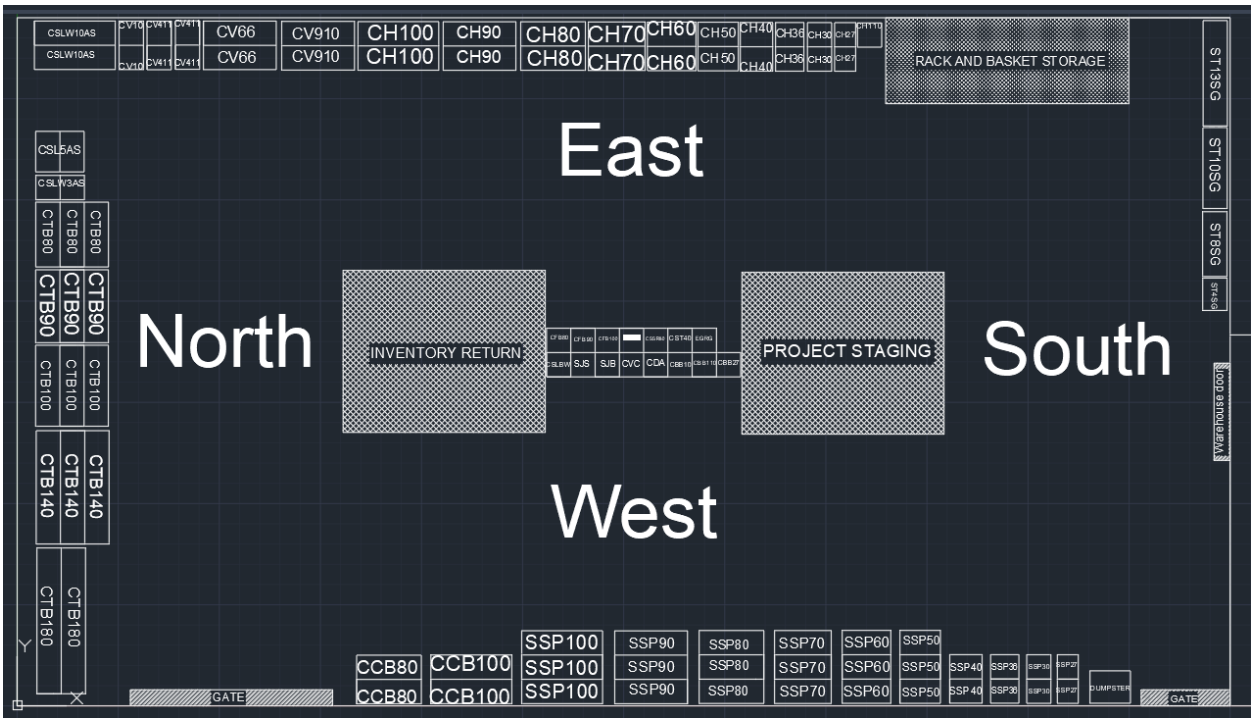

Figure 3.2: Yard Design

3.1 SECTIONS OF WAREHOUSE

Before this project, we used to store lumber outside in the yard without any cover, causing problems like mold and rot, which significantly reduced its usability. To address this issue, I introduced a dedicated section in the warehouse for lumber storage and fabrication. This change brought several benefits. First, it extended the lifespan of the lumber by three times. Additionally, organizing the lumber by size made it easier to find, speeding up the material procurement process. Notably, the lumber rack shown in Figure 3.3 was built in-house using scaffolding parts, showcasing a collaborative and resourceful approach within our organization.

Figure 3.3: Lumber Storage and Fabrication Section

In the earlier facility setup, workers encountered persistent issues finding their Personal Protective Equipment (PPE) as it was scattered unpredictably throughout the warehouse. This inconsistency not only prolonged the time it took for workers to access essential gear but also impeded efficient inventory management. To rectify these challenges, I implemented a solution by designating a specific area in the warehouse exclusively for PPE and safety equipment. Figure 3.4 visually represents this intervention through a cost-effective shelf constructed using recycled lumber and tools already in possession. This strategic approach not only streamlined accessibility for workers but also demonstrated a resourceful and sustainable utilization of available resources.

Figure 3.4: Safety Equipment Shelf

The next section I added to warehouse serves the purpose of storing the retractable lanyards. I wanted to give a clear space, so this important piece of safety equipment is easily accessible. I decided to hang these on the wall behind the safety equipment shelf. By the retractable being stored on the wall, I am saving a lot of physical space in the warehouse ("Warehouse Management PDF" 25). They are stored next to the safety equipment shelf to put all PPE and safety equipment in the same location to help make them easy to find and eliminate confusion.

