Mad Fiber Inc.

Intellectual Property

December 2012

Intellectual Property

- Original patents filed May 2009
  - Current wheel structure
  - Current process(process and design details)
- June 2012 provisional patents filed for:
  - Flex point related to rider weight
  - Bicycle wheel with unitary side construction
- Pending applications for:
  - System, method and apparatus for controlling residual stress in heat-bonded dissimilar materials
  - Carbon fiber curing, stack bonding system

Intellectual Property

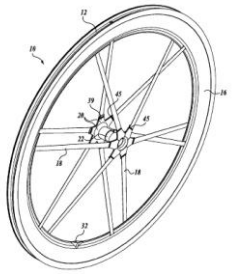
Countries where Mad Fiber has patent application filings:

Australia, Canada, China, Japan, Korea, Singapore, Thailand, and Europe (which includes Albania · Austria · Belgium · Bulgaria · Croatia · Cyprus · Czech Republic · Denmark · Estonia · Finland · France · Germany · Greece · Hungary · Iceland · Ireland · Italy · Latvia · Liechtenstein · Lithuania · Luxembourg · Macedonia · Malta · Monaco · Netherlands · Norway · Poland · Portugal · Romania · San Marino · Serbia · Slovakia · Slovenia · Spain · Sweden · Switzerland · Turkey · United Kingdom).

Intellectual Property

List of Patents Applied/Pending

TITLE: COMPOSITE FIBER BICYCLE WHEELS



INVENTOR/APPLICANT: Mad Fiber, LLC

US PROVISIONAL PATENT APPL NO: 61/216,977
FILING DATE: May 26, 2009

US PATENT APPLICATION NO: 12/709,178
FILING DATE: February 19, 2010

INTERNATIONAL APPLICATION NOs: PCT/US2010/036155, AU2010254129, CN201080033301.4, EP10781118.4, JP2012-513192, KR10-2011-7030909, TH1101003379, and TW099135725

FILING DATE: May 26, 2010

SUMMARY:
Mad Fiber has filed US and international patent applications in Australia, China, Europe, Japan, Korea, Thailand, and Taiwan to cover its process and design details. A subsequent filing will be made in Canada selected contracting member states. Examples of some of the principal disclosures for portfolio development and claim coverage include:

(1) **Assembling a wheel from flat carbon fiber parts, without any hollow molded elements.**

(2) A process sequence that enables intertwined spoke pattern in the final structure.

(3) Laminating rim sides from overlapping sextants with fiber orientation to support spoke and riding forces.

(4) Bonding spokes to rim sides through windows.

(5) Shaping rim sides to minimize spoke interference at entry.

(6) Making flat spokes of carbon with longitudinal fiber orientation and enlarged ends for bonding area.

(7) Using wishbone shaped drive spokes that nest around a drive insert to carry pedal force.

(8) Bonding all parts along flat surfaces without mechanical grips , joints, or fasteners and orienting all bond lines to force vectors.

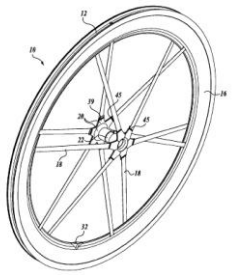
(9) Introducing tension by sliding hub flanges apart and bonding.

Intellectual Property

List of Patents Applied/Pending

TITLE: CARBON FIBER BICYCLE WHEEL WITH FLEX POINT RELATED TO RIDER WEIGHT

APPLICANT: Mad Fiber, LLC



US PROVISIONAL PATENT APPL NO: 61/664,671
FILING DATE: June 26, 2012

SUMMARY:
Mad Fiber has filed a US provisional patent application to cover its process and design details for its improved wheel with an engineered flex point for a smooth, comfortable ride. Subsequent non-provisional patent application filings will be made in the US and internationally prior to June 26, 2013. Examples of some of the principal disclosures for portfolio development and claim coverage include:

(1) Assembling a wheel from flat carbon fiber components arranged to provide an engineered flex pattern as function of the rider/bicycle's weight.

