GUIDELINES AND SUGGESTIONS FOR BALLOON GONDOLA DESIGN

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HUGO FRANCO
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
**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