Figure 3.5: Retractable Lanyard Storage

The warehouse encompasses a designated basket storage section, specifically designed for smaller scaffolding components, predominantly comprising an assortment of clamps and braces. Ensuring ample space for inventory fluctuations in this section was paramount ("Storage of Scaffolding Components" 25). Figure 3.6 visually shows this feature, revealing considerable room behind the baskets to accommodate inventory overflow. This arrangement aligns with the

logistical sequence, as these smaller scaffolding parts are typically packed atop larger counterparts and loaded last. The rationale behind this proximity to the garage door is rooted in optimizing the efficiency of the loading process, ensuring a seamless transition from storage to transportation ("Warehouse Management PDF" 25).

Figure 3.6: Basket Storage Section

3.2 SECTIONS OF YARD

The yard has been divided into four distinct sections; these sections include North, South, East, and West, serving as aids for comparison with the AutoCAD design. The rationale behind this organizational framework is explained in section 3.3, titled "Design Restrictions," wherein various constraints and considerations guided the focused optimization of the yard's current configuration.

This new layout is oriented towards optimizing the flow of inventory for Gribbins Scaffolding, resulting in improved operational efficiency. The movement of materials from the yard to job sites has significantly reduced overall job duration. Noteworthy features embedded in the design contribute to this streamlined process. At the center of the yard, two dedicated sections for material return and material staging have been positioned at each end. This configuration mitigates the risk of workers inadvertently storing parts intended for job sites, therefor enhancing precision in inventory management.

Furthermore, the yard's design facilitates the retrieval of scaffolding parts in an order opposite to their assembly sequence. This deliberate arrangement expedites the scaffolding construction process, as the top of the rack houses parts needed first, while the bottom contains those required last. This systematic approach not only improves the efficiency of scaffolding assembly but also underscores the meticulous consideration given to the logistical intricacies of material flow within the yard ("Storage of Scaffolding Components" 25).

Figure 3.7: West Section of Yard

Figure 3.8: East Section of Yard

Figure 3.9: South Section of Yard

Figure 3.10: North Section of Yard

Figure 3.11: Project staging Section of Yard

Figure 3.12: Inventory Return Section of Yard

3.3 DESIGN RESTRICTIONS AND CONSTRAINTS

In any project it is important to understand what your restrictions and constraints are, for these are what shape your solution. Some of these restrictions and constraints came from Gribbins management and some come from different standards from governing organizations. All of this must be considered and must be shown in your design. I have listed below some of the specific design criteria below in Figure 3.13. To help keep me organized I made a table of the requirement specifications to layout some of the rules I needed to follow to deliver a well-organized and efficient product. In every project, understanding the limitations and guidelines is crucial, as they define the parameters of the solution. Some restrictions come from Gribbins management, while others stem from industry standards. To ensure an organized and efficient outcome, it's important to consider and thoughtfully incorporate these factors into the design. To stay organized, I outlined the rules I needed to follow in the project as seen in Figure 3.14.

- The warehouse must be OSHA Compliant.
- The layout must work well with the flow of inventory.
- The warehouse needs to have a saw station to cut lumber to size.
- The yard and warehouse need to be forklift accessible.
- The yard must be pickup truck accessible.
- There must be sections for overflow stock to combat the high fluctuation of inventory.
- The warehouse must include an area to store all safety equipment and PPE to make it easily accessible to workers.
- Design must not use more than half of the warehouse.
- Gribbins set a deadline of October 2023.
- The yard needs an area for material return and material staging.

Figure 3.13: Specific Design Criteria

	Requirement Specification	System/ Subsystem Impacted	Technical Performance Measure
1	All racks & baskets can not be stacked more than 4 high.	The storage of all parts in the facility.	OSHA Standard 1926:759 All materials, equipment, and tools, which are not in use while aloft, shall be secured against accidental displacement.
2	Aisle ways must have clear path for forklift and Pickup truck to operate.	This impacts the overal layout of the facility.	OSHA Standard 1920:144 states that aisle ways must be at least 12 ft wide to operate forktruck.
3	All walkways must be free of all obstructions.	This Impacts the overall organization of the facility.	OSHA Standard 1926:34 states means of egress shall be continually maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.
4	Walk ways must comply with OSHA Standard 1910:37	This impacts the spacing of material in the warehouse.	Osha standard 1910: 37 states that walk ways must be at least 18" wide.
4	The yard must include a section for material return and material staging.	This impacts the staging & material return sections.	The yard will have two sections one for material return and the other for staging.
5	Warehouse Must be able to store all smaller scaffolding parts that are kept in baskets.	The basket section of warehouse.	All Items stored in a basket are stored in the warehouse and not the yard.
6	The parts should be organized in the reverse order that scaffolding is built.	The entire layout of the yard.	The parts are organized in reserve order that scaffolding is built for ease of acess when building scafollding.

