# BRAKE DYNAMOMETER


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## ABSTRACT


Asama Coldwater Manufacturing is a leader in the manufacture of brake rotors and other products for the automotive industry. Asama presented the Trine University design team with a vibration problem that would occur during rotor testing. The vibration would cause unreliable test results as the sensors would read additional vibrations being channeled through the mounting brackets of the fixtures, Figure 1. Asama stated modifying the fixture is desired to reduce costs for future modifications and make servicing the fixture much easier. The changes made must allow the dynamometer to remain aligned from end-to-end and function while improving test results to meet application specifications. The team's focus was to add another bearing to the dynamometer to reduce stress and vibration. The fixture was shortened and split into two pieces to reduce weight and make the fixture easily interchangeable while leaving enough room for adjustments. These solutions were designed within budget and timeframe to allow for a week's worth of testing on the dynamometer. Based on the test results, the group expects the changes will add feasibility to the process and bring the company's test results closer to the partnering plant's test results.

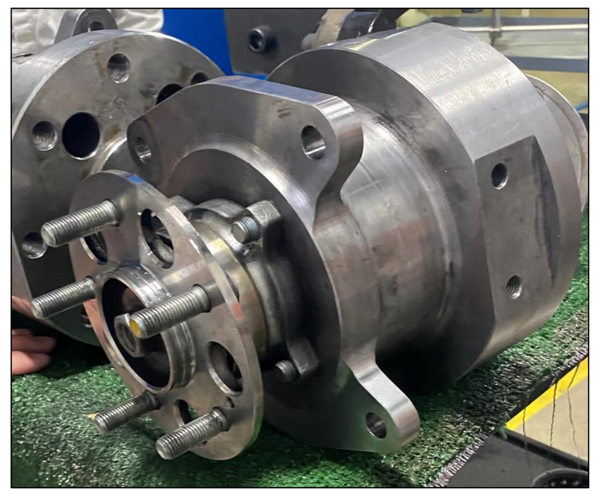



Figure 1: Original Fixture

## CUSTOMER NEEDS/SPECS

Table 1: Customer Needs Rank (5 most important, 1 least)

| Customer Needs | Rank |
|---|---|
| Drive shaft connect between Dynamometer and fixture | 5 |
| Must be aligned to test left and right hand corner components | 5 |
| Use ACM's current capacities probes for Y runout measurements | 3 |
| Y runout must be less than current fixture, testing required | 3 |
| 3D models using SolidWorks and saving so it can open in Catia | 5 |
| 2D drawing of components and assembles | 2 |

Table 2: Needs and Specifications List

| Needs | Specifications |
|---|---|
| • Utilize drive shaft<br>• Fixture must be left-handed and right-handed corner components<br>• Utilize SCM current capacity probes<br>• Results of test part must be current<br>• 3D models | • Modular design that allows for flexibility on different customer rotor shapes and calipers try to reduce 1-piece fixtures<br>• Components easily purchased or can be made in house<br>• Make the fixture modular/universal for different caliper plates |

## DESIGN CONCEPTS

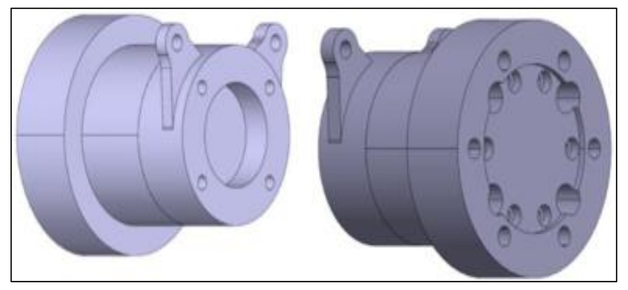


Figure 2: Sub-concept 1, Long Bolted in Back

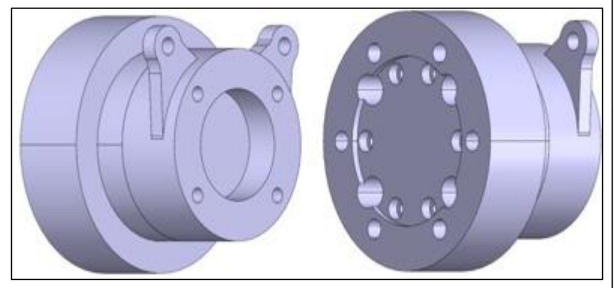


Figure 4: Sub-concept 3, Short Bolted in Back

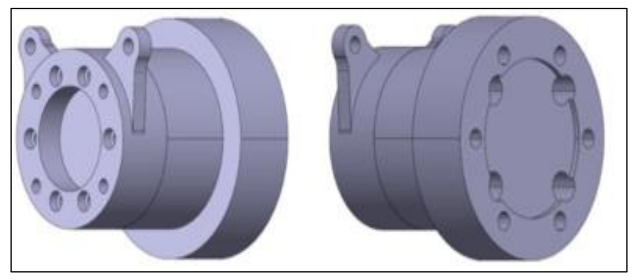


Figure 3: Sub-concept 2, Long Bolted in Front (bottom)

