Guidelines and Suggestions for Balloon Gondola Design

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Design Requirements

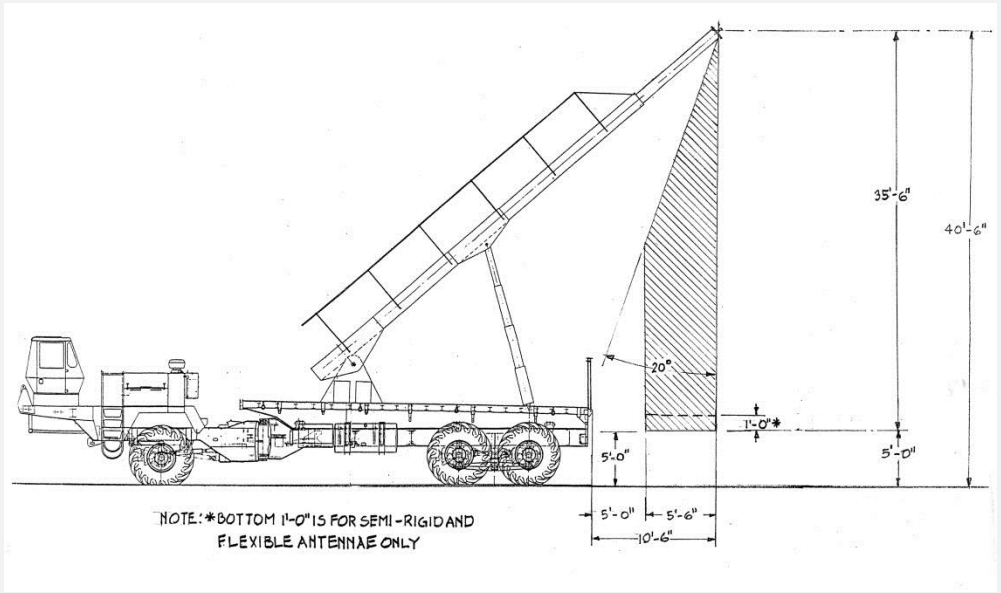
- **Structural Integrity**
  - Primarily to survive termination event
    - Safety
    - Mission assurance
  - Has been sufficient for landing – Although not a CSBF requirement
- **Launchability**
  - Important to prevent damage
  - Allows for less than ideal launch conditions
- **Staging/Pickup**
  - 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