Figure 3.14: Requirement Specification (Occupational Safety and Health Administration 25)

I performed a Failure Mode and Effects Analysis (FMEA) for my project. This analysis serves the purpose of anticipating potential issues in the system. FMEA not only aids in predicting shortcomings or accidents but also systematically ranks them in terms of importance, providing clarity on where to focus attention. The FMEA I conducted played a significant role in shaping the coordination of my system with the overall process. Additionally, it guided the identification of necessary safety measures for implementation.

Process Function	Poetential Failure Mode	Poetential Effect of Failure	Severity	Potential Failure cause	Occurance	Current Process Controls	Detectio n	RPN	Action
Workers can not find the correct PPE in the warehouse.	Workers do not have the corect PPE whie building the scaffolding.	Workers could get injured while building the scafoldding.	7	The PPE is hard to find and not in the right space in the warehouse.	6	PPE could be found in multiple different spots over time in the warehouse.	3	126	I built a designated shelf for all PPE to be stored.
Warehouse and yard cleanliness	Workers can slip or trip on spills and floor obstructions.	This can injure the workers.	5	Oil spills, ice in yard, onstructions on floor	8	Pro therm supply workers are responsible for keeping area clean along with many other responsibilties.	3	120	Gribbins Hired a Scaffolding superintendent to make sure area is clean and safe.
Workers put away parts that are meant for new job.	The workers confuse returned material, and material for new job.	The material has to be repicked wasting time and money.	3	Different workers are working in the yard and warehouse on different days and not communicating.	10	There is little to nothing in place to fix this issue.	3	90	The new yard design has two areas designited for returned racks and order procurement to stop the confussion.
Storage of materials	A rack or basket tips over.	Damages the material or seriously injured worker.	8	Improperly stacked baskets or racks.	3	Workers stack racks and baskets using a fork truck.	2	48	Scaffolding manager has frequent walkthroughs of facility, and thurough training for new hires.

Figure 3.14: FMEA

4 IMPLEMENTATION

The implementation phase of my project, which involved a substantial amount of physical labor and careful planning, ended up taking more time than initially anticipated. This extended timeline can be attributed to factors such as being assigned to other projects midway through implementation and the prerequisite task of cleaning out the warehouse space before placing the parts. Even with these challenges, I successfully adhered to the schedule and brought the project to completion with commendable efficiency. It is worth noting that, despite the interruptions posed by other project assignments, I managed to keep costs minimal for the company, demonstrating effective project management in a dynamic work environment.

4.1 PREPARATION

The warehouse before I implemented my design was similar to a large attic. The area was used for storage of a variety of different construction equipment, the shear amount of equipment made it difficult to be organized. To prep the space for implementation of my new design I used the fork truck to move equipment to one side of the warehouse and organized all the lumber by size. I also organized the smaller scaffolding parts into baskets.