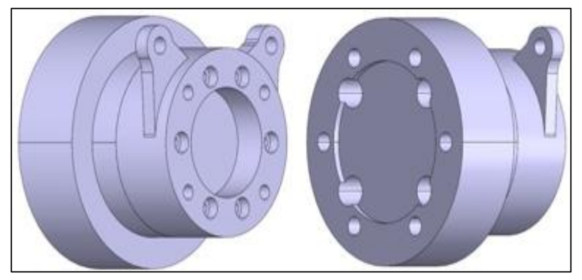


Figure 5: Sub-concept 4, Short Bolted in Front (bottom)

The brake dynamometer team was challenged with solving a vibration issue and by creating a fixture that would be modular, Figures 2 - 5. The team started by taking the solid fixture and splitting it into two pieces, a top, and a bottom. The team also noted that the shorter the fixture, the less vibration would be picked up during tests.

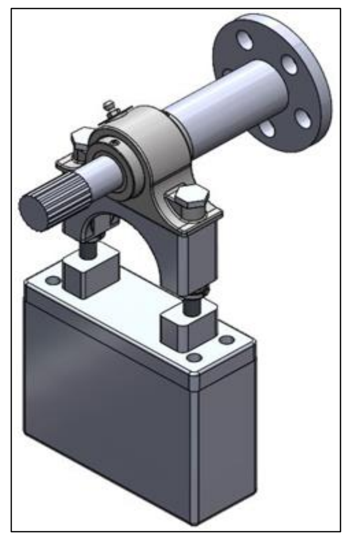


Figure 6: Support Concept 1, Bolt Adjustment

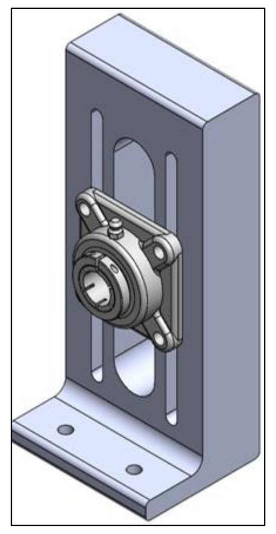


Figure 7: Support Concept 2, Slot Adjustment

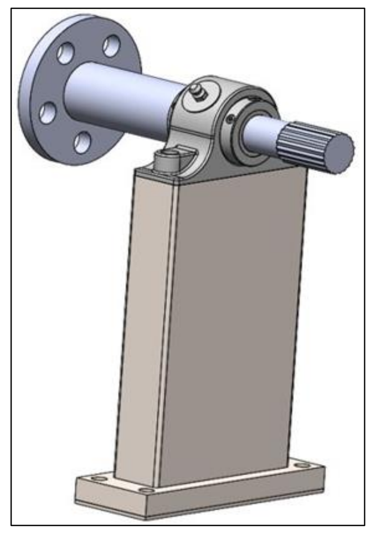


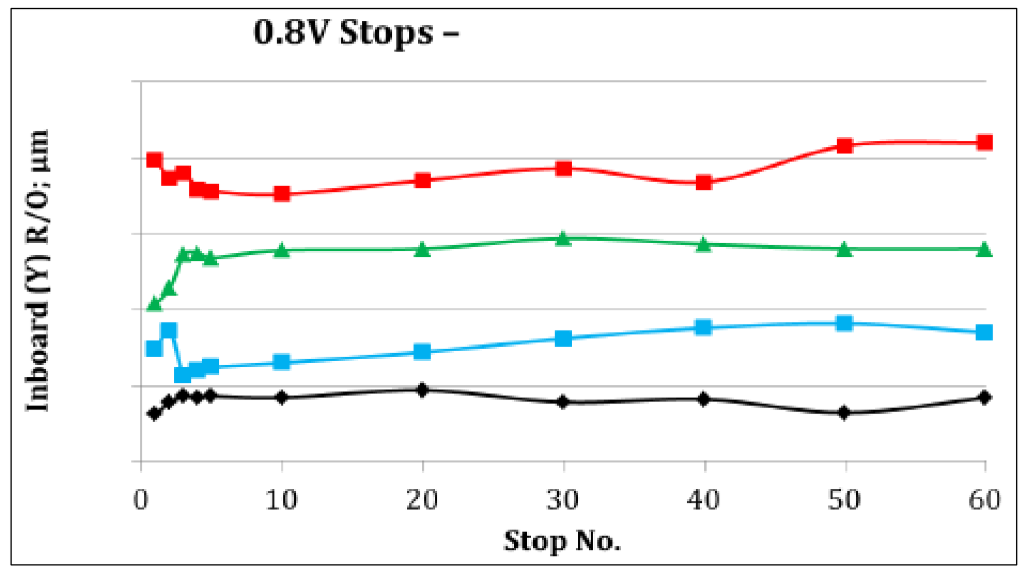
Figure 8: Support Concept 3, Shim Adjustment

The second design concept area the team produced was adding a secondary support bearing. This bearing would support the two-piece driveshaft and minimize driveline vibration. There were three variations of bearing supports drafted by the team, Figures 6-8. The first one is like the third concept except for the for mount is a different design. The second concept consisted of a different mounting design. The driveshaft would pass through the mount and the bearing was mounted on the side of the mount instead of resting on top. The final concept design consisted of a solid base and would be bolted to the table using t-slots. The bearing would be bolted to the top of the mount and secured with cap screws. The bearing was ordered through McMaster-Carr.

## TEST RESULTS

Though the team was unable to test whether the designs made would help complete the project's goals due to time, this chart, Table 3, shows the progress made. Red and Green are previous results. In Blue are where Asama is at currently, and in Black, is the goal Asama wants to reach.

Table 3: Current DTV Test




## FINAL DESIGN

The final solution the team produced was shortening the fixture and making it modular. The fixture itself will split into two separate halves to allow the top half of the fixture to be interchangeable with other fixture faces, Figure 9. The team also settled on design concept three for the bearing mount, Figure 10, as it proved easiest to machine and utilized a shim to allow for vertical adjustments. The bearing chosen was a mountable and greaseable roller bearing that would support the new splined driveshaft. The concept of the driveshaft was also picked and will be running into the hub instead of being bolted to the hub studs. The team created a wheel simulator that would apply even pressure when the brake rotor was bolted down to the bearing. A new centering plate was also designed to allow the driveshaft to be secured, Figure 11. The centering plate will have a hole drilled in the center to allow a socket with extension to pass through to tighten the nut on the end of the driveshaft, securing the driveshaft.

