PROJECT REPORT

LIFTING BARS

MODEL: ESL-100-9427

DESIGN ANALYSIS
(DWG: 100-9427)

SERIAL: 169264
DATE: 01/29/2024

03/19/2024

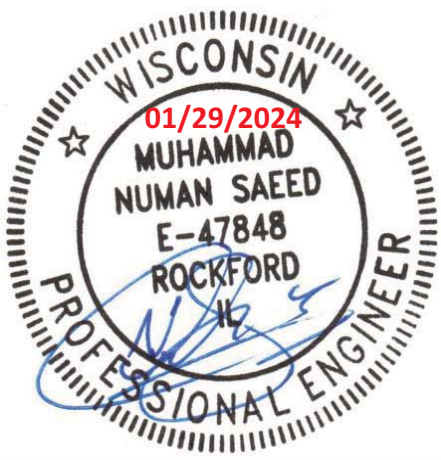

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. PROJECT OVERVIEW

The objective of the project was to review and validate the designed aluminum lifting bars to the design requirements of ASME BTH-1-2020 and ASME B30.20-2021. These bars will be used in a set of 4 to lift a 6,000 lbs. modular container. Loads were applied as required by code and the bars were evaluated for critical stress under operating loads. Traditional analysis through equations as well as computerized simulation such as Finite Element Analysis were used to analyze the structural integrity of the structure for the given capacity. This evaluation is for the structural design requirements of the lifting bars only and does not include any dimensional, operational, construction or inspection requirements in the codes as that is outside the scope of this engineering report. The attached hardware, if any such as shackles, hooks, chains etc. are not reviewed as these are purchased components.

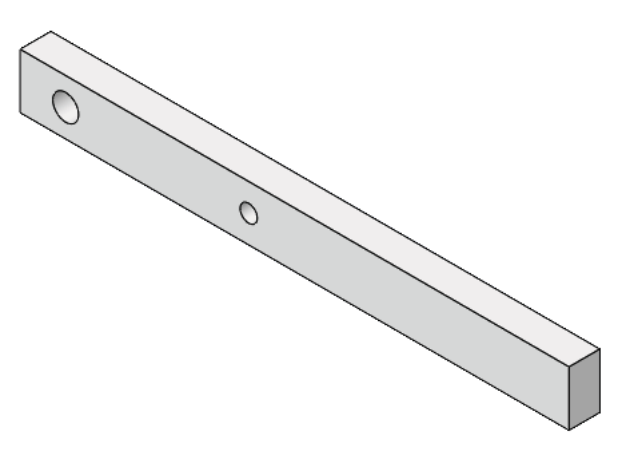

Figure 1: *Isometric view of the lifting bar*

2. DESIGN CODE REQUIREMENTS

Design requirements of ASME BTH-1-2020 and ASME B30.20-2021 were reviewed. Listed below is a summary of the design requirements for the aluminum lifting bars:

1. Lifting Bar reviewed to Design Category B, Service Class 1.
2. Lifting bar is rated for maximum total capacity of 2000 lbs. live load.
3. A total of 4 lifting bars will be used to lift a 6,000 lbs. modular container frame.
4. The design factor on structural components is N_d = 3.00, based on the yield strength of the material.
5. All live loads on the bars applied in a vertical direction and a maximum angle of 15 degrees from the vertical is allowed.
6. The lifting bar is used for material handling only and is not intended for personal handling.

3. MATERIAL PROPERTIES

The lifting bar is fabricated using 6061-T6511 Aluminum material.

***Table 1**: Material Properties in ksi*

Material	Tensile Strength	Yield Strength	Elasticity	Shear Modulus	Shear Strength
6061-T6511	45.0	40.0	10000	3770	30.0

4. LOAD CASES

The geometry used in the evaluation is per Dwg. No: 100-9427. The aluminum bar slides inside of container frame and secured with a 5/8” pin or bolt. A 7/8” shackle with a strap would be used in a 1.13” hole to lift the container using a set of 4 aluminum bars. A Load line with a maximum of 15 degrees is studied for worst case loading.

5. CALCULATIONS

Geometry obtained from the drawing 100-9427 is shown below as well as the standard loading case.

