Rio Tinto Cathode Punch System

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INTRODUCTION

Rio Tinto produces approximately 300,000 short tonnes of copper every year through Kennecott Utah Copper at the Bingham Canyon Mine. After the refining process, the product, copper cathode sheets are sampled. A punch presses out buttons from the cathode sheets in order to be quality tested. The incorporation of product sampling is crucial in providing a reliable assessment of the raw material quality, which is a crucial factor in determining its market value and potential.

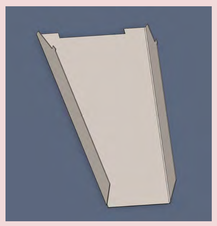
OBJECTIVE

The primary objective of this project was to understand, characterize, and redesign the current collection system to improve its efficiency and increase the number of samples collected. Specifically, the goal was the collection of a minimum of 172 out of 207 samples (called “buttons”), which would represent a significant improvement over the current system. Additionally, Rio Tinto aimed to identify the current losses experienced by the system, in order to identify areas for improvement and optimize the collection process overall.

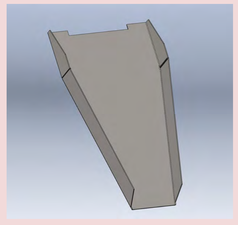
PROPOSED REDESIGN

Chute A:

- Extending top of chute: 1.5 in
- Decreasing angle: from 25 to 23 degrees
- Wider “throat”



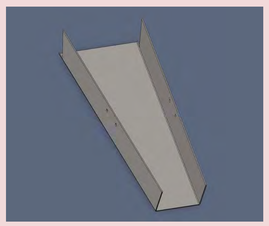
Original



Redesign

Chute B:

- Widening top of chute: 7 in
- Undershoot Chute A: 1.25 in



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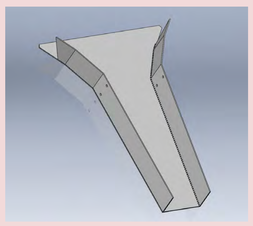
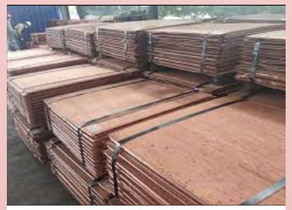


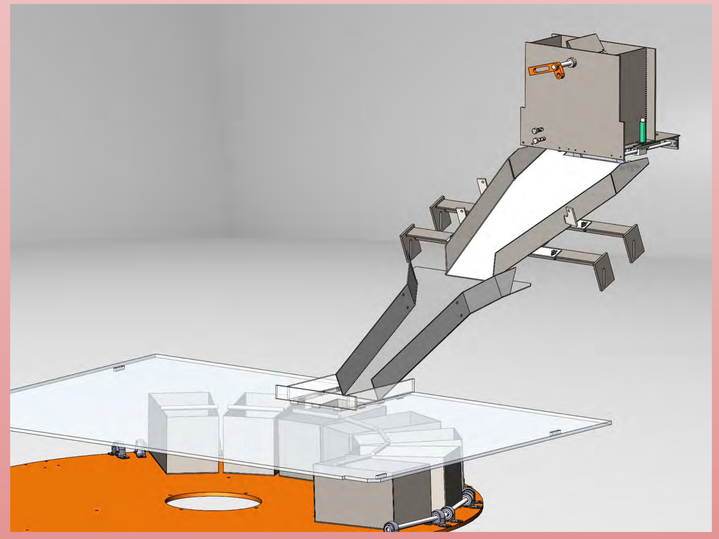
Redesign

Bingham Copper Mine, Credit: Rio Tinto



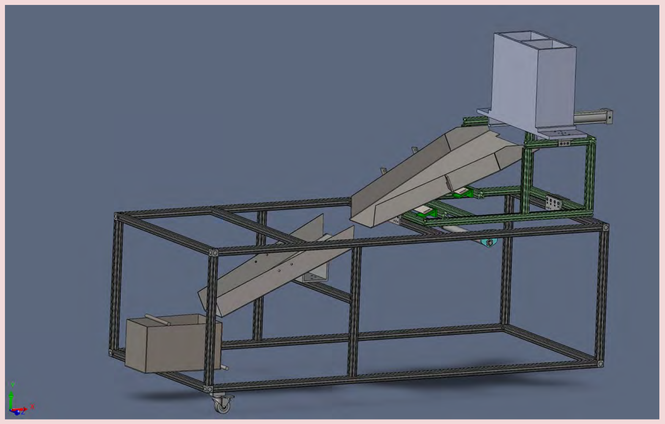
Palleted Copper Sheets, credit: wy-technology.com

FINAL REDESIGN



PROTOTYPE DESIGN

To test our modifications, we built a frame using T Slot that could hold the collection bin, both chutes and the carousel collection container. We used this frame and a 1:1 model of our new design along with pneumatic controls in order to simulate real world motion for ex situ testing.

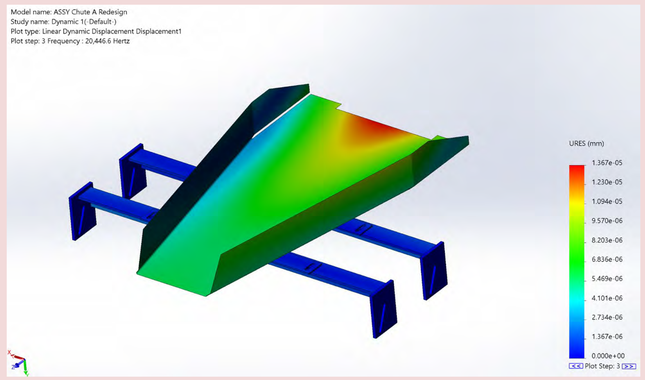


TESTING

We tested our new design at 3 different alignment locations; centered, 3.5” misalignment, and 7” misalignment. Within the 3 test locations we ran a total of 10 trials to determine the average amount of buttons lost.

FINITE ELEMENT ANALYSIS

A Finite Element Analysis on the mounted vibration motor at different frequencies was conducted to ensure that the new design will not experience large or damaging deformations.



CONCLUSION

Our testing resulted in meeting Rio Tinto's goal of collecting the minimum required samples, even at differing misalignment points. Redesign fabrication, assembly and testing came in under budget. Fitment and function conforms to site constraints and requirements. Rio Tinto plans to implement modifications this summer. Upon successful implementation, this design will result in significant savings through elimination of unnecessary copper quality downgrades.