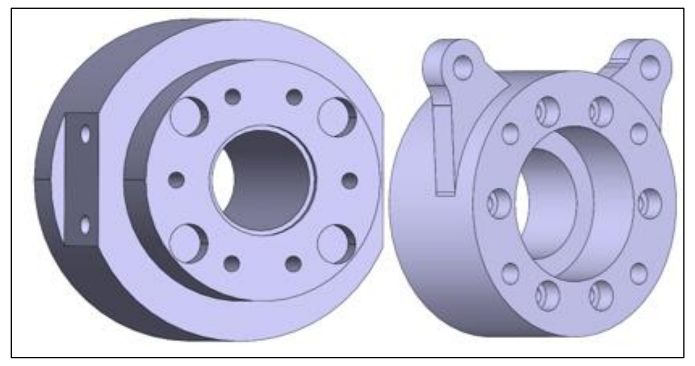


Figure 9: Final Fixture Design

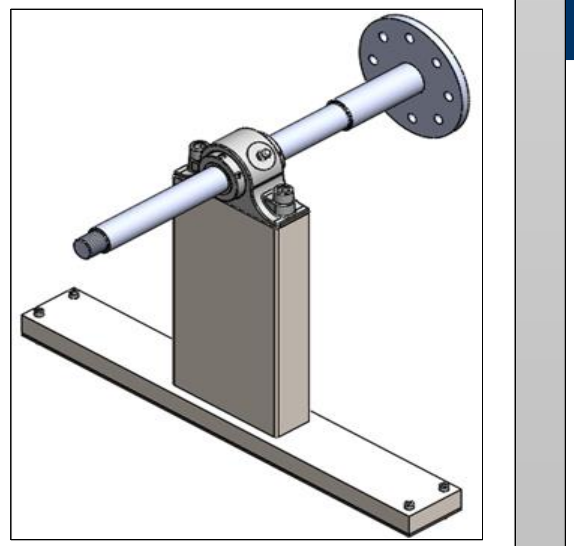


Figure 10: Final Mount Design

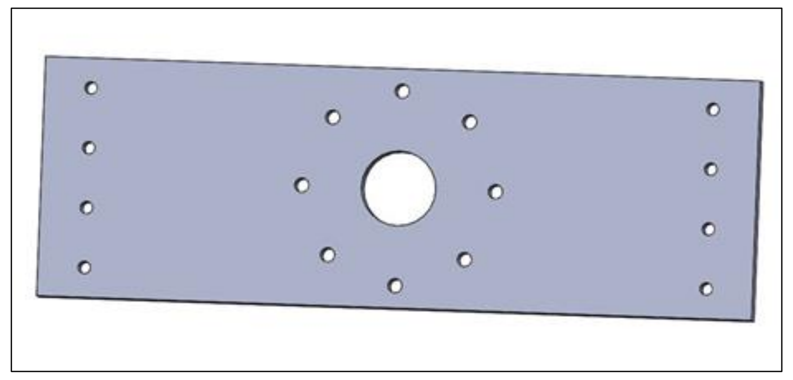


Figure 11: Back Plate

## CONCLUSION

The team managed to complete an entire assembly with completed drawing files. The team was able to deliver a concept that would help solve vibration issues and created a modular design for the new fixture.

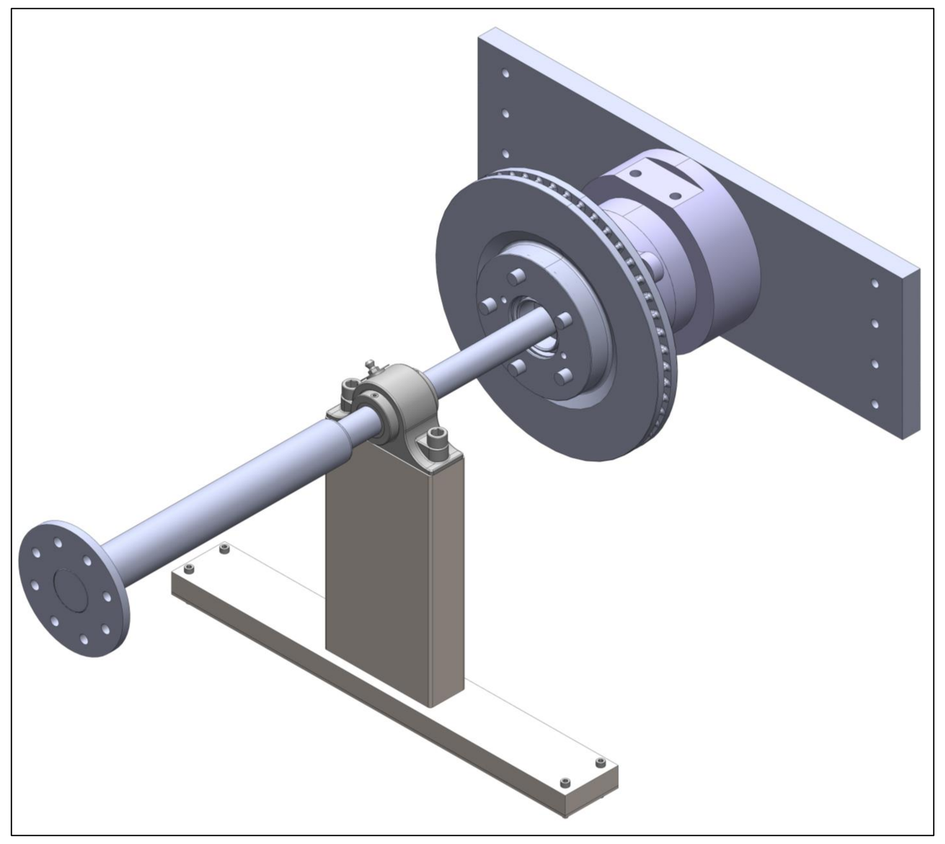


Figure 11: Final Assembly

## LESSONS LEARNED

Throughout this project, the team learned:

- Communication between the customer and the engineers
- Attention to detail is crucial in every aspect of a project
- Leave enough room for errors
- The design process is always evolving

## ACKNOWLEDGMENTS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