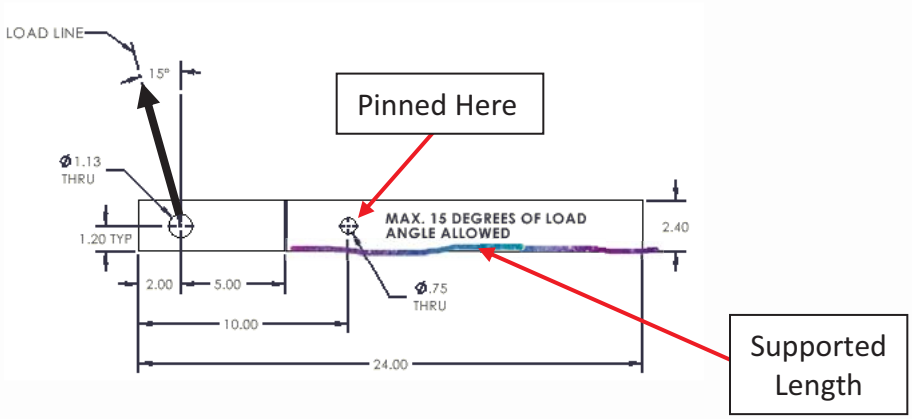

Figure 2: *Front view of aluminum bar with Loading set-up*

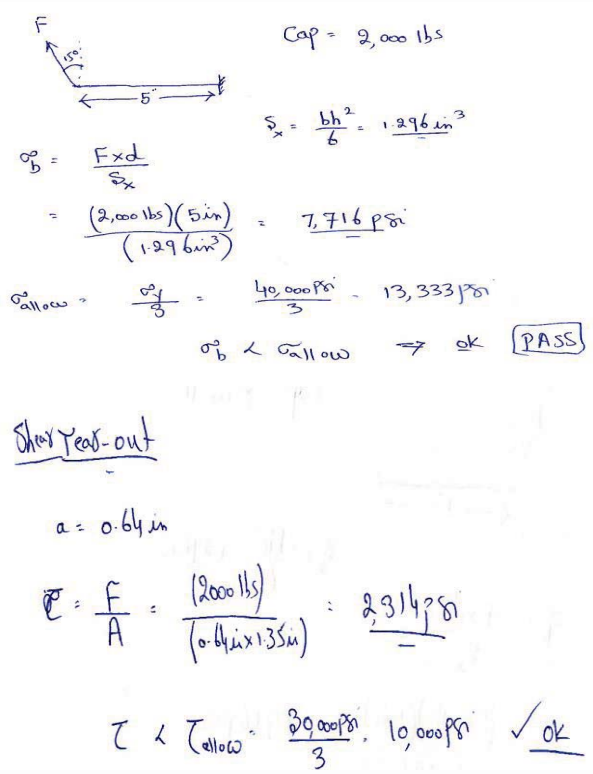

Figure 3: *Aluminum bar Stress Calcs*

FEA Study: Full Load

Fixed Point = ¾" Pin Hole

Roller Support: 17"

Load Point = 1.13" Hole @ full capacity

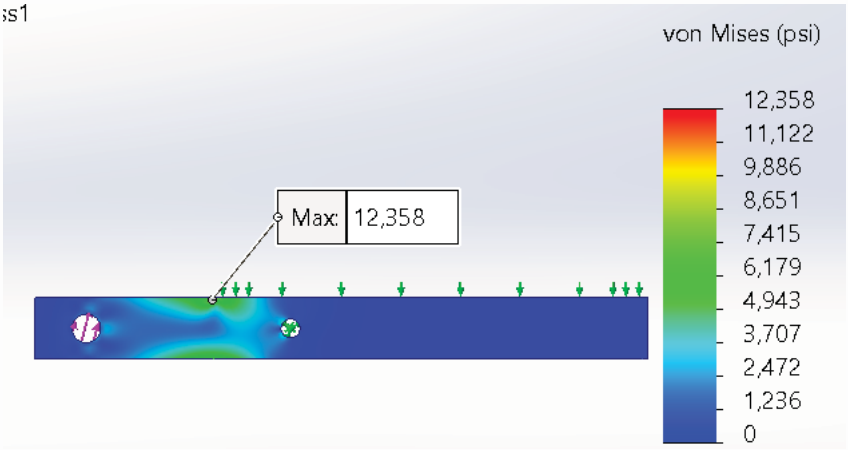

Figure 4: *Stress Plot of Aluminum bar using FEA.*

FEA study also showed that the aluminum bar is within the allowable criteria. The maximum on the bar is seen at 12,358 psi, which is below the 13,000-psi allowable stress.

6. PROOF TEST

The bars were tested with a specially designed test fixture in a set of 2. The tests were carried out at 125% of the capacity of the bars. The figure 5 below shows the test setup. The extra load did not cause any deformation to the bars and the tests were successful.

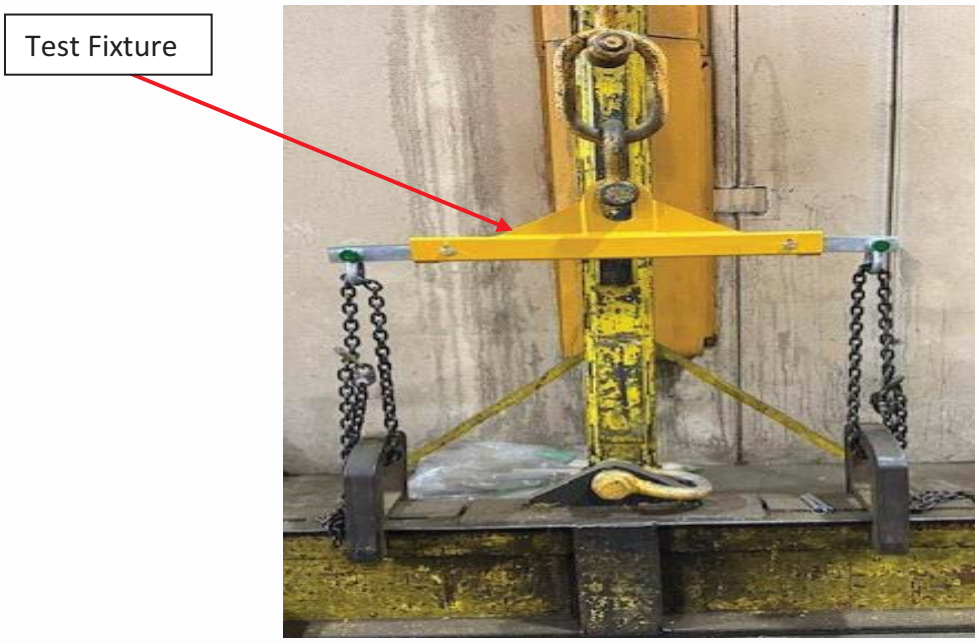

***Figure 5**: Bars proof test set-up*

7. SUMMARY OF RESULTS

The load applied to the lifting bar per typical operation shows the stresses to be within the allowable requirements of the ASME BTH-1 and ASME B30.20 standards. The Proof test further proved that the bars are fully capable of handling the intended load without any deformations.

All theoretical and simulation data suggest that this lifting bar meets the design conditions and is therefore able to function as intended at the full capacity of 2,000 lbs. without modifications.