Deliverable D - Design Criteria

Group 3

Ziyan Zhao

Nate Probert

Noah Brouillard

Nnamdi Momah

Obaidah Moati

Feb 11, 2024

Abstract

Ambico as a door manufacturing company is heavily dependent upon jigs. However, Ambico's current jig often acts as a hindrance rather than an aid. This is due to the vast inefficiencies associated with the current jig. Which include, lack of self-centering, lack of attachment, prone to human error, and time-consuming. Such inefficiencies often hinder business practices, impact the time of manufacturing and potentially increase costs. By improving such a jig and addressing the necessary needs of Ambico, the production time is heavily decreased and other issues such as human error and such are addressed as well. This document outlines the design criteria, the user needs, and the subsystems of the design of the new and improved jig. Overall, the flush bolt jig aims to improve the ease of use, time efficiency, and precision during use.

Table of Contents

1 Introduction

A door manufacturing company needs an efficient flush bolt cutout process by means of a purpose-built jig that eliminates manual steadiness issues, increases ease of use and adaptability to different door specifications, doesn’t damage the door, and reduces manufacturing time, all while adhering to specified budget constraints.

1.1 Related Work

2 Design Criteria

2.1 User Needs

The needs of Ambico were determined by speaking with users including operators and the engineering team at Ambico in addition to visiting their site and manufacturing floor. The main concerns are that the current jig takes too much time to use, involves manual marking of dimensions, varying door sizes, being in a rough environment, and has to be held manually. Ambico's main needs require the jig to be fast, efficient, and user-friendly. Some other needs can be determined such as:

- Being adjustable
- Having a fastening device
- Having a measuring component
- Being long-lasting and durable

2.2 Design Criteria

To meet the specific needs of our project, the door jig is intended to facilitate door installation processes by providing a user-friendly, adjustable, and durable solution.

User-Friendly and Easily Manipulated Settings:

The design incorporates intuitive controls and interfaces, allowing users to manipulate settings effortlessly. Feedback from users during prototype testing will inform adjustments to optimize user experience.

Faster Usage:

The jig is engineered for swift placement and adjustment, with defined benchmarks for time (in seconds).

Streamlined mechanisms and ergonomic design principles are integrated to enhance efficiency.

Non-Damaging Interaction with the Door:

Material selection and structural design focus on minimizing weight (in kg) while ensuring sufficient strength to interact with the door without causing damage.

Protective coatings or padding may be applied to sensitive surfaces to prevent scratches or dents.
Adjustability:
The jig offers adjustable parameters, including minimum and maximum width and length (in cm), catering to various door sizes and configurations.
Robust locking mechanisms and precise calibration systems enable accurate adjustments.
Easy-to-Use Fastening Device:
The design incorporates a user-friendly fastening mechanism, prioritizing simplicity and efficiency.
Iterative testing and user feedback guide refinements to optimize functionality and ease of use.
Cost_Effectiveness:
Material selection, manufacturing processes, and component sourcing are optimized to minimize costs while maintaining quality and functionality.
Measuring Component for Backset Matching:
A dedicated measuring component is integrated into the jig to accurately match the backset according to the door's thickness. Precision instruments and adjustable guides ensure compatibility with various door specifications.
Durability and Longevity:
Material selection prioritizes durability and longevity (lifespan in uses), with emphasis on high tensile strength(in psi) and resistance to wear and corrosion.
These design criteria are essential to ensure the jig addresses the needs effectively. The conceptual design of the door jig draws the basic view of the jig might be a modular frame constructed from lightweight yet durable materials, such as Alum Alloys or high-strength polymers to minimize weight without compromising structural integrity. Intuitive controls and ergonomic handles allow for effortless manipulation and adjustment of settings, promoting user comfort and efficiency. Adjustable arms and clapping mechanisms accommodate a wide range of door sizes and configurations

2.3 Subsystems

2.3.1 Auto-center

The subsystem to auto-center the jig on the door consists of sliding tracks on both sides of the jig that also are used to clamp the jig to the door. These tracks will have increment locks at ⅛ inch increments on each side so that the locked position is ¼ inch overall, as the standard sizes of doors increase or decrease by ¼ inch at a time. These tracks will include a method of locking the jig at each interval to ensure proper measurements (as well as reducing human error).

2.3.2 Clamp The Door

The subsystem to clamp the jig to the door includes sliding tracks on both sides of the jig that can be adjusted in ⅛ inch increments to factor in the total increment of a ¼ inch from each door size. The section of the clamp that will be in contact with the door will be a rubber (or

other materials that can compress slightly) piece to ensure that the door is not damaged during the clamping and use of the jig.

2.3.3 Frame of the Cutout

The frame of the cutout will consist of the main U-shaped frame (which is what will be "wrapped" around the door), a rubber or other soft lining to avoid damaging the door, and the cutout which will be centered on the face of the frame. The inner part of the face will have a component (on the top and the bottom of the face) in which a wedge can be added to factor in the angle of the bevel (86.4 degrees). On one side of the frame, there will be a 12-inch long attachment with a lip at the end of it to ease the setup for cutting out the flush bolt (as the flush bolt is always 12 inches from the top of the door) as well as reduce the possibility for human error when using the jig. The frame will be wider than the largest door width specified to ensure that the jig can be used for all specified door specifications.

4 Conclusions and Recommendations

In conclusion, a purpose-built jig that addresses several design criteria is necessary for an efficient flush bolt cutout process for Ambico. After extensive analysis of user needs and consideration of design criteria, the proposed jig incorporates user-friendly features including adjustable settings and sliding tracks with increment locks. Subsystems such as the auto-center mechanism and the clamping system would ensure the compatibility of the jig to different door sizes. In essence, the developed jig meets the specified criteria that are required at Ambico.

5 Future Work

6 References