Current Plans for Testing HL-CRM in 14x22

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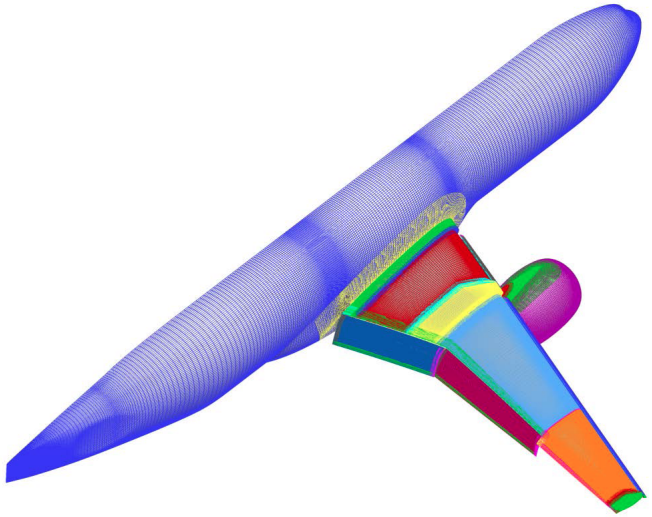
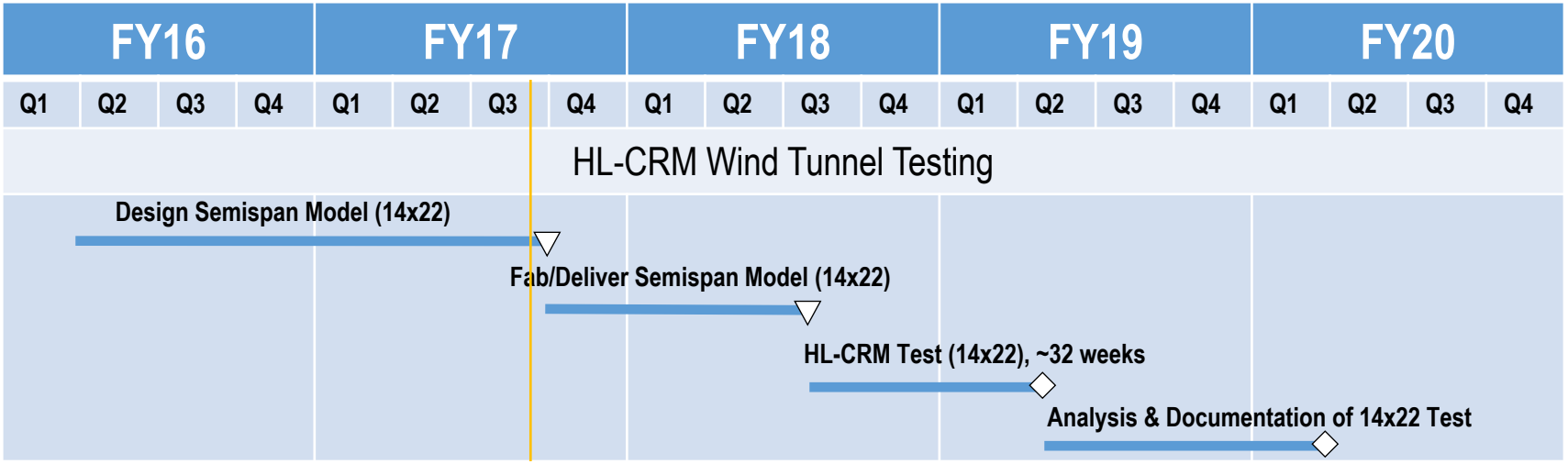
CRMs Are Multiplying

- CRM: Common Research Model
  - used for DPW workshops
- HL-CRM: High-Lift Common Research Model
  - CHL: Conventional High Lift
  - SHL: Simplified High Lift
- NLF CRM: Natural Laminar Flow Common Research Model
- 13.5 AR CRM: 13.5 Aspect Ratio Common Research Model
- . . .