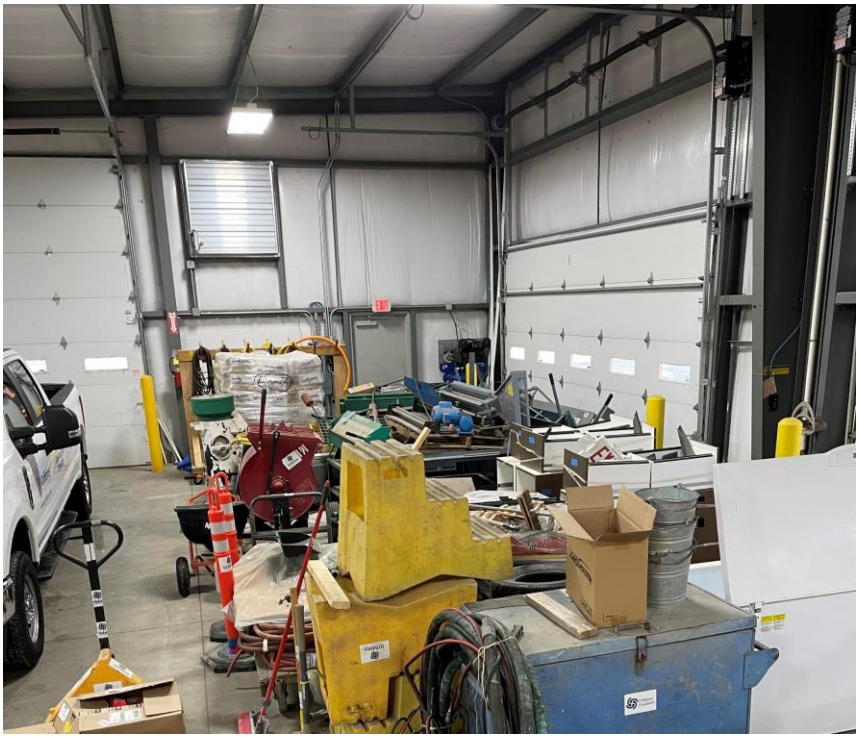

Figure 4.1: Before state of warehouse

Figure 4.2: Warehouse Prep 1

Figure 4.3: Warehouse Prep 2

4.2 SCHEDULE

This schedule was made in the beginning stages of the project in pre-senior design. It was important to think about every single aspect of my project's scope to make a schedule. It was a challenge estimating how long I felt each aspect of my project will take from start to completion of each individual task. Once I felt I had a good grasp on this I took the schedule to Gribbins Management to get it approved.

Figure 4.4: Project Schedule

5 ECONOMIC CONSIDERATIONS

Although I wasn't given a specific budget by Gribbins Management for this project, the costs incurred were remarkably low. This is mainly because of the extensive resources already available at Gribbins Insulation & Scaffolding. By making use of these existing resources, the project not only remained cost-effective but also yielded a considerably greater return on investment. This strategic utilization of in-house resources highlights the efficiency of the project, showcasing the inherent value derived from tapping into the abundant resources within the company.

5.1 ECONOMIC IMPACT

The changes made to material procurement have significantly accelerated the process, according to Gribbins management, estimating an impressive 30% reduction in the time it takes to acquire materials for jobs. Additionally, the extension of lumber lifespan to three times longer is proving to be a substantial improvement. This not only translates to cost savings but also reflects a more efficient utilization of resources for each job undertaken by Gribbins.

5.2 RETURN ON INVESTMENT

In terms of the project's impact, Gribbins management has quantified the savings at over $10,000 every quarter. This financial benefit underscores the tangible and substantial positive outcomes resulting from the strategic initiatives and optimizations implemented during the project. These improvements not only enhance operational efficiency but also contribute significantly to Gribbins' bottom line.

6 CONCLUSIONS AND RECOMMENDATIONS

In summary, the project at Gribbins Insulation & Scaffolding has resulted in significant improvements across various aspects of the operation. From redesigning the warehouse layout to strategically allocating sections for specific purposes, such as lumber storage and material staging, the project has streamlined processes and made the overall workflow more efficient.

By foreseeing potential issues through a Failure Mode and Effects Analysis (FMEA) and addressing design restrictions, the project has created a safer and more organized work environment. The smart use of in-house resources has demonstrated prudent project management, resulting in substantial financial savings and an impressive return on investment.

Gribbins Management's estimations of a 30% increase in material procurement speed and the ability to use lumber three times longer showcase tangible improvements. The quarterly savings exceeding $10,000 underscore the project's success in delivering both operational enhancements and financial benefits.

In essence, the project exemplifies the positive impact of strategic planning, resource optimization, and a commitment to safety protocols. It not only addresses specific operational needs but also reflects a dedication to ongoing improvement and fiscal responsibility within Gribbins Insulation & Scaffolding.

6.2 FUTURE RECOMMENDATIONS

Looking back, I realize the importance of making the project scope clear from the start. To achieve this, I would hold a formal meeting with management in the early stages of the project. This meeting would help align expectations, define project objectives, and ensure everyone has a clear understanding of the scope. By promoting clear communication and addressing potential misunderstandings early on, we can streamline the project and ensure everyone involved shares the same vision and goals. This proactive approach would contribute to a more effective project execution.

