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
**RECOVERY**

- **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