HL-CRM Project Plan and Schedule

- Phase 1 Model fabrication to be completed by 3/30/18
- ~32 weeks of tunnel occupation time at 14x22 (4/26/18 to 1/29/19)
- Aerodynamic test – 1st half
  - Conventional (baseline) configuration
  - Simple hinged flap with AFC on flap LE
- Acoustic test – 2nd half (noise reduction)
  - Conventional configuration (fixed rigging)
    - With and without landing gear
  - Slat cove-filler and slat gap-filler
  - Flap and slat side-edge treatments

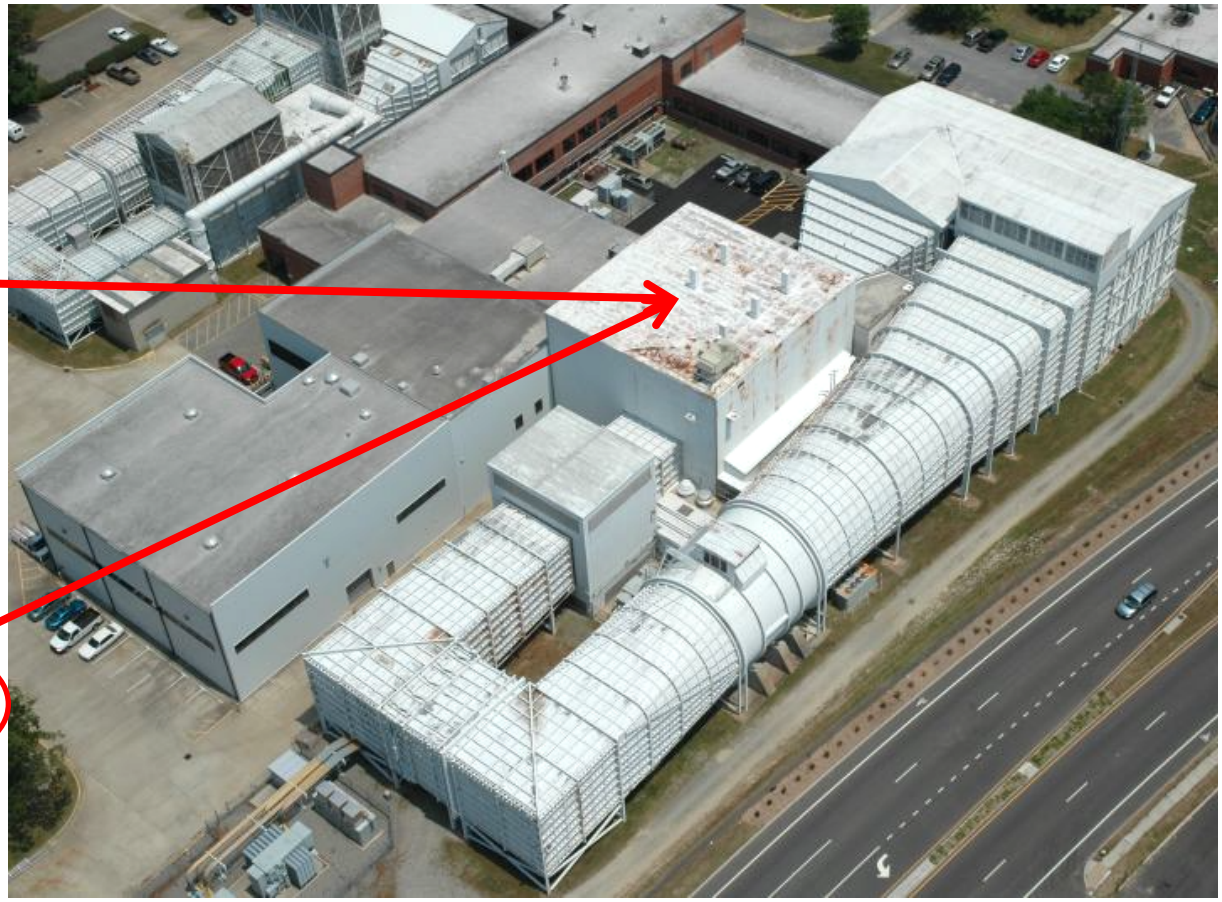




NASA Langley 14x22 Foot Subsonic Wind Tunnel (14x22)