(2) A process of forming a wheel by arranging the carbon-fiber arrays to achieve a balance of strength and flexibility based upon expected load during use.

(3) A carbon fiber wheel specifically engineered for improved performance based upon the rider/bicycle weight.

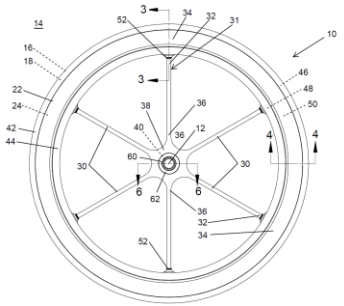
(4) A fiber-based wheel having a selected elastic radial displacement of the rim as a function of the rider/bicycle weight for maximum energy return while maintaining a smooth ride over rough terrain.

Intellectual Property

List of Patents Applied/Pending

TITLE: BICYCLE WHEEL WITH UNITARY SIDE CONSTRUCTION

APPLICANT: Mad Fiber, LLC



US PATENT APPLICATION NO: 13/535290
FILING DATE: June 27, 2012

SUMMARY:
Mad Fiber has filed a US patent application to cover its process and design details for its carbon-fiber wheels with a unitary side assemblies having integrally connect sidewalls, spokes and hub on the same side of the wheel's centerline. Subsequent international patent application filings will be made prior to June 26, 2013. Examples of some of the principal disclosures for portfolio development and claim coverage include:

(1) A method of making flat, integrally connected carbon fiber sidewalls and spokes prior to attachment to the rim and hub.

(2) A manufacturing process sequence that enables manufacture of unitary, fiber-based side panels and spokes in a flat arrangement prior to final wheel assembly.

(3) Assembling a fiber-based wheel with unitary sidewalls and spokes that do not cross-over the wheel centerline.

(4) A carbon-fiber wheel with unitary spoke sets on opposing sides of the wheel centerline and tied together at their radially outward ends.

(5) Making fiber-based wheels with unitary side panels having continuous fibers spanning between sidewalls and the spokes.

Intellectual Property

List of Patents Applied/Pending

TITLE: SYSTEM, METHOD AND APPARATUS FOR CONTROLLING RESIDUAL STRESS IN HEAT-BONDED DISSIMILAR MATERIALS

APPLICANT: Mad Fiber, LLC

US PATENT APPLICATION IN PREPARATION
FILING DATE: TBD

SUMMARY:
Mad Fiber is preparing a US patent application to cover its process and design details for heat-bonding dissimilar materials with different coefficients of thermal expansion. Subsequent international patent application filings are expected during portfolio development. Examples of some of the principal disclosures for portfolio development and claim coverage will include:

(1) A method of heat-bonding carbon-fiber material to aluminum or other metals without joint failure during heat induced expansion and corresponding shrinkage.

(2) A manufacturing process sequence that controls residual stresses in metal rims to allow heat-bonding of carbon-fiber sidewalls and spokes to the rim.

(3) A precision carbon-fiber or other fiber-based wheel having an alloy rim.

