

# **Airship Design Issues – Why Early Understanding And Realism Are Important**

**Examples: Altitude, Weather and Payload Reality**

## Appreciating Airship Design Challenges:

- Suppose the requirement is to conduct airship cargo operations in NE Africa – Ethiopian Highlands, Roof-of-Africa – altitude has little surface falling below 4,921 ft with summits reaching heights of up to 14,928 ft
- Consider three issues:
  - Payload reality
  - Altitude
  - Weather
- Payload – useful payload is distinct from solely cargo payload and for any mission length, fuel/POLs may be an independent variable
  - Nominally, airship structure needs to be designed for a  $\leq 50\%$  efficiency (structure wt/AUW)
  - Max useful payload:  $[Fuel-POLS + Ballast + other consumables + crew (25\% AUW)] + [Cargo (25\% AUW)]$
  - Means that 60 tons cargo  $\rightarrow$  60 tons (fuel + other) + 120 tons structural  $\rightarrow$  240 tons GTOW
  - Hindenburg LZ-29 around 240 tons (130 tons empty + 65 tons fuel/other + 45 tons cargo)



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- **Altitude** – impacts payload capability
  - 3,000 vs 12,000 feet – loss of 30% of lift because of ballonnet size constraints
  - Example: High altitude WW I Zeppelin high altitude airships:
    - Inflated to 85% full with lifting gas
    - Required venting with altitude
    - 15-20% payload limitation at launch
  - Practical impact on an airship might halve cargo capability – need out-of-box thinking (e.g. a refueling stop at low altitude)
- **Winds** – limits when flights can occur, suitable routing and fuel economy
  - Nov–Feb – North East Monsoon effects, Arab Dhow winds outbound to Africa
    - Fair weather, useful winds out of the NE
  - May–Sep – South West Monsoon, Arab Dhow return from Africa
    - Interred mid-May thru mid-Aug; winds too strong (up to Beaufort 7)
    - Best times – outset of Monsoon in late Apr and tail end Sep
    - Jul winds out of SW average 23 kts; up to 34 kts for 20% of the time
  - Useful routes might be:
    - Northern Winter (NE Monsoon) – follow Monsoons across Africa, pick up NE Trades to the west and USA or beat against the NE Monsoon winds to the Northern Horse latitudes (30-35N) and Sirocco to Europe
    - Northern Summer, SW Monsoon winds, Northern Horse and beat against Northern Tropical Continental to Europe and the North, there-off