Acoustic test section

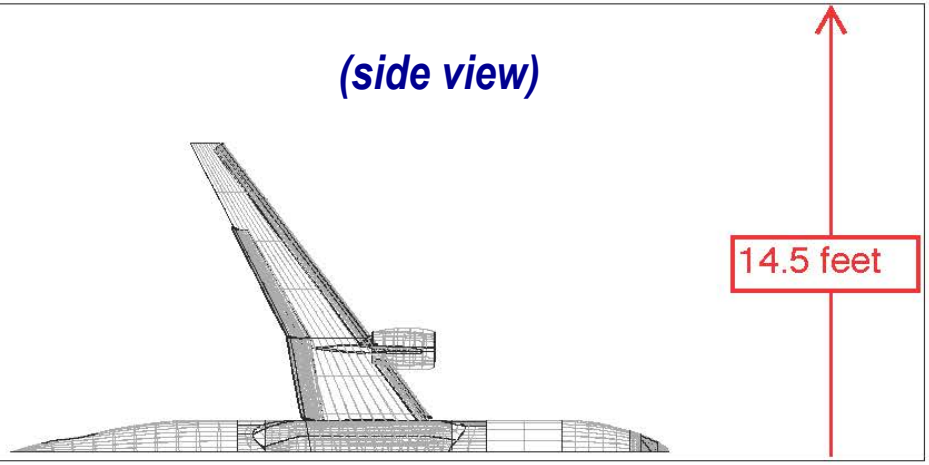
Aerodynamic test section



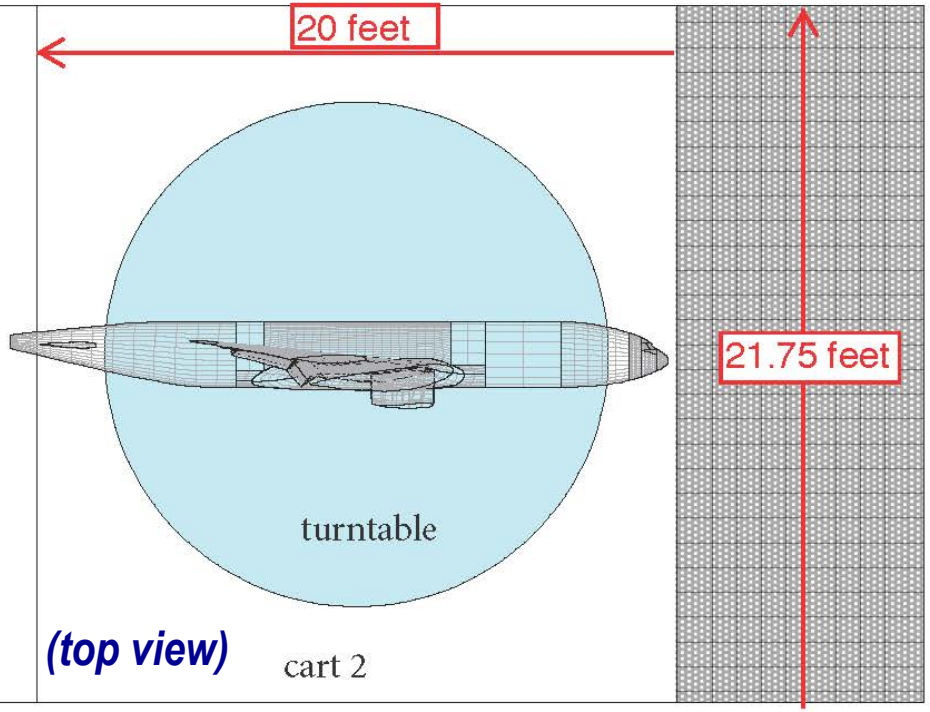
- Semispan (1/10th scale) model
- M_∞ = 0.20 for landing configurations (Re_C = 3.27x10^6)
- M_∞ = 0.26 for takeoff configurations (Re_C = 4.24x10^6)

