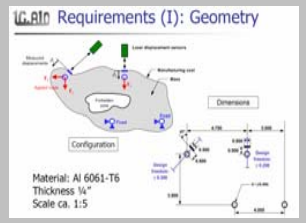
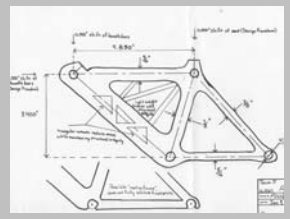
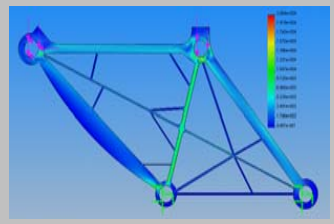
# Design Evolution

## Phase 1



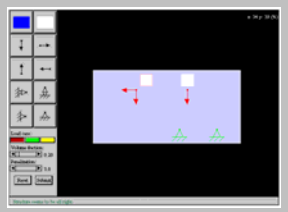



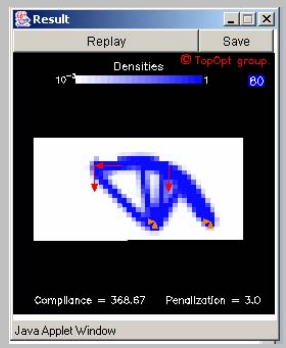


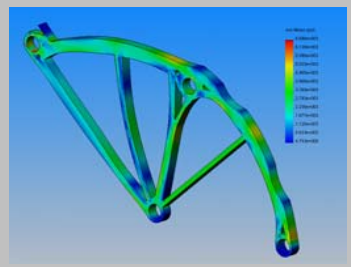
Problem Statement → Sketch → CAD Model → CAE → Rapid Prototyping Validation ↓

## Phase 2

Design Optimization (Trimming!) → CAD Model V2 → CAE V2 → Rapid Prototyping V2 Validation V2





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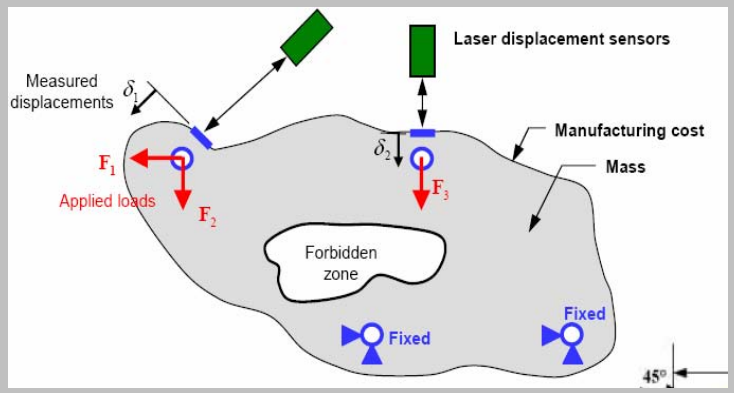
# Comparison of Metrics

| | Displacement 1 | Displacement 2 | Mass | Natural Freq | Cost |
|---|---|---|---|---|---|
| **Requirement** | 0.071 mm | 0.011 mm | 0.160 lbs | 505.7Hertz | 7.8 $ / Part |
| **CAE 1** | 0.303 mm | 0.0455 mm | 0.160 lbs | 460 Hertz | $14.83 |
| **Experimental 1** | 0.7473 mm | 0.08625 mm | 0.166 lbs | 477.45 Hertz | $14.83 |
| **CAE 2** | 0.1568 mm | 0.010998 mm | 0.160 lbs | 432 Hertz | $10.19 |
| **Experimental 2** | 0.390 mm | 0.043575 mm | 0.165 lbs | 426.2 Hertz | $10.19 |

**Table 1:** CAE and Experimental Data

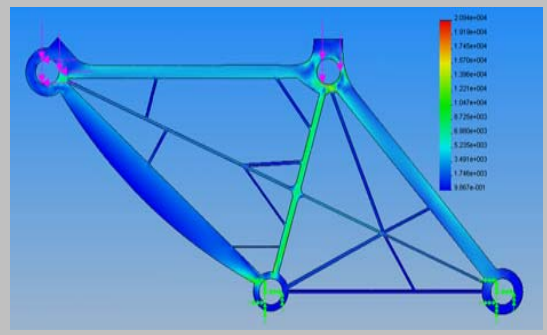



## Load Case

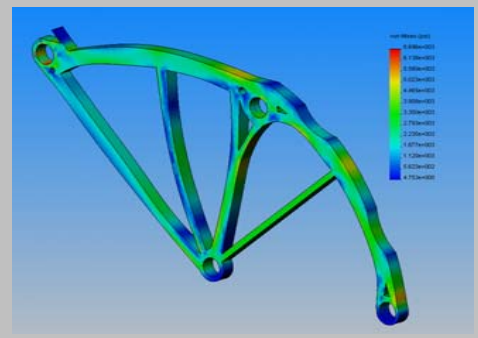
F1 = 100lbs

F2 = 100lbs

F3 = 50lbs



Version 1 CAE



Version 1 CAE

Version 1 CAE

Version 1 CAE

# FIVE

| Attribute | Constrain | Optimize | Accept |
|---|---|---|---|
| Cost | | | ■ |
| Performance | | ■ | |
| Mass | ■ | | |

**Table 2:** Priorities

## Final Specifications in Comparison to Requirements

| | | |
|---|---|---|
| Manufacturing Cost | $10.19 | $7.80 |
| Performance | 0.390mm, 0.0435mm | 0.071mm, 0.011mm |
| Mass | 0.165 lbs | 0.160 lbs |
| Surface Quality | 5 | 5 |

## Design rational

•Focused on requirement delta2 to achieve stiff and rigid power train region to give rider a sense of good acceleration

• Met mass requirement as weight is an important factor in racing bike

• Cost was largely ignored, as it is an acceptable criteria and optimizing for the other factors naturally improved cost efficiency

# Final Conclusions

- Design analysis arrived at performance and weight results with in a reasonable window for the 2nd product
  - δ1 was 221% of the target, while δ2 was 99.9% of the target deflection
  - Mass was at 100% of the target
- Testing did not align with the CAE to full satisfaction
  - δ1 was 248.7% of the prediction, while δ2 was 396.2% of Cosmos Works' predictions
- While the iterations were successively achieving better results, the final model has nearly approached the limitations of the materials being utilized
  - Only by blending materials and adding new parts to the assembly, can the performance to mass ratio be improved
  - Any advancements of this kind will require a new manufacturing process, which is currently available.
- While further iterations of the design and prototyping process could improve the designs performance, these iterations would not be cost effective