Intellectual Property

List of Patents Applied/Pending

TITLE: CARBON-FIBER STACK CURING, STACK BONDING SYSTEM

APPLICANT: Mad Fiber, LLC

US PATENT APPLICATION IN PREPARATION
FILING DATE: TBD

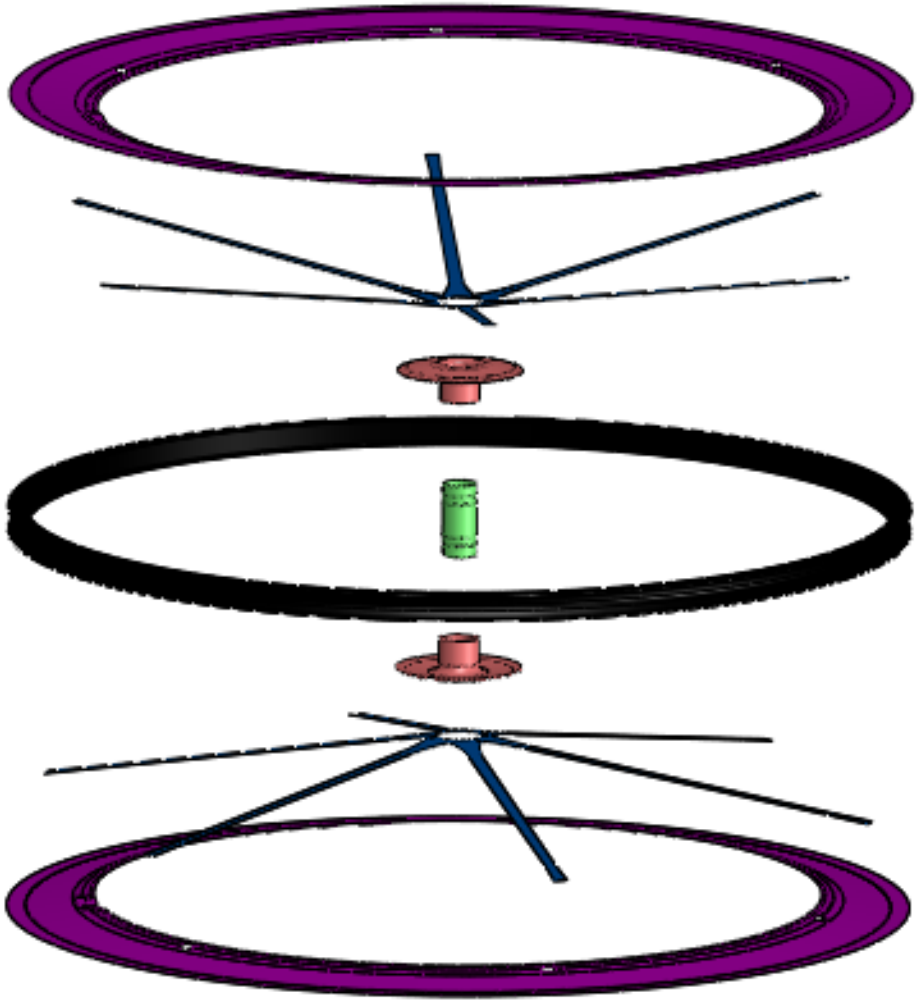
SUMMARY:
Mad Fiber is preparing a US patent application to cover its process and design details for manufacturing methods utilizing stack bonding and stack curing of carbon-fiber wheel components. Subsequent international patent application filings are expected as part of the portfolio development. Examples of some of the principal disclosures for portfolio development and claim coverage include:

(1) A scalable manufacturing process for curing and bonding carbon fiber wheel components and wheel assemblies in stackable bonding and curing jigs.

(2) A manufacturing process sequence that enables manufacture of fiber-based wheels in a minimum factory floor foot print using stackable, scalable bonding and curing jigs.

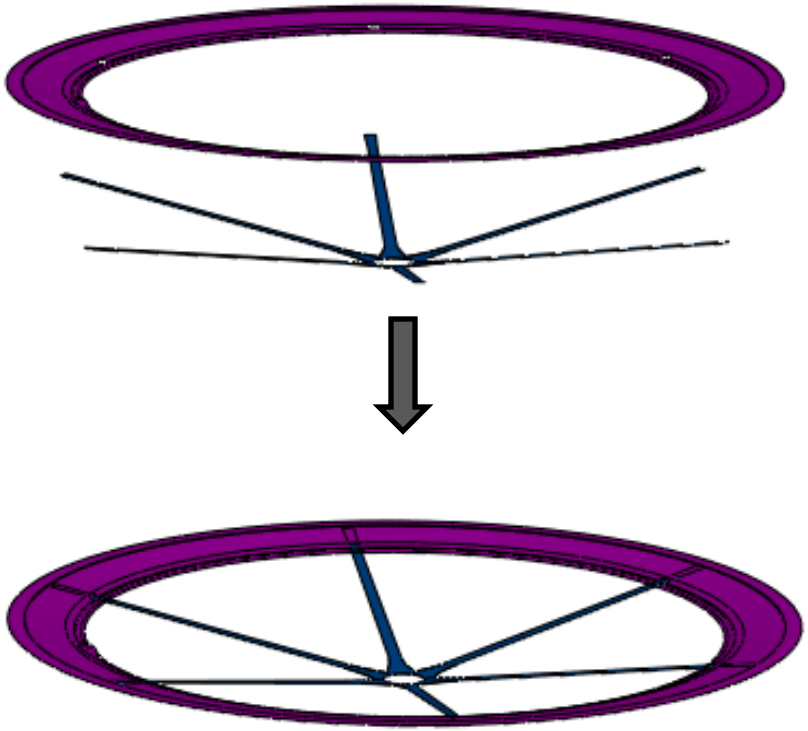
(3) Batch manufacturing unitary, flat carbon-fiber sidewalls and integral spokes in stackable jigs to minimize space requirements and maximize scalable batch processing.

