Solutions

Steel Joint Test
Steel tube test yielded favorable results to justify the use of steel joints instead of a carbon fiber joint construction. After careful calculations a final wall thickness for the steel tube joints was chosen at 0.07 inches to provide a balance between strength and lightweight construction. The test proved that the welded joint was incredibly strong and would provide an ample safety factor.

Manufacturing

Tube and Joint Creation
Advanced Composites, Inc. (ACI) was incredibly generous, donating carbon fiber material and the use of their equipment and facility. We were able to fabricate the carbon fiber tubes on their CNC filament winding machine. This ensured consistent tube properties. They allowed us to use other machines in the shop to machine and cut the tubing for the mitered joints. Coped and mitered joints were constructed at different angles and configurations to match each required joint in the frame design. The tubes and steel joints are joined together using a high temperature adhesive with a high strength that provides a joint separation strength that is greater than the yield of either the steel or carbon tube by itself.

Alignment and Construction

A frame alignment jig was fabricated to ensure the fitment of the donor motorcycle components.

Conclusion

- Mass production of a frame comparable to ours would require extensive research, testing and a large investment.
- Molds and other methods for joining tubes together would have to be developed to ensure an accurate and consistent bonding between parts.
- Due to our time constraints and available resources we had to build the frame using steel joints that complemented our carbon fiber tubes.
- Only one frame was produced and no further materials testing was performed.

Composite frame weight: 14.2 lbs
OEM Kawasaki donor frame: 28.0 lbs
49.3% weight reduction

ACKNOWLEDGEMENTS

- Advanced Composites, Inc.
- The Kitten Factory
- Dr. Daniel Adams
- Dr. K. L. DeVries