Semispan HL-CRM in 14x22 – Aerodynamic Setup

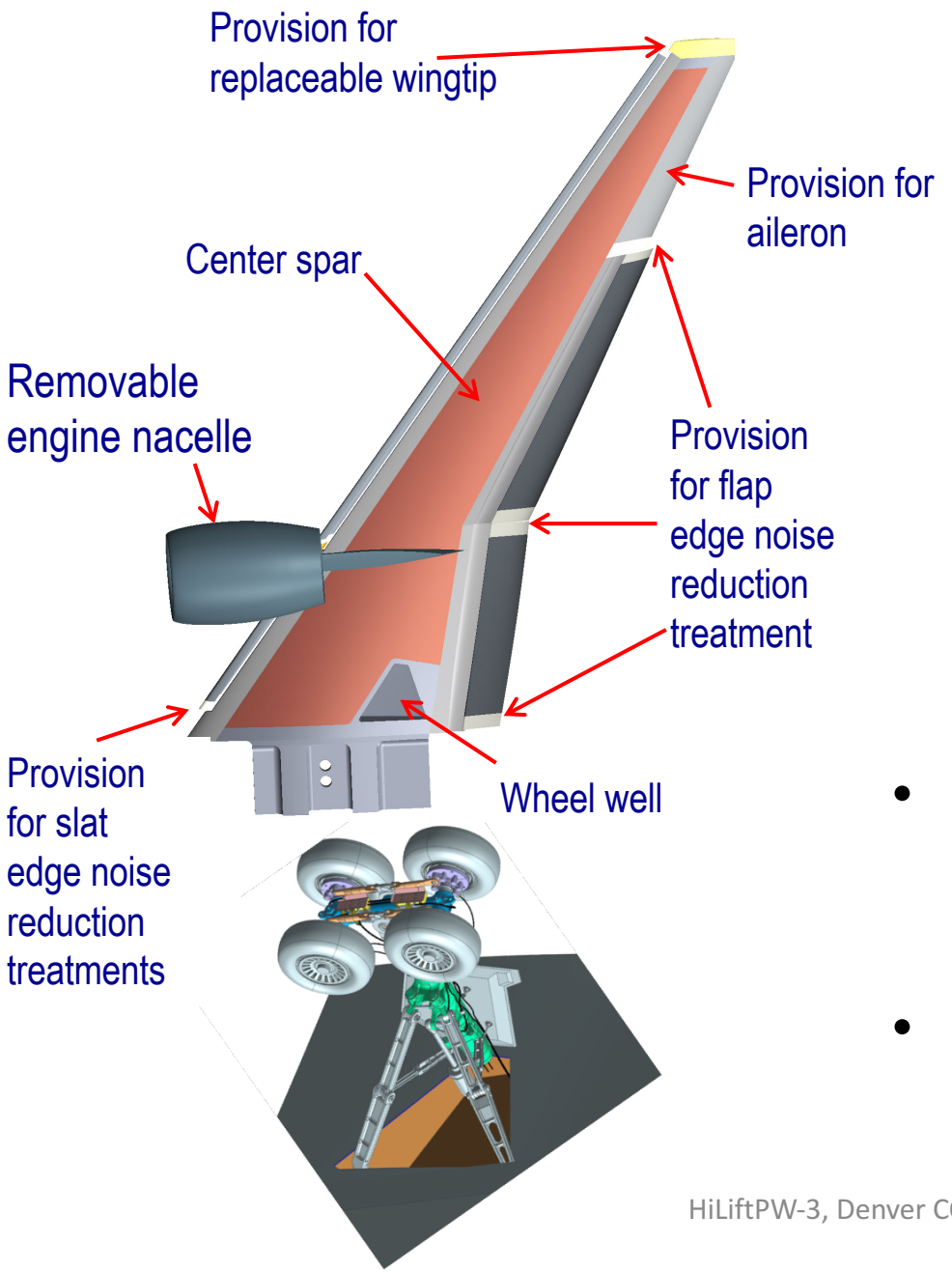
- 10% semispan model
- 115.68 inches semispan
- 3.5 inches standoff
- 68% tunnel span (vertical)



- Model center moved slightly aft from turntable center
- Fuselage extends past turntable & past end of cart
- Fuselage length = 20.59 feet