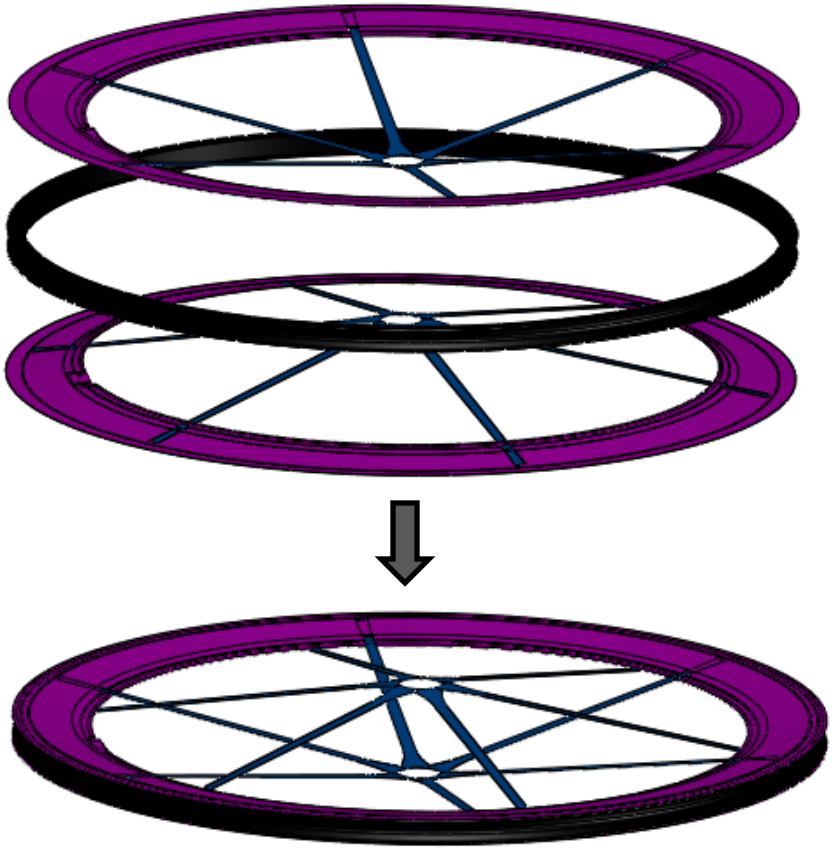
Current Design



- BOM
  - (12) individual spokes
  - (2) sidewalls
  - (2) flanges
  - (1) center tube
  - (1) rim
- (18) individual parts
- (4) bonding steps