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    - Summary of Findings: This document highlights good warehouse practices.
5. "Storage of Scaffolding Components." Aztex.Com, 2013, https://aztex.com.au/blog-articles/storage-of-scaffold-components/. Accessed 5 Nov. 2023.
    - Summary of Findings: This blog highlights good practices for scaffolding storage.

APPENDIX

Appendix A: Gribbins Safety Program Information Link

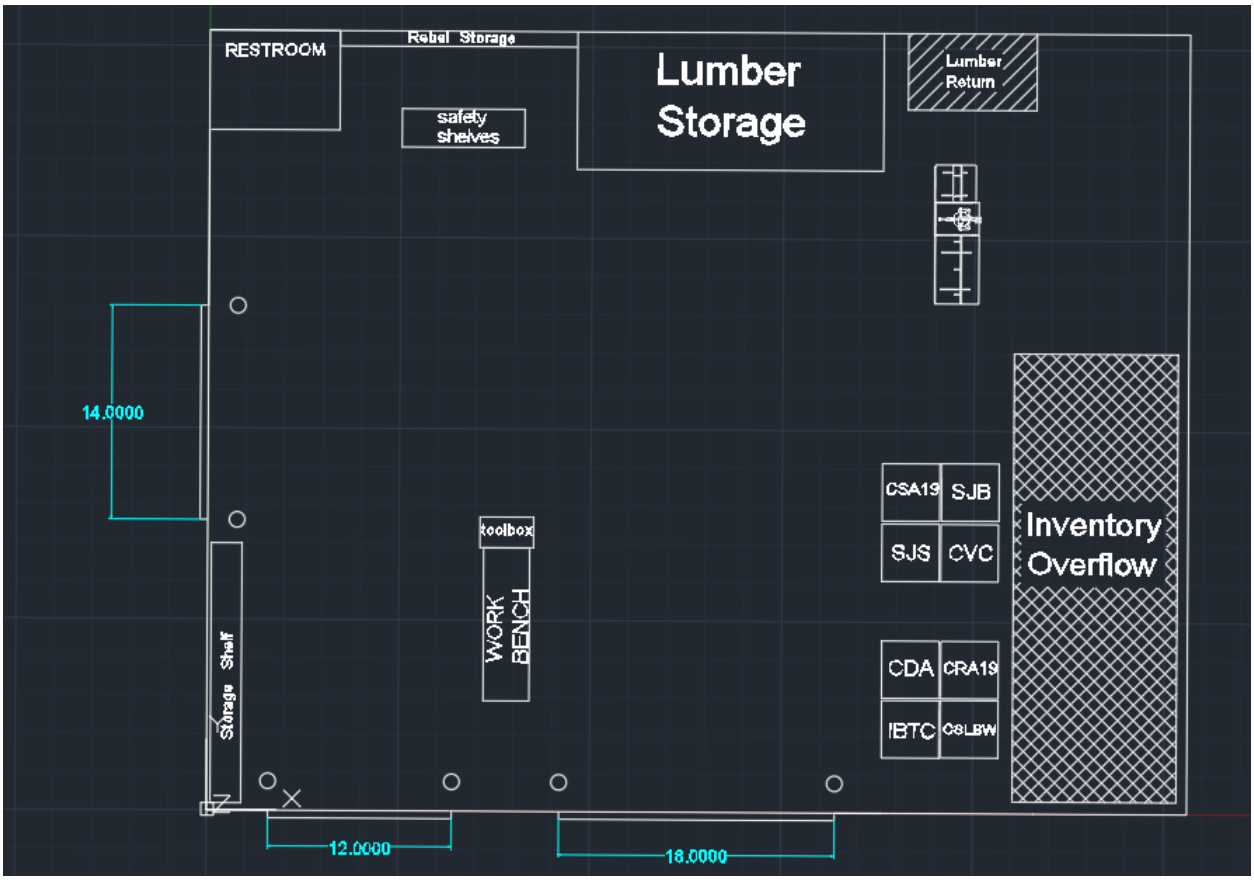
https://www.gribbins.com/safety-program/