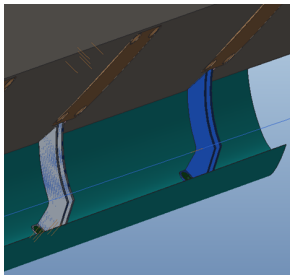


HL-CRM Features



- Modular components
  - Replaceable flap (with AFC-enabled hinged flaps)
  - Replaceable slats (with noise reduction concept slats) and slat tips
  - Removable engine nacelle
  - Provision for aileron
  - Wheel well
  - Replaceable wingtip
  - Flap edge noise treatment
  - Removable landing gear

  <u>Not pictured</u>
  - Removable horizontal tail



- Slat brackets
  - inboard: 3
  - outboard: 12
  - realistic width, U-shape
- Flap brackets/fairings
  - inboard: 1 external, 1 in fuselage
  - outboard: 2

Model Testing – Aerodynamic Test Section

- Conventional High Lift (goal is reasonable baseline for SHL)
  - landing configuration
    - M = 0.200, Re_c = ~3.2 million
    - start with flaps = 37 deg; slats = 30 deg
    - other riggings ??
  - nacelle/pylon ??
  - horizontal tail ??
  - artificially trip for transition or allow natural transition ??

- Simplified High Lift with Active Flow Control (AFC)
  - landing configuration focused around AoA = 8 deg, some through C_{Lmax}
  - hinged flaps ~ 50 deg; conventional slats
  - various AFC concepts

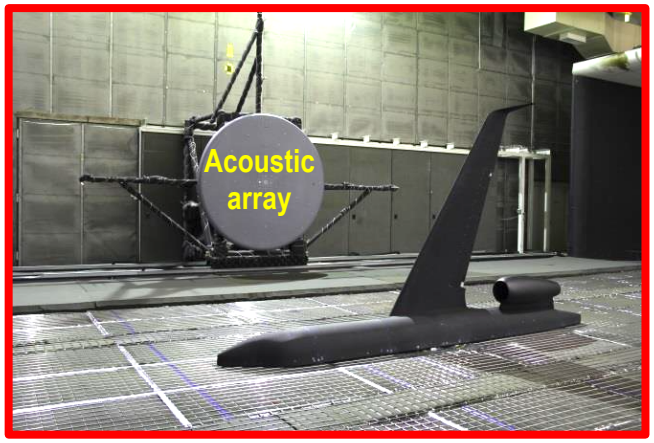
- Noise Reduction Concepts
  - Limited testing to C_{Lmax} to assess aerodynamic performance

Planned Measurements for Aerodynamics

- Forces/moments
- Surface static pressures
- Unsteady surface pressure
  - A few on the main element and around the outboard flap edge
  - Some on the AFC flap
- Model deformation – photogrammetry
- Transition detection – infrared cameras
- In-wall acoustic array for a limited number of configurations

Model Testing – Acoustic Test Section

- Noise Reduction Concepts
  - conventional landing configuration (fixed rigging)
    - with and without landing gear
    - with and without nacelle/pylon
  - slat cove-filler and slat gap-filler
  - flap and slat edge treatments



- Simplified High-Lift with Active Flow Control (AFC)
  - if time permits

Planned Measurements for Acoustics

- 97 channel microphone array
- Individual pole mounted microphones
- Forces/moments
- Surface static pressures
  - Reduced number on slat
- Unsteady surface pressure
  - Extensive on slat
  - A few on the main element and around the outboard flap edge
- Model deformation – photogrammetry and strain gauges on slat noise-reduction devices

Future Testing

- NASA project(s) planning in progress
- Collaborative discussions in progress
- Possibilities:
  - localized active flow control concepts
  - noise reduction concepts
  - several other possibilities are designed into model

- Suggestion for HiLiftPW:
  - start discussions about what can be done with the HL-CRM to further advance goals of HiLiftPW (seems like we are still working the first of four stated objectives)

HiLiftPW Objectives

- Assess the numerical prediction capability (meshing, numerics, turbulence modeling, high-performance computing requirements, etc.) of current-generation CFD technology/codes for **swept, medium/high-aspect ratio wings in landing/take-off (high-lift) configurations**
- Develop practical **modeling guidelines** for CFD prediction of high-lift flowfields
- Advance the understanding of **high-lift flow physics** to enable development of more accurate prediction methods and tools
- Enhance CFD prediction capability to enable practical **high-lift aerodynamic design and optimization**