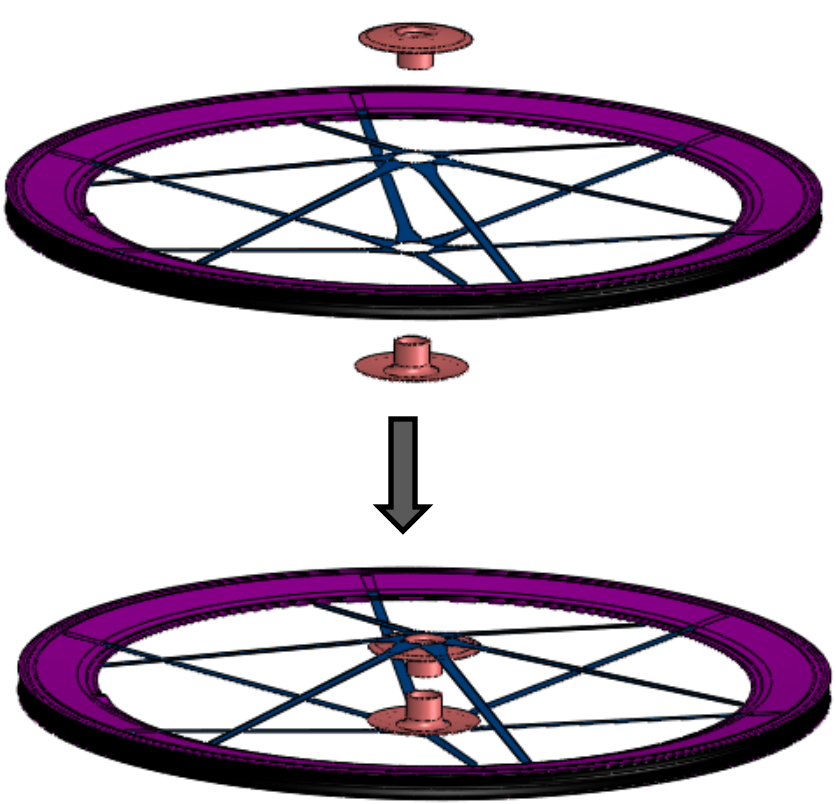
Current Design

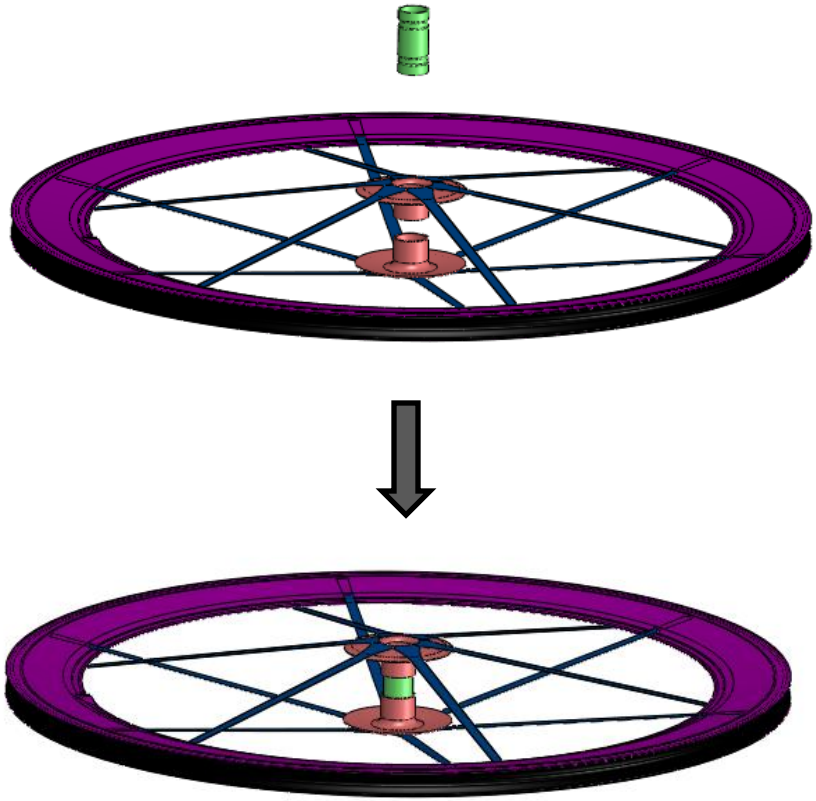




- Step 1
  - Bond spokes to sidewall
- Step 2
  - Bond sidewalls to rim

Current Design



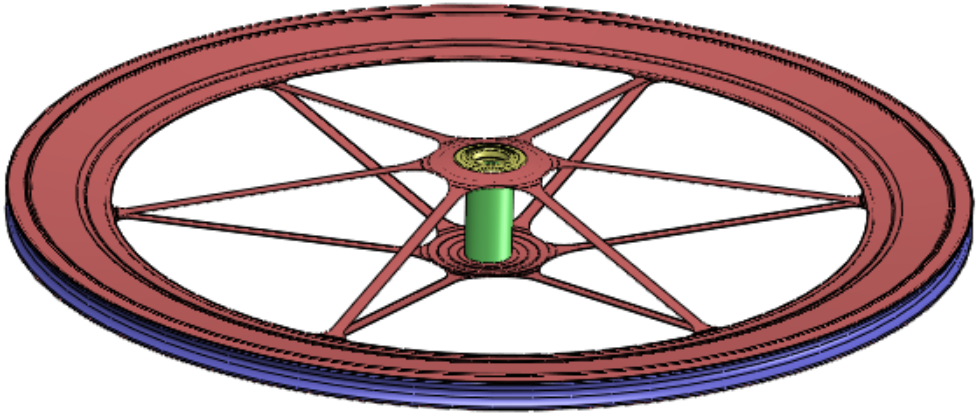


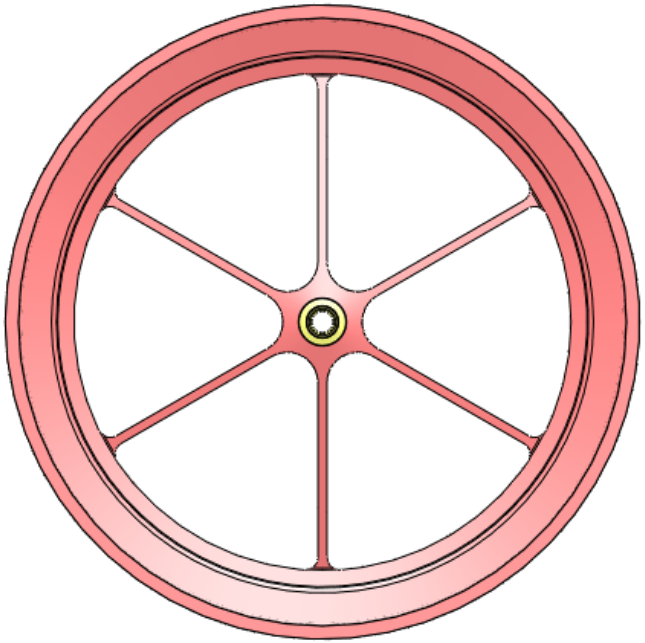
- Step 3
  - Bond flanges (hub) to spokes

- Step 4
  - Pull flanges apart to introduce tension into the spokes
  - Bond center tube in place

Unified Design – Concept

- List of parts
  - (1) rim
  - (2) sidewall/spoke/flange “mono” piece
  - (2) hub caps
  - (1) center tube