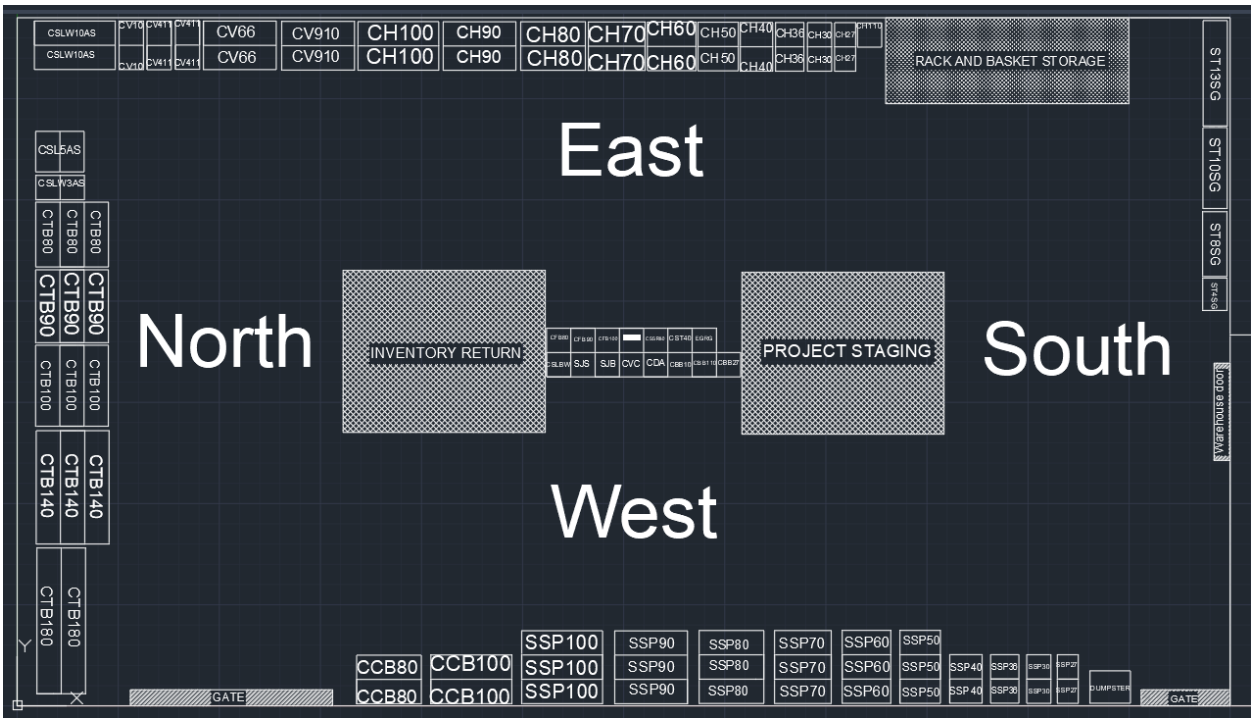
Appendix B: Project Schedule

Appendix C: Bill of Materials

- Auto Cad Software) $0.00
- Recycled 2x4’s 40ft) $0.00
- 2 Recycled Plywood 8’x4’) $0.00
- 3in wood screws 100pcs) $15.00
- Wall hooks 30pcs) $36.00
- Bubble Level) owned by Gribbins.
- Miter saw) owned by Gribbins.
- Circular saw) owned by Gribbins.
- Drill) owned by Gribbins.
- Fork truck) owned by Gribbins.
- Measuring Wheel) owned by Gribbins.
- **Total cost) $51.00**

Appendix D: Drawings





Appendix E: OSHA Standards

	Requirement Specification	System/ Subsystem Impacted	Technical Performance Measure
1	All racks & baskets can not be stacked more than 4 high.	The storage of all parts in the facility.	OSHA Standard 1926:759 All materials, equipment, and tools, which are not in use while aloft, shall be secured against accidental displacement.
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4	Walk ways must comply with OSHA Standard 1910:37	This impacts the spacing of material in the warehouse.	Osha standard 1910: 37 states that walk ways must be at least 18" wide.

Appendix F: ABET Design Factors

Design Factor	Page number, or reason not applicable
Public health safety, and welfare	17
Global	23
Cultural	My project follows Gribbins Insulation and Scaffolding best practices and has been approved with these factors kept in mind.
Social	My project follows Gribbins Insulation and Scaffolding best practices and has been approved with these factors kept in mind.
Environmental	23
Economic	23
Ethical & Professional	My project follows Gribbins Insulation and Scaffolding best practices and has been approved with these factors kept in mind.
Reference for Standards	16

Appendix G: Relevant Coursework

- Tech 103- Cad Fundamentals
- Tech 275- Statistics and Safety in Manufacturing
- IME 315- Process Improvement
- IME 319- Transportation and Logistics
- ENGR 417- Engineering Project Management
- ENGR 482- Engineering Organization and Management