GUIDELINES AND SUGGESTIONS FOR BALLOON GONDOLA DESIGN

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DESIGN REQUIREMENTS

● STRUCTURAL INTEGRITY
  - Primarily to survive termination event
    - Safety
    - Mission assurance
  - Has been sufficient for landing – Although not a CSBF requirement

● LAUNCHABILITY
  - Important to prevent damage
  - Allows for less than ideal launch conditions

● STAGING/PICKUP
  - Must be able to fit inside existing high bays
  - Allows for hoist pickup and roll out to launch vehicle

● RECOVERY
  - Some existing recovery limitations – particularly Antarctica
  - Crucial to stay within limitations for critical components
STRUCTURAL REQUIREMENTS

● 10G VERTICAL – 5G SIDE LOAD
  ➢ Based on ultimate load of the material (not yield)
  ➢ Intended to prevent freefall of components

● ROTATOR
  ➢ Critical Component
    – Single point failure
    – Watch for concentration factors

● SUSPENSION LINES (WHERE APPLICABLE)
  ➢ Great historical data for steel cables
  ➢ Have used synthetic systems before to save weight – Kevlar, Spectra
    – UV a concern, one time use perhaps

● STRUCTURAL MEMBERS
  ➢ Mostly made of Aluminum or other lite tough metals
  ➢ Have flown Carbon Fiber/metal hybrids
    – Still learning to test and approve for certification
**Launchability**

**Payload Must Be Able to Survive Launch**
- These are dynamic launches
  - Damage to antennae, solar panels or other protruding objects
  - Sensitive equipment can be damaged
  - Latching mechanisms

**Minimum Desired Distances from Launch Vehicle**
- “20 degree rule” – Assures minimum desired clearance Launch Vehicle
- 6 ft. of ground clearance – Avoids contact with ground
- 5 ft. of clearance from front end of vehicle – Avoids contact with front end of vehicle during launch

**Other Observations**
- Width/Length of payload – High MOI
- Wide sections near the boom (higher)
  - Risk of contact with boom and damage
**STAGING/GONDOLA PICKUP**

- **FACILITIES LIMITATIONS**
  - Height/Width of payload
    - Allow for weighing the payload inside the building (Antarctica)
    - Allow for ease of roll in/and out of building

- **CART/WHEELS**
  - Allows people to work underneath
  - Ideally allows for ballast hoppers and solar panels to stay attached for roll out.
    - Huge time saver
  - Must be big enough for easy rollout
  - Must allow rotation of payload for vehicle pickup
Gondola Disassembly

- Critical components to stay within a certain allowable size and weight
  - Limited by recovery vehicle
    - Helo
    - Twin Otter and Bassler (Antarctica)
    - Land Vehicles

- Easy/Quick Disassembly
  - Allows for quicker recovery - Antarctica
  - Data vaults and other critical components accessible
    - Trade off between access and protection
COMMON PITFALLS AND RECOMMENDATIONS

- **Waiting Too Long to Contact CSBF**
  - The sooner the better on gondola design
  - Pointing systems are critical and expensive components
    - The sooner we see the design the better
  - Placing CSBF equipment in appropriate location
    - Thermal considerations
    - Antenna placement

- **Providing Analysis for Maximum Weight**
  - Final weights are usually higher than predicted
    - Avoids rerunning the analysis if overweight

- **Protective Cage for SIP**

- **No Appropriate Casters/Tires**
  - Hard to maneuver