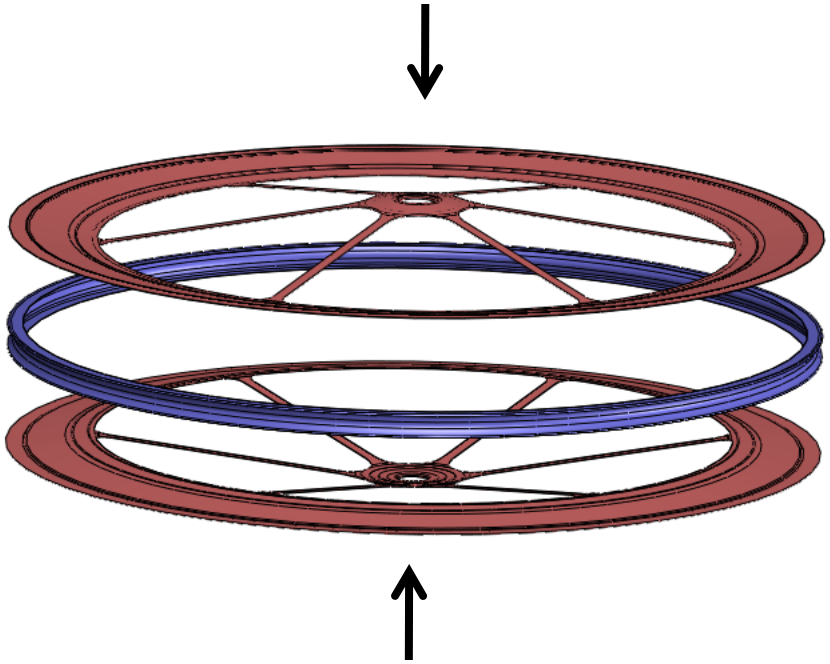


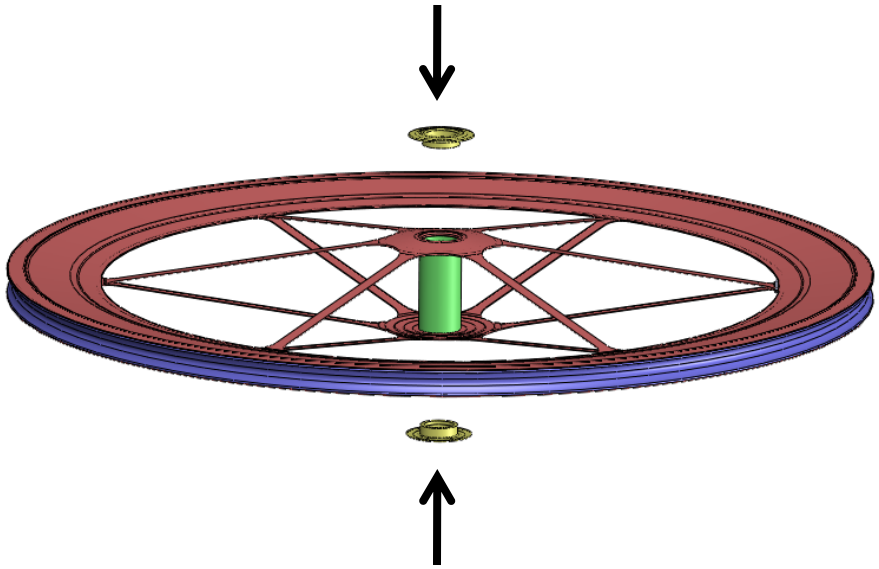
Front View

Side View

- Bonding Steps
  - Rim to Sidewalls (also lash spokes)
  - Tension and bond in center tub and hub caps

Unified Design – Concept

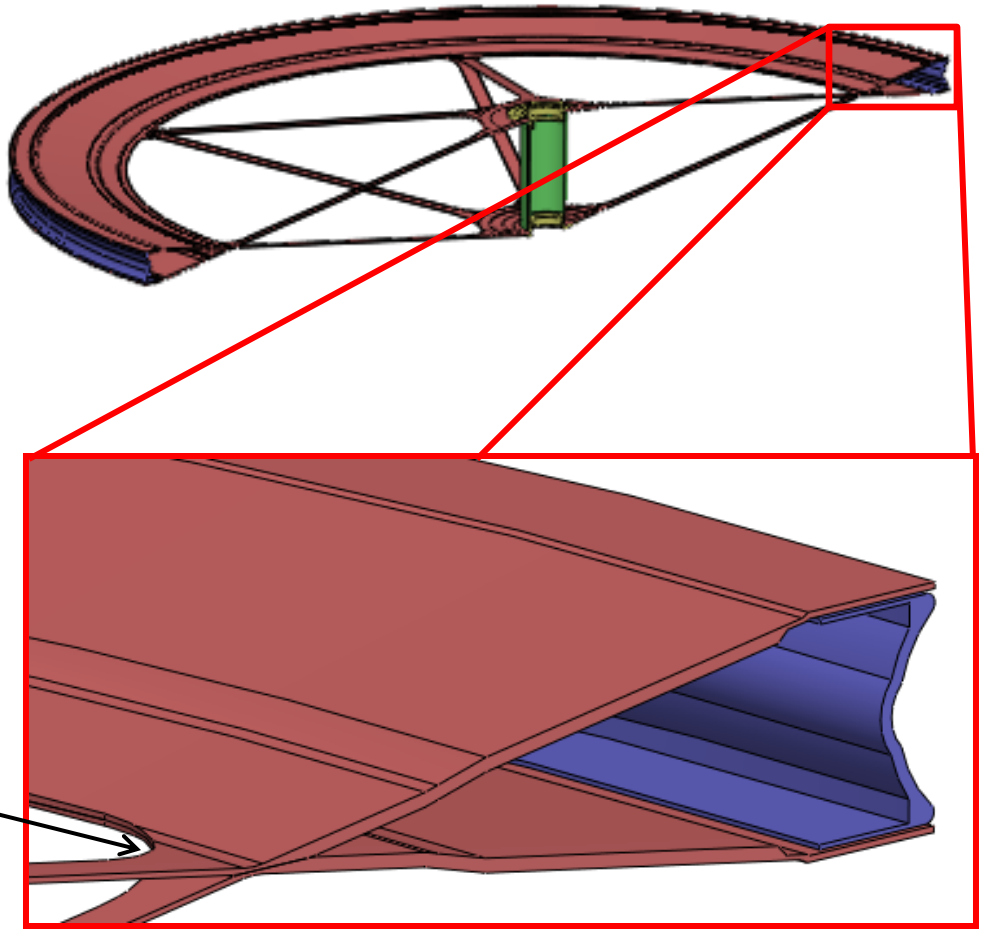




- Step 1
  - Rim and the (2) sidewall/spoke/flange pieces are bonded together
- Step 2
  - Pull the flanges apart
  - Slide in the center tube
  - Insert hub caps on either side to align center tube

Unified Design – Concept

- Spoke “Lashing”
  - Spokes are lashed where they make contact in order to effectively manage ID bond line forces
  - Lashing can be:
    - Fiber/epoxy
    - Rivets
    - Clip



Cross section of rim box

Unified Design – Discussion

- Benefits
  - Balanced Forces:
    - By “co-clocking” the rear spokes, the lateral forces from the DS and NDS spokes are balanced.
    - Improved trueness
  - Fewer Bonding Steps
    - Reduces the number of bonding steps from (4) to (2)
    - Fewer bond lines create cleaner looking wheel
  - New design possibilities
    - New rim widths
      - Aero benefits, cyclo-cross specific
    - New sidewall depths
      - Climbing wheel, deep aero wheel, etc
  - One step closer to future design using thermoplastics

- Challenges
  - “Lashing” Spokes
    - We need to identify how we will connect the spokes so that the forces at the ID bond line are managed correctly
    - Which method: Lashing, rivet, clip, etc?
  - Prototype
    - What is the most effective way to build (5) to (10) prototypes to start testing
  - Layup
    - Finalizing layup schedule so that it is:
      - Quick to layup
      - Provides a strong structure
  - Tooling Changes

Unified Design – Tooling

- Prototype/Testing
  - Front Wheel
    - Single plate to make front sidewall/spoke/flanges from to test initial design
    - Made from wood or composite for limited use at minimal cost
  - Lashing
    - Use prototype fronts to test out various “lashing” methods
  - Rear Wheel
    - Need (2) additional plates to make prototype rear wheels
- Production
  - Layup Tools
    - New set of sidewall/spoke/flange plates (front, NDS, and DS) to replace current layup tooling
  - Bonding Tools
    - No longer need BJ02
    - BJ03 should work with minimal changes
    - No longer need BJ04
    - New tension fixtures
  - New Productions Parts
    - New hub tube (front and Rear)
    - New hub caps
    - Lashing material, clips, etc